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Reflection on Canons of Sustainable Architecture in Valuation of Nautical Tourism in Portugal

(Case Study the Mondego River Estuary - Figueira Da Foz)

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PREFACE

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This study intends to give a theoretical perspective on the work done as part of the post-doctoral project in architecture, with a focus on the junction of sustainability and architecture in support of the valorisation of sport and nautical tourism in Portugal. Research item "Reflection on the Influence of Sustainable Architecture Canons on the Valorisation of Nautical Tourism in Portugal - Case Study of the Mondego River Estuary - Figueira da Foz" - 2021, Faculty of Architecture, University of Lisbon. The Mondego River estuary presents privileged conditions for the practice and development of nautical activities associated with recreation and sport, an aspect that is all the more relevant when this estuary occupies a privileged central position in the national maritime context. Experiencing the sea and the river from a perspective of leisure and recreational boating associated with the enjoyment of superior quality sports facilities is one of the concerns of the people of Figueira da Foz. The mouth of the Mondego River is surrounded by the city of Figueira da Foz and holds a territory of exceptional maritime public domain for the practice of nautical and sporting activities. In this context, the premise of this study in architecture was to combine the vectors of sustainable architecture in the valorisation of tourism and water sports in Portugal, particularly in the estuary of the Mondego River, located in the city of Figueira da Foz. Nautical tourism is an increasingly popular type of alternative tourism that is defined as active holidays in contact with the water, through activities such as sailing on sailing boats or yachts, as well as other recreational and recreational activities. Sports that involve the enjoyment of nature. Portugal has a unique climate in Europe for activities linked to the sea, with 2800 km of coastline, rivers and dams. The present work is expected to contribute to raising awareness of the benefits of the tourism and water sports sector in Portugal, in particular with regard to the implementation of new sports spaces and equipment, differentiating, innovative, sustainable, environmentally friendly and which above all everything fulfils the purpose for which they were designed. The study is structured in a sequential manner called chapters with the purpose of achieving the stated objective, consisting of eight distinct chapters, respectively: Chapter 1 (navigation approaches to new spaces and times); Chapter 2 (Sustainability combined with the canons of architecture), Chapter 3 (materials and sustainability); Chapter 4 (canons of sustainable architecture in the current context); Chapter 5 (site geometry); Chapter 6 (specificities of recreational boating combined with sustainability); Chapter 7 (benchmarking, ordering and planning strategies); Chapter 8 (final reflection), (Fortin, 1999). The work carried out has as its target audience a wide range of readers who are in some way connected with the areas of sports management and architecture, with the main focus on the intersection of the aspect of sustainability combined with architecture in favour of the valorisation of sport and of nautical tourism in Portugal.

Chapter 1

NAVIGATION APPROACHES TO NEW SPACES AND TIMES

1.1. Canon

According to the Portuguese Language Dictionary, the definition of “canon” refers to a precept, rule, norm. However, in the architectural context, the term is cumulatively and directly related to a set of authors and works that in a certain period of time in history, in a certain social and cultural context, and which are considered exemplary.

1.2. Inference to Architectural Treatises

Brief historical synopsis - Throughout history, more precisely since classical antiquity, there has always been a set of concerns regarding the framing of architectural canons. At that time, in the 1st century BC, there was the so-called “architectural treatise”, which was based on the architect and engineer Marco Vitrúvio Polião, where he considered through his writings that architecture is obtained through practice and theory, aided by knowledge of the sciences and arts. According to Vitruvio's narrative, Garrafoli (2017), theoretical knowledge could not be dissociated from practice, considering that architecture came together with the combination of these two forms (technique and theory), acting in an aggregated and cumulative way. Still from the same author's perspective, he understood the architect and engineer Vitruvius as being a

person with a utilitarian nature, in which his work sought to demonstrate the value of the act of building. Vitruvius decided to write a treatise with ten books that to this day are defined as the oldest theorization of architecture, as well as, in terms of urban planning and construction. Architecture was understood and based on three main vectors, building, gnomonic and mechanics (Maciel, 2015). In the context of buildings, Vitruvius addressed the theme of fortified and religious enclosures, noting that temples were characterized by so-called eternal works. Religious architecture brought together its own orders, influencing different constructive behaviours over generations. In this line of thought, Vitruvius approached the canons of architecture: the origin, proportions, attributes and rules of each composition and component in detail, in order to understand the multiplicity of layout of sacred temples and, on the other hand, the diversity of associated methodologies there is a variety of species and genera (Garrafoli, 2017). For Garrafoli (2017), Vitruvio's constant concern was to establish a work that brought together theoretical concepts combined with practical resources, ensuring that each typology had the necessary robustness. **Canon ordering and disposition** - Defining it as the fair proportion in the measurement of the parts of the work considered separately and, in a global view, assuming proportional comparison with a view to commensurability (Maciel, 2015). It is made compatible by quantity, which in Greek is defined as posotes, which is distributed in measures of parts of the execution of the work itself. On the other hand, the arrangement deals with the appropriate placement of things and the so-called aesthetic effect of the work with the quality that results from these same adjustments. These are the types of arrangement, which in Greek allude to the external appearance, highlighting: iconography, spelling, scenography. They are characterized as follows: - Iconography (appropriate use of compasses and rulers); - Spelling (frontispiece elevation and custom-painted figure in accordance with the layout of future work); - Scenography (the sketch of the frontispiece with the side parts in perspective and the correspondence of all lines in relation to the centre of the circle). These species emerge from reflection and invention. Since reflection expresses full dedication to study and work, personal satisfaction with the proposed objective. On the other hand, invention addresses the explanation of obscure issues and knowledge of a new reality discovered with due rigor. **Eurythmy** - It is characterized by its elegant exterior shape and pleasant appearance in adapting the different portions of the architectural object. This situation takes shape when the parts of the work are directly proportional to each other, that is, the height in relation to the width, in the latter in relation to its length. In short, when all parts are commensurable (they have a common measure between them), (Maciel, 2015). **Commensurability** - It is defined by the balance of the members of the work itself and the correspondence of a certain part (the basis of the modular relationship from which the proportion results), with the harmony of the work as a whole in a logic of symmetries (Maciel, 2015). **Decorum** - It relates to the aspect of the work, arranged with authority through proven things, expressed through thematise (fulfilment of a certain principle according to a certain custom). Decorum is expressed according to custom, when vestibules (entrance, patio) are built, with elegance and convenience for buildings where their interior is superb. If denticles (a small projection of the quadrangular sector) are carved within the Doric epistils, on the cornices or if certain writings are inscribed on the pulvinate columns (columns with Ionic capitals) or on the Ionic epistils, the appearance will be affected due to the transparency of the characteristics of different style for another type of work, taking into account that certain architectural rules have been established. In the natural context, decorum occurs naturally according to the nature of the cubicles (bedroom) and in libraries the light is taken from the East; in baths and winter rooms, in the Winter Sunset, in art galleries (painting galleries) and in environments where it is necessary to project light from the north, taking into account that this side of the sky is neither beaten nor obscured by rotation of the sun (Maciel, 2015). **Distribution** - It is defined as the appropriate distribution of resources and land, as well as an economic balance in the construction expense accounts. The architect assumes a preponderant role in that everything will only make sense if the architect does not first look for those things that cannot be found or prepared except at great economic expense. In another type of distribution, building layouts must be suitable for each type of person (Maciel, 2015). **Vitruvian Triad** - It is in the context of the definition of "edificatio", that the so-called "Vitruvian Triad" comes to the fore, in which all constructions must achieve firmness and solidity "Firmitas", within the scope of functionality and utility "Utilitatis" and beauty "Venutatis". In the context of a city, it was argued that it should be located in a place with good sun exposure, protected from winds and with good drainage capabilities for land for agricultural use. On the other hand, good accessibility was still advocated. In the context of protection and security, the use of walls was also advocated, as

well as the layout of streets and squares to protect them from strong winds (Ferreira, 2011). **Architectural Anthropomorphism** - Architectural anthropomorphism is based on an architecture based on the shape and proportions of the man Vitruvius (a man included in a circle and a square, with his navel as the central element). As canons that were expressed in a version that is very specific to Greek architecture, we have temples and public buildings, theatres, baths and elements of the architectural lexicon such as columns, capitals, bases, cornices, etc. Vitruvius valued the genres of columns "genus columnae", Doric, Ionic, Corinthian, with the Tuscan of Italian origin, placed in the background (Ferreira, 2011). **Vitruvius and the Middle Ages** - Vitruvius's treatise was verifiable by a varied group of authors, highlighting Isidore of Seville (7th century) Carolingian, to those from the late Middle Ages, confused with the dawn of the Modern Age. It is inferred that most of the manuscripts of "The architecture" were written in the Middle Ages. Alberti Treaty - Alberti (1404-72), born in Florence, wrote "De re aedificatoria", between 1443 and 1452, which is believed to have been printed in 1485. Similar to Vitruvius, Alberti's treatise was also structured in ten books, respectively: Book I: Principles of Architecture (res aedificatoria) and design procedures. Book II and III: Construction materials and techniques (firmitas domain). Book IV: Public works and cities, their functions and typologies (domain of utilitas). Book V: Particular works, their functions and typologies (domain of utilitas). Book VI to IX: Gli ornamenti; importance of beauty; religious buildings, profane buildings, private buildings; concinnitas and proportions (domain of venustas). Book X: The restoration of Gli edifici; maintenance and restoration of the building, considering the surrounding environment (region) where human life takes place. In the understanding of Alberti (1404-72), architecture (res aedificatoria) focused on the concept of a happy life, pleasant to men in general, and the most important of the arts. The res aedificatoria, of a utopian nature, would encompass the entire space and environment where life and human activity take place. Architecture was something centered on the intellect, the architect used the hands of the artifice, the builder, to put his ideas and thoughts into practice. The building was seen as a living body, suited to its respective functions. There are six Roman canons, which Alberti understood should be considered in any type of building:

Regal: place or environment, corresponding to localization procedures; area: implementation and total area, corresponding to the implementation procedures; partitio: division and compartmentalization, corresponding to the building plan; paries: surrounding facades and partitions, corresponding to elevations and sections; tectum: ceilings and coverings, corresponding to the respective plans; squeeze: openings or communications between the building and the outside. The aesthetic assumed an important role, concinnitas (harmony or completeness), which brings together the entire life of man and his laws, and presides over nature as a whole. Concinnitas was obtained by the combination of three important factors: numerus (number, quantity), finitio (limit, delimitation), and collocatio (placement, arrangement), making it clear when in a work there was nothing more, nothing was missing, and nothing could be changed. It is the ethical-aesthetic ideal of Classicism, the combination of sophrosyne and kalokagatia, par excellence: that of the perfect, finished, unalterable work, in agreement and mimetic consonance with Man and the Cosmos, also called completeness. From the point of view of social relations, there was concern in treating the entire environment in order to make it conducive to human life (Ferreira, 2011). **Florentine Treaty** - Florentino, like Alberti, wrote a treatise of 25 books, between 1461-64, when he worked in Milan, as an architect, for Francesco Sforza, Duke of the city. It was the first architectural treatise written in Italian (volgare), which the author justifies as being a document to reach a less knowledgeable public. Florentino was the first to use drawings to illustrate his theoretical principles, and to present models of the buildings he described. In Florentino's understanding, his treatise was divided into three parts: The first part contained the origin of the measurements, as well as those of the building; also, what anyone who wants to build should know to be a good architect, and also what should not be observed. The second part covered the way and construction for those who want to build a city and in what place and in what way the buildings and squares and roads should be divided, wanting it to be majestic, beautiful and perpetual (bella and buona and perpetuates) according to the natural course. The third part contained how to build based on the old guidelines. And it will be rightly understood that in the past more dignified buildings were built but now they are no longer built. (Ferreira, 2011). Francesco di Giorgio was considered the first orthodox Vitruvian in the Theory of Architecture, as Vitruvius mentioned, all art and reason deals with the being of the well-composed and proportioned human body, the city, fortress and castle must be formed in the manner of the human body (Francesco di Giorgio, ob. cit., I, p. 3). One of the great examples was related to the relationship between

the fortress and the city, the main chapel, where it is seen as the main member of the head of the temple. Appearing represented in drawings, as well as various types of temple plans in the form of polygons composed of quadrangular, rectangular and circular figures, as well as columns, their descriptions and drawings seem to derive directly from Vitruvius, and goes so far as to effectively develop the architectural orders based on the proportions of the human body, hence the striations can be explained by the number of man's ribs. **Pacioli Treaty** - Pacioli (1445-1514), was born in Borgo S. Sepolcro, Franciscan monk, professor of mathematics and disciple of Piero Della Francesca, he would have interacted with the great artistic personalities of the time. His treatise "divina proportione", which is believed to have been completed in 1497-98, and published in 1509, address's themes linked to philosophy, perspective, painting, sculpture, architecture, music, mathematics and, essentially, geometry, ranging from elementary plane figures to solid figures; is divided into three parts: - The Architecture Treaty; - The Libellus in tres partiales tractatus divinus; - The third, based on the aforementioned work by Piero Della Francesca. The Divine Proportion is the best known and most popular, in addition, for the beautiful drawings of geometric solids by Leonardo da Vinci. Furthermore, the theme of divine proportion is very Renaissance and a theme connatural to the architecture of the time, so concerned with proportions. Luca Pacioli intended to deduce and substantiate the divine proportion in the golden section, (proportio habens medium et duo extrema), which worked with irrational numbers, in the 32nd sense of unlimited, 1.618. In the Renaissance, they preferred to work with whole numbers, referring more to Fibonacci and his method of deducing the golden section from the summed and continuous relationship of whole numbers: 1:1:2:3:5:8:13:21:34, etc. One of the curious aspects of his theory about regular bodies is the correspondence he attributed to them with what he called the five simple bodies of nature (earth, air, water, fire, quintessence). **Palladian Treaty** - Palladio (1508-80), and his treatise I, became the summary of Renaissance Classicism, and its culmination is ordered as follows: Materials and Rules (book I): After the dedication to Count Giacomo Angarano and a proem to the readers, we immediately go into the materials: wood, stone, sand, lime, etc.; construction of a house from foundation to roof; general procedures and principles for the architecture of public and private buildings; architectural orders, chimneys, stairs. Housing (book II): Deals with private houses within the city and villas in the countryside; It begins with the naming of the compartments (program), followed by the drawings (idisegni). Urban Spaces (book III): After an introduction to readers, it deals with streets or paths (vie) inside and outside the city, bridges, squares, basilicas, etc. Monuments (book IV): Prefaced as a prize for readers, it deals with ancient temples in Rome, and some others in Italy and outside Italy. In short, it could be said that the four books are organized as follows: Materials and Rules; Housing; Urban Spaces and Monuments. Palladio's method is closely linked to practical experience and the measurement of things, so to speak, it proceeds in reverse, going from the parts to the whole, in advance of induction. The Theory of Architecture, although it has its origins in an ancient architect, Vitruvius, in the Modern Age begins to be assumed and reformulated, essentially by men of letters: Alberti, a notable writer of his time (whose performance as an architect raises doubts), and Sulpicio, humanist and philologist. The architects and painters, Filarete, Di Giorgio, Cesariano, etc., came later, and were accompanied by literati: Colonna, Calvo, Barbaro, and mathematicians, such as Pacioli. Vitruvianism had its genesis in Early Modern Europe, marked by Humanism and the Renaissance, in the middle of the 15th century, expanding and consolidating itself between the end of the 16th century and the beginning of the 17th century (Ferreira, 2011).

Chapter 2

SUSTAINABILITY COMBINED WITH ARCHITECTURAL CANONS

2.1. Sustainability

Before making some reflections on sustainability combined with the canons of architecture, it is pertinent to first understand the concept of sustainability, sustainable development and environmental awareness. Therefore, according to Uhl (2004), sustainability is understood as the ability of an ecosystem to maintain ecological processes and functions, biological diversity and productivity over time. According to the writings of Partidario (2007), the concept of sustainability is understood as that which lasts over time and is

directly associated with the concept of sustainable development, namely: development that meets the needs of the current generation without compromising or jeopardizing the ability of future generations to meet their own needs. According to Leão, Alenquer and Veríssimo (2008), the concept of sustainability can be characterized by a group of five principles or values that surround any sustainable institution or place (city), namely: a) Respect all forms of life; b) Limit the use of natural resources; c) Value the place where we live; d) Consider total costs; e) Share the benefits. In the understanding of Rosmaninho (2014), the concept of sustainability encompasses different meanings and several levels of approach, being in the current context a common term in the lexicon of most areas of knowledge and human activity, its meaning and operating modes, not always they assume a holistic and ethical perspective that was underlying their initial characterization, often lacking greater rigor and depth. Sustainability is understood as the way of allowing a biome to remain protected, fed with nutrients to the point of being kept in a perfect state of conservation, as well as always being up to the risks that may arise, in other words, it implies that the biome is capable of not only being preserved as it is, but also being able to prosper, strengthen and evolve (Ventura, 2019).

2.2. Sustainability in Construction

In the understanding of Sampaio (2017), the concept of sustainability in construction has, over time, undergone several mutations that give rise to conscious changes in the environment in which they operate, in order to understand the needs of the building, housing and user use, preserving the environment with the aim of ensuring citizens. The search for efficiency in the different phases of the design and construction process allows sustainable construction to be considered as one that makes use of the best procedures and techniques with a view to minimizing impacts on the environment. It is inferred that so-called sustainable construction is based on a set of practices, canons with environmental, economic and social concerns that generally allow the needs of human beings to be met without jeopardizing ecological sustainability and future generations. For the same author, so-called sustainable construction also brings together a diverse set of phases in the life cycle of a building, based on the following canons: - Construction of energy-efficient buildings; - Adequate planning of construction, conservation and maintenance of buildings; - Reduction/minimization of waste generated during the construction phase; - Use of eco-efficient materials; - Maximize the reuse of resources; - Save the use of energy and water; - Maximize the durability of buildings; - Control the emission of gases responsible for the greenhouse effect and Co2; - Minimization of impacts associated with construction; - Cost rationalization.

2.3. Contributions of the Canons in Sustainable Architecture

Sustainable design is founded on a set of canons and norms that, when properly applied, efficiently contribute to the valorisation of materials and the preservation of the environment in which they are placed, hence decreasing negative environmental impacts. Furthermore, it promotes social and cultural growth while also being economically feasible. We emphasise: - Analysis of the surrounding area and integration of the architectural project into the territory under study; - Sustainable use of the land, maintaining the natural topography and avoiding changes in soil morphology; - Correct and integrated project planning avoids waste on site and ensures better execution and final results; - Adaptation to climatic conditions, using appropriate architectural elements, in order to minimise energy consumption and consequences. - Respond to consumer demands while respecting the environment; - Respect for conformance with laws and urban norms; - The judicious utilisation of energy. - Predict the reduction in water consumption. - Reduction of sewage volume. - Making rational use of materials and avoiding waste. - The use of energy-efficient technologies; - So-called sustainable landscaping, in which plant actively contributes to energy efficiency; - Prioritise the health and well-being of occupants. - Economic viability, the project must make the construction attractive by adding value and reducing operation and maintenance costs. - Analysis of the construction life cycle. - Increase awareness among individuals involved in the construction process by supporting environmental education (Cunha 2015).

2.4. Sustainable Development versus Environmental Awareness

According to Gauzin-Muller (2002), the concept of sustainable development is built on three major pillars: the material life cycle, the utilisation of natural materials from specific locations, raw materials, and renewable energy. The concept should be regarded as something that meets present demands while allowing future generations to meet their own

human needs. The sustainable notion must integrate peace, economy, society and the environment. Sustainable development attempts to meet present demands without jeopardising the future, while also responding to their needs, particularly the most vulnerable, which must be prioritised (Caseiro, 2013). Cunha (2015) believes that sustainable architecture should be characterised as a practice rather than an architectural style. It is regarded important to have control over things and, above all, to understand how to manage and anticipate everyone's demands. With environmental preservation and recovery, architecture becomes more useful, but also serves as an example for everyone else. Construction and architecture must adapt to their surroundings, not the other way around (Ventura, 2019). In terms of environmental consciousness, the goal should be to create with as little environmental damage as possible while maximising social gains. In 1987, the World Commission on Environment and Development (WCDE) stated in the report Our Common Future that sustainable development is defined as responding to present demands without jeopardising future generations, lending credibility to the notion of sustainability. The United Nations Conference on Environment and Development was held in Rio de Janeiro in 1992, with discussions on subjects such as sustainability and resource protection. As a result, Agenda XXI emerged, raising worries about development and the environment (Martins, 2018). The Brazilian Agenda XXI (2004) saw planning the building of sustainable projects in the construction area as a valuable tool, as long as it balanced environmental protection, social justice, and economic efficiency. When it comes to the building business, authors such as Priori (2008) argue that it currently consumes around half of all global resources, highlighting its critical role in the planet's sustainability. A building's sustainability is determined by a more complete approach to the environmental, economic, and social challenges in which it is embedded (Zambrano, Bastos, & Fernandes, 2008). According to the Housing Development Institute (IDHEA, 2012), the important criteria to consider in an ecological and sustainable construction project are: a) Work analysis; b) Site analysis; c) Life cycle of project guidelines (materials and technologies); d) Soil study; e) Sustainable architecture and landscaping; f) General and sustainable planning; g) Study of the building's material and energy consumption; h) Plan the logistics of materials and resources in Construction is crucial and indispensable to human life in this sector, so it is critical to pay particular attention to a project, as it can serve as a significant stimulus for the sustainability element (Ventura, 2019). In terms of reducing the so-called "ecological footprint," the main benefits of sustainable construction are based on saving energy, water, and materials; using reusable materials of natural and vernacular origin; lowering polluting emissions; recycling waste associated with the life cycle of buildings; and increasing the life cycle of buildings. After adopting these principles, the activity of sustainable construction is strengthened by the implementation of an evaluation and certification system (Dinis 2010).

2.5. Technological Sustainability

With regard to technological sustainability, authors ORR (1992) argue that the concept of technological sustainability derives from sustainability and is seen as a type of sustainability based on technological concepts, of high complexity, and duly coordinated by “experts” in technological areas. For Martins (2018), the concept of technological sustainability is associated with large office buildings using glass and steel, where the focus is on innovative materials and technologies, very much in the context of eco-tech. Still, with regard to the thermal component, the relationship between temperature control in summer and energy costs in winter, as well as the materials used, their impact on the environment is often called into question. Among the various architects associated with high-tech sustainability, we highlight Norman Foster, Renzo Piano, Richard Rogers. Combined with the concept of technological sustainability, several systems for evaluating the energy efficiency of buildings have appeared.

Building energy efficiency assessment and certification systems - For Pedro & Amado (2012), there is a diverse set of certification systems for buildings, highlighting some of the most important from the point of view of environmental sustainability and energy efficiency. **Breeam certification** - Environmental assessment method of the building research establishment. The Breeam Certification system (Building Research Establishment Environmental Assessment Method) was developed in the United Kingdom and consists of a methodical process that aims to assess the environmental performance of a given building based on ten scoring criteria for valuing environmental impact (construction management, energy consumption, water consumption, contamination, materials, health and well-being, transport, waste management, land use and ecology and innovation). Regarding the results obtained, they are translated into the following scale: approved,

good, very good, excellent and excellent (Ventura, 2019). **Leed Certification** - System leadership in energy and environmental design. The Leed (Leadership in Energy and Environmental Design) system is based on a system that aims to assess the sustainability of buildings. The Leed system provides for a diverse set of criteria for the design, construction and operation of buildings in a context of environmental sustainability. It also promotes an integrated approach to construction, known as "green", analysing the behaviour of seven aspects of construction, respectively: sustainable portions; energy and atmosphere; indoor air quality; regional importance; water use efficiency; materials and resources; innovation in design (Ventura, 2019). **Bepac certification** - Environmental performance assessment. The Bepac (Building Environmental Performance Assessment Criteria) system was developed in Canada in 1993 and has the particularity of creating versions of regional criteria adapted to the characteristics of the locations. This system establishes standards for base building design, base building management, occupancy design, and building occupancy management (Ventura, 2019). **Gbc Certification** - Evaluation system - Sbtool. The system *Gbc* (Green Building Challenge) was developed by Canada and its method aims to differentiate the generation of evaluation systems developed, with the aim of reflecting the different priorities, technologies, construction traditions and cultural values of different countries or different regions of the world. same country (Ventura, 2019). **Hqe Certification** - High environmental quality of buildings. The system *Hqe* (Haute Qualité Environnementale des Bâtiments) was developed in France, and its method aims to certify environmental quality and building management. Regarding the level of evaluation parameters, it is based on ecological construction, management, comfort and health (Ventura, 2019). **Nabers Certification** - Assessment of Australian buildings. The system *Nabers* (National Australian Buildings) was developed by the Australian Government, and its method aims to compare the variation in environmental behaviour between buildings. It is a system that analyses parameters such as energy, water, the interior environment of buildings and waste (Ventura, 2019). **Lead Certification** - Lead for the environment. The Lidera system - Voluntary System for the Assessment of Sustainable Construction) was developed in Portugal by the Instituto Superior Técnico de Lisboa in 2005, and its method is based on the analysis of the environmental characteristics of buildings versus their relationship with the surrounding environment where inserts. As times evolve, it tends to address a different set of criteria, namely: integration into the location, resources, environmental loads, environmental comfort, socioeconomic experience, environmental management and innovation (Ventura, 2019). After carrying out a comparative analysis of these systems, it was concluded that the most complete and comprehensive system is the Leed system, from the United States of America, as it has a greater number of parameters in its structure than the other systems under study. However, the involvement of a huge number of parameters sometimes makes their practical application more complex and expensive (Pedro & Amado, 2012).

2.6. The Connection between Sustainability And Rehabilitation

Sustainability and rehabilitation are intertwined, there are common values that are similar and connected, taking into account that rehabilitation is putting sustainability into practice and sustainability is rehabilitation. The rehabilitation of old buildings is a complex and highly relevant procedure, taking into account that the preservation of cultural, environmental and economic values is paramount. When developing a sustainable architectural project, it is essential to take into account a complex diversity of factors. To obtain results, aspects and the analysis of all the circumstances inherent to the project, in terms of sustainability, should not be overlooked (Madeira, 2015). According to Madeira (2015), in the context of sustainability in construction, rehabilitation is a fundamental task for global development. A rehabilitation process is the true promotion of the preservation of heritage values, values that characterize the identity and history of cities. The image of cities must be rehabilitated, not only through new construction, but also by adapting buildings and public spaces to new experiences. Rehabilitation is not limited to the requalification and reuse of space, it cumulatively allows for lower consumption of materials and energy, compared to the most recent construction. By using elements from the construction itself, rehabilitation instils environmental protection, taking into account that less energy is consumed in its construction. Conventional rehabilitation processes focus on physical degradation, time and costs, while sustainable rehabilitation adds to these related issues such as maintenance and demolition and environmental

factors and human comfort (Madeira, 2015). The rehabilitation uses traditional materials corresponding to natural resources, such as stone, sand and lime, already commonly used. From the same author's perspective, rehabilitating is no more expensive than building from scratch, in the vast majority of cases, it even becomes more economical, depending on the condition of the building and the reuse of materials that make it up that can be done (Madeira, 2015).

Chapter 3

MATERIALS AND SUSTAINABILITY

3.1. Materials and Sustainability

Over the decades, waste arising from the construction and demolition of buildings has always caused a large amount of waste on our planet, with the resulting harmful consequences for the environment. Over the years and with a view to minimizing this type of issue, it was understood that the choice of material would prove to be one of the most important stages in the construction process as, compliance with environmental responsibility parameters, preservation and recovery became a priority compared to others of lesser importance, such as aesthetics. The choice of materials based on the location of the building has become a preponderant factor in conserving the environment. On the other hand, regional materials reduce costs due to ease of transport and quick reuse. The construction and demolition process is currently one of the biggest responsible for the production of solid urban waste, and the consequent impact on the environment. With a view to minimizing impacts, it is understood that good practice should comply with the "3R" concept, that is, reduce (optimize energy performance throughout the life cycle), reuse (use materials that can be recycled), recycle (recovery of end-of-life construction materials) (Silva 2015). Authors such as Mourão and Pedro (2012) argue that in reality there are no sustainable materials, but rather so-called sustainable forms that are applied in the construction process. Based on the sustainability component combined with materials, the choice of construction materials assumes extreme importance in the environmental performance of the building, with pertinent issues related to the possibility of depletion and scarcity of finite and non-renewable raw materials. The materials used in the construction process are generally divided into natural, artificial and synthetic materials, depending on their origin and the type of processing. Still, it is believed that this distribution is insufficient to define an adequate selection of materials in the construction process to ensure that a building is environmentally sustainable (Silva 2015). **The impact of materials on the surrounding environment -** There is increasing concern about producing ecological materials that have the least impact on the environment. In this context, the materials, namely their choice, must be made in line with certain environmental parameters, benefiting the use of recyclable materials, with low environmental impact during their life cycle. There are materials that require a high energy expenditure process in their manufacture, extraction, transformation, however they are widely used due to their ability to be reused in the medium and long term, such as sand and natural stones. Even so, the relationship between the impact of materials and the surrounding environment is based on a diverse set of factors, namely: - The impact of material production (destruction of fauna, flora and habitats); - The nature of the resources involved (availability, scarcity and inaccessibility); - Emission of CO2 and embodied energy during production; - Modes of transport and distances; - Risks to health or the local environment (period of construction and use); - Toxicity of the material to humans and ecosystems; - Useful life of the material; - Final destination of materials (after the useful life of the material has expired); - Reduction and separation of waste and construction waste; - Prevention of the production and deposition of waste of high toxic value; - Potential reuse and recycling (Silva, 2015). The inherence of materials with bioclimatic concerns: **Bioclimatic balance** - Bioclimatic balance concerns the ability to balance human comfort needs and climatic agents, based on the appropriate use of energy and based on the seasons, in winter heating and in summer cooling with a view to balance and comfort thermal of the building. Average comfort values are around 20ºC to 25ºC and a relative air humidity of 30% to 60% respectively. On the other hand, heating is characterized by the period in which the average daily temperature is lower than the minimum comfort temperature (<20ºC), while cooling is the period in which the average temperature is higher than the maximum comfort temperature (>25ºC). Other factors also

come into account in the design of a bioclimatic building, influencing its thermal characteristics, such as: location, type of vegetation cover in the region, geomorphological characteristics, winds, solar exposure and orientation, shading, water courses, etc. (Faria, 2010). **Thermal legislation - Thermal legislation is based on the following:** - Decree-Law No. 78/2006, Building certification system; - Decree-Law No. 79/2006, Regulations on energy systems and building air conditioning; - Decree-Law No. 80/2006, Regulation of the thermal behaviour of buildings. This is a simplified regulation, particularly in the case of residential buildings and services, whose assessed requirements are not complex, to the point of requiring more demanding and complex calculations, thus simplifying the process of making a series of environmental factors compatible. **Composite materials** - With regard to composite materials, authors such as Galante (2003) infer that they are light, strong and very resistant materials. On the other hand, authors such as Beber (2001) state that there is no universal definition for composite materials. Composite materials are defined in macrostructural terms, such as matrices, particles, fibres, where the material assumes a combination of two or more distinct materials having an interface between them, with the first material being the reinforcement and the second being the polymer resin. A major characteristic of composite materials is their orthotropy, which allows those who work with these materials to orient the laminated fibres with a view to increasing the individual resistance of each panel. Among the composite materials most used in the nautical industry, we highlight fiberglass, carbon and aramids, also known as Kevlar (Galante, 2003). In the context of the sustainability and durability of this type of materials, their pH and viscosity properties are directly connected to the environment in which they are located, in which the resins are exposed. Whenever there is a variation in temperatures, particularly when temperatures are low, the useful life of the resin is prolonged, but it must, however, remain conditioned. At a temperature of 50ºC, composite materials increase their viscosity and decrease their pH. To obtain good performance from the existing resin, strict control of viscosity and its pH is necessary. On the other hand, ultraviolet rays also act on resin degradation at a higher level than that resulting from temperature (Giordano, J. and Campos, J., 2000). Currently, new composite materials have been at the center of the development of competition and recreational sailing, with the application of noble, lighter and more resistant materials. As an example, we highlight the construction of the Hydroptère, a vessel that is built with new composite materials using carbon fibre impregnated with epoxy as well as titanium parts (Hydroptère, 2012). Another boat with a radical design, the Sailrocket also uses a wide variety of composite materials such as pre-impregnated carbon fibre with a NOMEX core, a highly abrasion-resistant resin. The Sailrocket also incorporates titanium parts and the sail is covered in heat-treated polyester fibre. **Wood** - Given the huge variety of wood and wood-derived products, it is vital to briefly discuss this natural product. Wood's heterogeneity - Since the dawn of history, wood has been used to build shelters for both humans and animals. Wood began to play a more secondary role throughout the Industrial Revolution, but it remains essential due to its vast range of applications and the fact that it is a natural material (Caseiro, 2013). Wood's structural features are thought to be a substance resulting from tree development, species type, and climate. Wood is regarded as a heterogeneous material with an anisotropic structure (the quality of certain materials whose qualities change depending on the direction), serving three functions: transmitting sap, processing products and storing substances for reserve, and, ultimately, supporting the plant. Wood is classified into two broad groups: endogenous woods, which form the stem (trunk) from the inside out, and exogenous woods, which grow swiftly and are frequently employed in many construction procedures (Caseiro, 2013). When depicting the longevity of wood or woody materials, it is critical to consider two very distinct concepts: the age and provenance of the wood. The wood is classified as: a) Resistant and very resistant - Juniper, Sequoia, Tuia, Líboledro, Olive; b) Moderately Resistant - Oak, Chestnut, Holm Oak, Pseudotsuga, Australina Acacia, Plantain, Ash, Cryptomeria, Cypress, Comclipar, Pink and Black Heartwood Eucalyptus, Walnut; c) Not very resistant - Poplar, Birch, Sycamore, Pine, Eucalyptus, Cherry, Slag. Wood has an endless number of applications due to its properties, which may be transformed by evolving technological procedures to produce new derivative products (Ventura, 2019). **Solid wood** - Solid wood is extracted from the wood of coniferous trees, such as pine and fir. They are highly inert woods, which improves the thermal insulation of buildings in the summer months. The European standard that classifies solid wood is EN 338. In Portugal, the LNEC published NP4305 referring to the most common species in the national territory, respectively maritime pine (Vilela, 2013). **Solid wood laminates** - Wood laminates result from mechanical

transformation processes of solid wood in which all defects and irregularities are carefully eliminated, resulting in smooth surfaces. Its composition is based on a succession of wooden sheets, normally three, whose thickness varies between 6 mm and 33 mm, glued together with resins at low pressure, in which the boards are placed sequentially with the grains arranged perpendicularly to the previous board, creating thus providing greater structural resistance. Wood laminates, when exposed to the elements, require chemical treatment based on oleaginous products. The development of the laminated wood industry also allows it to overcome gaps and enable other forms that any natural material would not allow (Vilela, 2013). **Wooden Plywood** - Wooden plywood sheets are created by gluing together several sheets of wood with the grain direction crossed relative to the next sheet. In this way, superior resistance is achieved. Various phenolic or resorcinol resins are used in the gluing process. They are characterized by being more stable pieces and resistant to bending compared to solid wood. They are normally made up of three elements, sheet, core and glue between the different sheets. This type of materials presents advantages at an economic and environmental level, since shavings and other wood waste are used in their design (Vilela, 2013). **Medium Density Fiberboard** - Medium Density Fiberboard, known as MDF, is manufactured with fragmented wood fibers mixed with a resin, through thermodynamic processes. MDF agglomerates have good resistance to fire and humidity. **Oriental Fiber Boards** - Oriented Strand Board oriented long particle agglomerates, called OSB, are constructed using layers of long wood, oriented perpendicular to each other. They are characterized by good stability and resistance, and are often used as thermal stabilizers in residential buildings. If we compare MDF fiber agglomerates with OSB particle agglomerates, we can say that they have greater mechanical resistance. **Cross Laminated Lumber** - Cross laminated wood, also known by the acronym CLT, defines cross laminated wood panels. They are panels made from spruce wood lamellas glued orthogonally, arranged under the guidance of a specific longitudinal and transverse grid, with the aim of minimizing variations, highlighting warping. **Parallel Strand Lumber** - According to the author, parallel fibre wood defines wooden panels made up of fibres glued parallel to the length and bonded using phenol formaldehyde resins. It is a panel similar to laminated wood with superior resistance, allowing it to be used in construction processes where this resistance is more demanding. With regard to the quality of the wood, the wood can be considered as first category or second category, the class varying depending on the knots it has and other defects, such as fissures and cracks. In a more summarized way, wood classified as first category must contain the following characteristics: natural colour, clean on both sides, dry, without knots, correctly sawn, square edges and corners, free from defects, without holes in larvae, no stains, no cracks, fibres, indentations, rotting, irregular drying, bulging and arching (Caseiro, 2013). The most used wood in Portugal - The woods most used in construction processes in our country are: a) Pine - maritime pine is the most used in the construction of buildings, while stone pine is most used in the construction of various furniture; b) Mahogany - brown wood, originating in Brazil and Africa, widely used in carpentry, doors, tables and chairs and has the particularity of being very resistant to insect pests; c) Walnut - characterized by a hard, compact wood, widely used in superior quality furniture, which increases its price; d) Chestnut - characterized by a wood similar to Walnut, hard, compact, but more resistant and heavier; e) Oak - is characterized by a dense, heavy, yellow, hard wood, widely used in carpentry work. Formerly used to frame roofs; f) Eucalyptus - characterized by a slightly hard wood, not recommended for construction. This is a type of wood normally used in scaffolding. **Sustainable Construction and Wood** - The topic of the ecological footprint and the conservation, preservation and sustainability of natural resources is increasingly being debated, with a view to ensuring the survival of future generations and the balance of ecosystems. When examining the life cycle of concrete, steel and wood, it is clear that wood has a superior performance, particularly with regard to reduced release of pollutants into the water environment, lower emission of gases into the atmosphere and lower production of solid waste, differentiating it from other materials. However, to carry out aso-called more sustainable use, it is important to ensure the global reforestation of tree species, with the ability to conserve resources, in order to maintain their natural balance. **The fiberglass** - Which is largely used in recreational boating, is known by a variable range of names (fiberglass, fiberglass, fiberglass-reinforced plastic, etc.), but which have the same meaning. According to Galante (2003), the history of fiberglass began in 1836, when a method of weaving malleable glass was patented in Europe. It took around a century for this material to re-emerge on world markets during lockdowns. From 1940 onwards, the development of synthetic resins promoted widespread use of

this type of fibres, particularly in the nautical sector. Glass fibres are produced from liquid glass, which in turn is cooled at high speed. Through the flow velocity component combined with temperature, various types of filaments with variable diameter are produced. The continuous diameter filaments are treated to improve their adhesion and resistance to abrasion and moisture. In nautical use, the type of glass used is "E", much of it used in fiberglass laminates in the most diverse applications. Glass fibres are found commercially in the form of fabrics, blankets and woven roving's (fibres). Fabrics can be unidirectional, flat and multiaxial. With regard to unidirectional fabrics, these are defined as fabrics in which the majority of fibres run in a single direction; a small amount of fibre may run in another direction with the main intention of keeping the main fibres together (Galante, 2003). **Carbon fibre/aramids** - Is a synthetic fibre that has unique characteristics resulting from its molecular structure, which enables the development of a product that has high modulus, low elongation and, above all, light, great impact resistance (hence its wide use in ballistic area). Aramid is five times more resistant than steel and does not corrode in fresh or salt water, which is why it is widely used in boating. Aramid is non-combustible. Therefore, it is an ideal option for application as reinforcement in hulls, cables, ropes and sails. It is used in the construction of boat hulls to partially replace fiberglass. The resins used in aramids are isophthalic or orthophthalic polyester. Isophthalic has better resistance to osmosis than orthophthalic. Epoxy and vinyl ester resins are preferred in structures that require high strength, toughness and rigidity. Aramid fibres are also used in the manufacture of fabrics for high-performance sails and have exceptional resistance to stretching, that is, a high modulus, allowing the sail to maintain its geometric shapes and resistance in the most diverse conditions. Combined with the reduced weight and flexibility of the wires, this property generates a sail suitable for high speed, with excellent durability and outstanding behaviour. Without forgetting the high resistance to piercing or tearing observed in this type of sail. Aramid fibres can also be used in the construction of parts of sailboat structures, as a partial replacement for heavy steel and aluminium cables. Aramid structures can be both rigid and flexible. This raw material can be used in wooden structures in unidirectional strips with epoxy resin, known as pre-peg, which are laminated at +45º/-45º on a layer of fiberglass at 0º, which, in turn, it is laminated onto wood. It is recommended to use aramid on the inside of the boat, as, in the event of a collision, the aramid fibres withstand greater stress. Aramid fibres have the following advantages: a low specific weight compared to glass fibre, due to its unique combination of strength, rigidity and low specific weight, allows the same mechanical characteristics to be obtained using less material; high energy absorption; resistance to cracking and increased rigidity of the structure. These characteristics enhance a yacht's sailing navigation (low weight in the water, rigidity that allows for high tension on the equipment and more navigation force). Aramid increases the comfort and performance of motor yachts. Its lighter weight allows installations with more equipment and luxury items for the same engine power (Nautica, 2008). **The steel** - Steel is a strong, ductile, resistant material, with high structural consistency and good fatigue behaviour. The strength of the steel is not affected by the welding process and has the advantage of being able to be repaired on site if necessary. It is an easy-to-handle material with no risk of damage and is widely used in marina walkways. Steel is normally galvanized, thanks to a controlled sacrificial treatment that results in a useful life of the material, applied to a walkway, of 15 to 20 years. If the walkway is submerged or subject to splashes, this period decreases considerably. Steel can also be painted to improve its corrosion behaviour. Galvanized steel should be used in temperate climate zones, such as protected basins without splash zones, in places where mooring and mooring efforts are considerable and in places where loads caused by wind action are important (Costa, 2012). **The aluminium** - Aluminium is characterized by an expensive material due to the price of the raw material and its use is mainly used in profiles with a smaller section. In relation to galvanized steel, the most used aluminium alloys have greater resistance to marine corrosion. When these alloys are intended for walkways, they undergo heat treatment and reduce their resistance by half as a result of welding, which requires inert gas and specialized operators (Costa, 2012). **The concrete** - Concrete is a material whose quality can vary greatly depending on the raw material and manufacturing processes. It is also dependent on steel, which provides tensile strength and connection strength. It is a material with risks of rupture due to failure and which is difficult to handle and transport. For reasons of covering the reinforcement, it is impossible to use concrete in small structures. It is especially suitable for the construction of floating breakwaters and large and stable jetties (Costa, 2012). **The rock** - Stone has always had a preponderant and active role in conquering land from the sea, in our study area it was also no exception, with the removal of the existing

rock and placement of stone it allowed, not only the embankment of the cove (dock), but also a platform where the municipal market and some access areas were later built, a noble material that has lasted for decades. **The glass** - In the context of the inherence of materials with bioclimatic concerns, we highlight glass and its transparency, as one of the elements that best express these vicissitudes. Glazing, namely window openings and skylights, are defined as architectural elements that connect the two spaces, interior versus exterior and vice versa. They are fundamental components in that they are elements responsible for the natural lighting and ventilation of your interior space. To obtain good window performance, the type of glass to be used must be taken into account. Single glazing has a percentage of incident light identical to the use of double glazing, however its insulation level is approximately half. Double glazing involves the use of two panes separated by an air gap between them. It presents itself as an advantageous solution in terms of both acoustic and thermal insulation, on the other hand, it presents greater mechanical resistance, resulting in greater durability and safety. Prismatic glass translates into an element that redirects the incidence of natural light through a series of triangular prisms, which prevent direct sunlight from entering, at the same time, redirecting it to the ceiling or open space. Chromic glass is a special glass, which presents mutations in the context of its characteristics and exposure to light (photochromic), temperature (thermochromic) or electrical charge (electrochromic), and can go from clear and transparent to dark, semi-transparent. to opaque, or vice versa. Chromic glass is commonly used to control solar radiation that enters the interior of the building, preventing overheating and glare (Silva, 2015). **The frames** - With regard to frames, they are understood as sealing elements for a gap and their function is to control thermal exchanges between the exterior and interior environments. Behaviour varies depending on the material used, the type and thickness of the frame, the relationship with the glazed area, etc. Aluminium, commonly used in frames, is a material with great thermal conductivity, but through the application of profiles with thermal rupture, its value can substantially reduce. Wood is defined as a material with good thermal performance, as it has low thermal conductivity, although it requires maintenance and is not very durable when combined with other materials. PVC is defined as a multipurpose plastic, with great insulation and resistance. Nowadays, it is one of the most used materials in construction (Silva, 2015). **The color** - Color plays an important role in characterizing a building, giving it identity, but it also has a direct relationship with the thermal performance of the building as it affects the absorption and reflection coefficients of surfaces in relation to light. Bright light, commonly used in hot regions of the Alentejo region, reflects solar radiation and, when applied to exterior surfaces, minimizes solar gains. In your interior space, as they have the ability to reflect light, they enhance the size and lighting of the space. On the other hand, dark colours absorb radiation, applying them to exterior surfaces maximizes solar gains; mostly used in heating strategies, such as trombe walls, in order to improve the building's energy performance (Silva, 2015). **Green roofs** - green roofs are based on the placement of topsoil on a properly waterproofed inverted roof (waterproofing membrane, geotextile blanket, which blocks root penetration). A drainage area is created around the roof, consisting of a gutter filled with gravel to avoid moisture. The type of vegetation used depends on the microclimate of the location. Regarding the benefits of this system, they are mainly aesthetic and acoustic (Faria, 2010). **The walls** - Regarding the exterior walls, they are all those that have a direct contact with the outside air. On the other hand, interior walls respect those that do not have direct contact with the outside air. Energy inputs from the outside are via thermal bridges, flat or linear. Flat thermal bridges are made up of pillars, beams and blind boxes, with energy inputs and losses being more evident through materials such as stone or cement. Brick walls, on the other hand, are characterized by good insulation. Linear thermal bridges concern areas where energy is lost, being respectively the connections between walls and slabs and the connection between frames and the jambs and sills of doors and windows (Faria, 2010). **The ventilation** - With regard to ventilation, also commonly referred to as indoor air renewal, the larger the volume of the building, the more easily the air can be renewed. The old habit of opening windows to renew air and remove odors continues to be a common practice among populations. When this procedure is carried out, all the preserved temperature dissipates, regardless of whether the sun comes in or not, taking into account that the outside air temperature in winter is above 20º. In this way, it allows us to understand that a house presents more thermal problems than an apartment, largely due to the fact that an apartment does not have as many horizontal and vertical connections with the outside environment (Faria, 2010).

Chapter 4

CANONS OF SUSTAINABLE ARCHITECTURE

4.1. Importance of Instruments in the Sustainability Component

Carvalho (2018) believes that in today's world, the relevance of sustainability instruments is recognised on both an environmental and social level, as it ensures quality of life and fosters societal dynamic equilibrium. In an era of significant changes in consuming habits, information, and consciousness as a result of digital technology and the current "COVID-19" pandemic crisis, humanity requires new solutions in tourism, housing, economic, social, and environmental areas. There is an increasing need to think and rethink buildable spaces and their canons as sustainable construction models while preserving the natural environment in which they are located (2015). On the topic of sustainable architecture, it is possible to weave a set of perspectives that in the future could serve as a lever and support for the development and preservation of heritage. Among the most crucial aspects of our living environment are: - Raising awareness and training populations becomes a preponderant and essential factor in promoting sustainable practices; - The planet's natural resources are finite and, as such, must be preserved for the benefit of future generations, through the structuring of appropriate territorial planning methods; - Promote the natural balance of the planet's existing resources with a view to their renewal; - The rational use of the planet's non-renewable resources, in order to; - Compatibility between development and the need to protect and improve the human environment for the benefit of its community; - Planning oriented towards human settlements and urbanisation with a view to avoiding serious and irreversible repercussions on the environment; - Use of science and technology for the benefit of economic and social development; - Application of the concept of educating to preserve, addressing new generations and beyond, who pay due attention.

4.2. SEA as a Strategic Vision of Sustainable Architecture in the Future Context

Based on the writings of Partidario (2007), in Strategic Environmental Assessment (SEA), the impact motivating factors are intentions, also called strategic development objectives, which correspond to the development models defined for the territory, highlighting: economic, social, with objectives and goals defined in the medium/long term, based on strategic methodologies, actions and/or projects, which will serve as a line of action to implement a given plan or program. The (AAE) is based on three important principles regarding the strategy to be adopted: - Ensure the integration of environmental, social and economic considerations in the planning, programming and drafting process in the political context; - Detect risk opportunities, evaluate and compare alternative development, design, elaboration, discussion, approval, execution, environmental and sustainability review options. - Contribute to the establishment of more appropriate development contexts, as well as proposals for future development.

4.3. AAE as contributions to sustainable architecture

Based on the principles discussed above, the Strategic Environmental Assessment (SEA), in the environmental and sustainable context, contributes to: - The identification, selection and justification of winning Win-Win options in view of environmental and development objectives; - It also contributes to the decision of more sustainable options in environmental, social and economic terms; - Detect problems and strategic opportunities in the options under study and facilitate the consideration of cumulative impacts; - Suggest follow-up programs, through strategic management and monitoring; ensure participatory and transparent processes that involve all agents; - Promote integrated decisions in relation to different points of view (Partidário, 2007). According to the same author, SEA is based on strategic thinking in decision-making processes and in the organizations involved, it allows defining a theoretical vision of the future, with major objectives, targets and indicators and guidelines that require flexibility and a strategic decision-making culture to allow rapid adjustment to context changes. One of the central pillars of SEA lies in the ability to assess possible strategic opportunities and risks for territorial and sectoral development, with sustainable development objectives in mind. Thus, it is understood that SEA presupposes judging the merit, opportunity or risks of following a given strategy or possibly proposing better lines of action for the strategies to be followed, whether in the economic, social or political framework (Party, 2007).

4.4. AAE as a Strategic Sustainability Simplifier

SEA is characterized by a strategic simplifier of sustainability processes as it allows: - Understand the strategy that is the subject of an SEA and the evaluation context; - Maintain a long-term horizon and a holistic, transversal and integrated perspective; - Focus only on factors critical to the decision and work with trends (processes); - Adopt an attitude of decision facilitator, supporting the decision maker and encouraging sustainable decisions; - Frequently inform the decision in a strategic and pragmatic way (in critical decision windows) with the purpose of assisting the decision; - Use communication strategies, consider multiple perspectives and act through good governance; - Ensure follow-up of decisions taken "monitoring" (Partidário, 2007).

4.5. Critical Decision Factors in SEA as a Sustainability Strategy

According to the guide prepared by Partidario (2007) on Strategic Environmental Assessment, among the numerous critical decision factors (FCD), those with greater expressiveness in the SEA, in the sustainability strategy, stand out, namely: climate change; Territorial Planning; development sustainability; competitiveness; governance; regional and local economic development; territorial management; biodiversity; natural and cultural resources; natural and technological risks; human development; competitiveness. Regarding the strategic-based methodology component to be used in SEA, the author defends the application of the following criteria: - Identify the object of evaluation; - Identify the critical factors for the decision; - Identify the objectives of (AAE); - Establish the appropriate stakeholder forum and communication and engagement strategy; - Establish integration between processes and identify decision windows; - Analysis and evaluation; - Use possible future scenarios and consider options and alternatives to achieve the proposed objectives; - Analyse the main trends linked to (FCD); - Evaluate and compare options that allow choices - Evaluate opportunities and risks; - Propose guidelines for planning, monitoring, management and evaluation; - Follow-up; - Develop a follow-up program (planning, monitoring, management and evaluation guidelines) and the institutional arrangements necessary for good governance.

Chapter 5

THE GEOMETRY OF THE SITE

5.1. The Geometry of the Territory of Figueira Da Foz

Due to a paucity of official documents, we cannot correctly pinpoint when primitive man first settled in Mondego. As far as we can tell, Foz do Mondego initially appears in historical records in the 11th century, first in donation letters and then in other documents attesting to maritime-commercial activity. Later, in the 14th century, it became a port for exporting wines and other goods, as well as receiving construction materials and containers by sea; as a result, the first shipbuilding businesses formed. All of this contributed to its elevation to the status of Town in 1771, under the name Figueira da Foz do Mondego (Pombo, 2003). Based on 1850 cartography, a mesh of Figueira da Foz streets with regular geometry can be identified in the areas closest to the estuary, where Bairro Novo, the bathing area, and Forte Santa Catarina stood out, with perfectly demarcated roads arranged in an East-West and North-South direction that defined quadrangular or partially quadrangular blocks (Santos, 2014). On September 20, 1882, it was granted city status. The population, which had previously been centred along the river, spread to the north and east as a result of the economic boom. The local economy, which has had turbulent moments throughout its history, is developing harmoniously in the vicinity of the historic centre. The Mondego River, the sea, and the Boa Viagem Mountain range can be defined as the city's main limits, with the latter serving as a barrier against Northerly winds, which are very common in the city, and also as a place of high scenic value, with eucalyptus and pine species dominating the landscape. According to Pombo (2003), the water lines that cross the city have their origin in the aforementioned mountain range, creating valleys where cultivated land remains, particularly next to the rivers of Abadias, Buarcos, and Várzea. Respecting the Ribeira das Abadias and adhering to the 1963 General Urbanisation Plan, it was transformed into a green space that is well integrated with the surrounding urban fabric. The most major commercial and service units are organised in two ways:

the first, representing a traditionally older profession, starts from the nucleus of S. Julião and fades to the orthwest, spreading out towards Buarcos. and further south, towards the pier, along the streets of Paço and Estendal (Pombo 2003).

5.2. Access to the Territory of Figueira Da Foz

Figueira da Foz, due to its location on the seafront, with the Mondego River to the south and the Serra da Boa Viagem to the north and a little far from the main national road axis (EN1), has always presented a deficit in terms of accessibility. In the last decades of the 19th century, accessibility to Figueira da Foz received a major boost, firstly, the new road from Figueira da Foz to Coimbra was opened to traffic in 1871, allowing regular access, followed by the royal road Figueira/ Leiria, starting from Lavos in 1875. According to article 14 of the PU (1995, p. DR 3433), the most important routes for the city are highlighted: RU - Road with collecting and distributing characteristics, urban rapid, connecting the EN variant109 to Buarcos; V1 - Track with collecting and distributing characteristics; V2 - Main access on the Coimbra - Figueira da Foz axis, with the main distribution purpose, developing parallel to the south coast of Figueira; V3 - Cross distribution road connecting the EN109 junction to V1 and providing accessibility to Tavarede and the clusters of Serra da Boa Viagem; V4 - In order to alleviate congestion in the Salmanha, Fontela and Vila Verde areas, as well as their difficult connections, this route will connect to the second node of IP3 (Pombo, 2003). With regard to maritime accessibility, the port of Figueira da Foz and, in addition, the port of Aveiro correspond to the two infrastructures included in the National Port System that are located in the Central Region. The Port of Aveiro, integrated into the network of main ports (together with Leixões, Lisbon, Setúbal and Sines), has had a Strategic Plan since the beginning of 2006 which, following the Port Infrastructure Expansion Investment Plan launched in 2000, it encompasses a series of large investments to expand its capacity and improve its operational conditions. The Port of Figueira da Foz, integrated into the network of secondary ports (together with Viana do Castelo, Faro and Portimão), the infrastructure consists of a terminal dedicated to the movement of fractionalized general cargo (Terminal de Carga Geral) and another dedicated to the movement of solid bulk, and a Liquid Bulk Terminal is under construction (CCDR-Centro, 2008). Maritime access to the port facilities is through the bar, which is delimited by two jetties, to the north and south, built in the 60s of the 20th century, and by the navigation channel. Between 2008 and 2010, the north pier was extended by 400 m as part of the works carried out to minimize the problems that affected the navigability conditions in the port, namely, the silting of the bar and the access channel to the port and the maritime unrest in the area of commercial pier. Maritime accessibility to the port of Figueira da Foz is divided into three zones: the bar, the foreport and the interior navigation channel. The bar is located at the entrance to the port and is delimited by two jetties. The north pier, with an approximate length of 1050 meters, has the function of sheltering the port from the most violent sea agitation coming from offshore, with dominant NW directions, and mitigating the entry of sediments into the navigation channel (sands). The south jetty, with an approximate length of 900 meters, has the main function of providing shelter from sea agitation, mainly from the SW. The port's navigation channel extends beyond the bar area at elevation - 8m ZH, up to the elevation - 7.5m ZH established for the inner channel, with alignment on the bar / bulkhead in accordance with the port entrance (SW direction). The foreport area is understood as the area inside the port's outer jetties up to the guiding jetties, in an area of approximately 26 ha. This area establishes the connection between the bar area and the interior channel and, in general, is sheltered from the most violent unrest climates, promoting safe entry into the interior navigation channel. The guiding jetties, with a length of approximately 150 meters each, delimit the entrance to the inland navigation channel and have the function of directing the ebb and flood currents in the area. As for the navigation channel, it has a total length of around 2,200 meters (up to the Edgar Cardoso bridge) and includes, along its length, parking basins for docked ships and a manoeuvring basin, upstream of the shipyard dock. (GT Security and Navigability Fig. Foz, 2015).

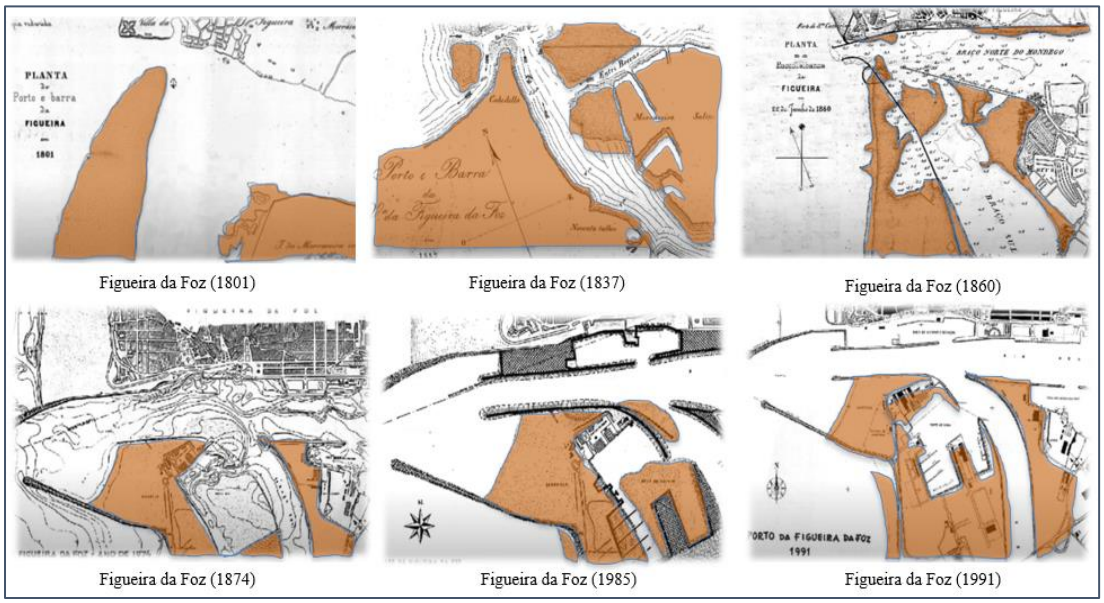
5.3. Porto and Barra Da Figueira Da Foz, Their Historical/Cartographic Evolution

The commercial port of Figueira da Foz is, due to its natural characteristics, an estuary port located at the mouth of the Mondego River, a course that, at least in a large part of its length, mainly from Coimbra, presents certain characteristics of solemnity. These, arising from the progressive deepening of its bed and consequent silting, are reflected in its landscape by the meandering of the river. Have already been corrected by man, although there is still the occurrence of floods which, in the winter months, plague the surrounding fields on the so-called island of Morraceira. With the extension of the north pier, the

maritime movement of the local port has shown significant improvements, even so, over the last few centuries, there have been many breaks, due not only to the constant digressions of its mouth and the silting of the estuary, but also to fluctuations in which are subject to some of Figueirense's main economic activities: maritime trade, fishing and the shipbuilding industries, directly dependent on its impracticality. It should be remembered that it was only at the end of the 1960s that the maritime movement resumed the upward development seen at the end of the century, due to the work on the bar and the consequent dynamization of local economic life, which had stagnated for a few decades, thanks to the establishment of an industry heavily exporting sector, cellulose pulp, which exported a large quantity of this product through the local port.

The different conditions of use of the Figueira da Foz bar, expressed by the natural conditions observed over time, figure 1, largely due to the lack of equipment and the lack of funds that allow the entry of large draft ships, oppose to the expansion of port activities, once equally contradicted by the constant wanderings of the mouth of the Mondego River. Date of 1791, D. Vandelli[1] highlighted the presence of sand spits near the mouth, but it was only in 1837 that they were, for the first time, the subject of study, carried out by Eng. Mouzinho de Albuquerque (Pombo, 2003). For a better understanding and understanding of the evolution of the bar, a set of cartographic elements is expressed with a view to a better understanding of its evolution.

Figure 1 - Plan of Porto and Barra da Figueira da Foz (1801 to 1991)



Fonte: APFF (2020)

Within the "scope of the 1st phase of the Port Plan"[2], consisted of fixing the south bank of the mouth, thus putting an end to the bar's digressions, improving access conditions to the port and expanding its commercial facilities, so that they could satisfy traffic needs. Once the works were completed in 1934, a long period of testing and studies followed until, in 1959, the project for the exterior works of the Port of Figueira da Foz was finalized, budgeted at 400,000 euros, and the construction of new buildings began. Improvements, the first phase of which was inaugurated in 1966. This consisted of the construction of two converging jetties, one to the North and the other to the South of the river, which allowed the creation of essential conditions for dredging and deepening of navigation channels, docks and anchorages. At the same time, one of the port's fundamental problems was resolved, that of the practicality of maritime access and shelter in the foreport and estuary, with the

[1]*Vandelli, Domingos - "Memory on the Plumbing of the Mondego River" – In: Economic Memoirs of the Royal Academy of Sciences – Tomo III, Lisbon, (MDCCXCI, p.12)*

[2]*This Port Plan is the implementation of the so-called "Ports Law", Decree-Law No. 12,757 of December 2, 1926*

set of works carried out serving as a basis for other improvements.

5.4. Main Vectors Associated with the Sustainability of Barra Da Figueira Da Foz

Among the main vectors associated with the sustainability of Barra da Figueira da Foz, the following stand out: currents, swell and waves, winds, north/south sandbank, sea strength and sedimentary dynamics. **Chains** - Near the port of Figueira da Foz, the predominant current appears from the north, with values that, as a rule, do not reach 1 knot. However, currents can arise from any direction associated with the prevailing winds, particularly those from the SW which, when blowing powerfully, can cause dangerous currents whose values reach 3 knots. In the port area, the current develops in the direction of the bar, reaching around 4 knots at ebb. **Ripple and wave** - The swell is predominantly from the northwest, with the exception of the months of November to February, which is felt with some frequency from the southwest quadrant, spreading beyond the jetties along the bar and making it sometimes impractical. As a rule, the effects of maritime unrest are not felt in such a significant way inside the port. **Winds** - The predominant winds in the port are from the north and northwest, which on average blow at 3 to 4 knots. **Restinga North/South** - The morphodynamic balance that is established in the region of the Figueira da Foz port bar tends to form a restinga with a north-south orientation close to the head of the north jetty, between 6 and 7 meters deep, referred to as the ZH, which extends south of this jetty to a distance of 600 meters. The presence of this sandbank in the vicinity of the bar channel tends to constitute an increased risk factor for navigation that practices the bar, particularly for small vessels, especially when the wave breaks over the sandbank. **Sea Force** - The product of the significant height of the swell, wave and wind is established by direct observation and analysis of forecasts made available by the Hydrographic Institute, IPMA, and services provided by external entities via the internet, as well as by records of wave buoys located in other locations (Leixões and Nazaré). **Sedimentary Dynamics** - Implementation of a sediment dynamics monitoring program in order to evaluate the effects of the measures taken and the evolution of the coastal zone.

5.5. The Figueira Da Foz Recreational Marina and its Surroundings

Before making some considerations about the Figueira da Foz recreational marina, it was considered appropriate to make a brief clarification of the different typologies associated with recreational boating. In this context we have: Recreational Marina - is characterized by a set of infrastructures exclusively dedicated to recreational boating and sports, framed by a hotel and residential complex, integrated into a sheltered water surface and providing the necessary support for vessels and crews (Costa, 2012). Recreational Port - is characterized by a set of infrastructures exclusively intended for recreational boating and sports, integrated into a sheltered water surface and providing the necessary support for vessels and crews (Costa, 2012). Recreational Dock - a recreational dock consists of a simple area inside a port, with water conditions and medium support services on land. Recreation Centre - is the simplest type of work of the 4 typologies presented in this work. It is a set of infrastructures in a sheltered water surface, integrating simple parking devices, predominantly dry, and appropriate hauling systems (Costa, 2012). The Figueira da Foz recreational marina, is located on the north bank of the Mondego River and 0.8 nautical miles from its mouth, the Figueira da Foz Recreational Port consists of a wet area of 5 hectares, having walkways and floating fingers, with a capacity of 200 berths for vessels from 6 to 15 meters and with a draft of 3 meters. The walkways are equipped with water and electricity and access to them is via a coded magnetic card. It also includes a 120m long dockable pier, intended for service and pleasure vessels of larger sizes. Its numerous support services (which include hull and engine repair workshops) and its geographical location make the pleasure port not only a shelter for crews to rest, and for technical repair and refueling stops, but also a pleasant choice vacation, with multiple leisure options. The Figueira da Foz marina is formed by two main walkways, one downstream (closer to the Administration of the Port of Figueira da Foz, the nautical clubs, and related commercial spaces), and another installed upstream, closer to the building central to the City Hall. In addition to the multipurpose square, the recreational sports area, and the Santa Catarina Fort, there is the marina to the west, as well as the commercial spaces within the jurisdiction of the port administration, as well as the sailing club.

5.6. SWOT Analysis of the City of Figueira Da Foz

In the current context, there are several tools that allow you to aggregate relevant information for the management and strategic planning of the means, resources, skills and performance necessary for different types of scenarios, avoiding unnecessary costs and maximizing results. As a

diagnostic element of the work, a SWOT analysis is presented with the characterization of the strengths, weaknesses, threats and opportunities of the central coastal region, particularizing the city of Figueira da Foz, with a view to aggregating a set of relevant information with a view to implementation of a strategy and consequent decision-making.

SWOT Analysis - Strengths - Regarding the "Territorial Planning" factor, the city of Figueira da Foz has a privileged geostrategic location, presenting high territorial biodiversity and great aquifer potential. Regarding the historical and cultural importance of activities linked to the sea, the recreational marina located in an important and central area of the city stands out; the requalification of the mouth, the domain area is inferred as a potential for growth in occupation, which is assumed to be core strategic vectors of the city's development sector. Regarding tourism and nautical tourism, the rich natural heritage that exists throughout the municipality stands out: mountains, lagoon, waves, wind, salt flats, beaches, marina, recreational port, protected forest. It embodies an enormous, rich nuclear potential, as a promoter of development, complemented by the region's growing hospitality and hotel and gastronomy offer. Among the sectors that we intend to highlight, there are sporting spaces and activities, with a strong sporting vocation of the municipal population combined with the practice of various land, aerial and nautical adventure sports. The associative movement, very participatory in promoting sport; the extensive seafront, as well as the entire estuary, make it possible to practice various water sports activities; the extensive beach front allows the installation of various equipment to support the practice of highly competitive nautical activities (surfing, rowing, football, basketball, swimming, bodyboarding, orienteering). The privileged geostrategic location combined with the good road network, which connects Figueira da Foz to the entire country, with a railway network with the possibility of improvement and expansion, as well as the sea and river front with tourist potential. Thus, from a territorial point of view and in the vision of Ventura (2019), it is assumed the achievement of a municipality of opportunities and quality of life, with a diverse set of strategic guidelines being proposed, highlighting: the connection of the city to the world; concept of a tourist, sustainable and competitive city.

SWOT Analysis - Weaknesses - With regard to the so-called most fragile sectors, we highlight the increase in artificialized areas in recent decades, a poorly consolidated urban fabric, the Municipal Master Plan under review for several years and the decentralization of public services for the city of Coimbra, it is assumed as negative points in the municipality. In a sea and river policy, there are high legislative restrictions for the construction and implementation of new support equipment in coastal areas. The lack of high-luxury hotels, combined with seasonal tourist activity (summer), assisted by the slowness in obtaining authorizations, licenses and high taxes, make nautical activities in the region difficult; the delay in the development of recreational boating, the lack of infrastructure and the lack of quality services to support recreational boating also translate into a common problem. Regarding sports spaces and activities, the general index, of large fields, sports halls, indoor swimming pools, and athletics tracks are below reference values (Ventura, 2019). The high general community index hides qualitative deficiencies in terms of other typologies. Various equipment is located in educational establishments, with access sometimes restricted; there is a low number of covered sports spaces. The city of Figueira da Foz is considered a peripheral territory in relation to Europe with a railway network in need of improvement and a sea route only for maritime port trade. On the other hand, the population decrease in recent decades, complemented by the increasing aging of the resident population, as well as the decrease in the migration balance, translate into a critical point in the sustainability of the territory in question.

SWOT Analysis - Threats - In the territorial component, the threat factors translate into an increase in artificialized areas. On the other hand, the poorly consolidated urban fabric, combined with the lack of timely review of the Figueira da Foz PDM, has also contributed to the slow development of this territory. The decentralization of public services to the city of Coimbra, as well as the previously existing universities, made the city a hostage to the centrality of Coimbra. In the maritime context, the very high restrictions on licensing stand out. The silting of the bar could jeopardize the sustainability of the commercial port and, in addition, the disappearance of the "wave" at Cabedelo beach (to the south), very popular among surfers, resulting in major losses in the region. The lack of luxury hotels, complemented by seasonal and summer activity and the lack of superior quality tourist infrastructure linked to recreational boating, results in an explosive mix of tourism loss in the region. It was found from statistical data that there continues to be a loss of inhabitants in the municipality,

qualified young people tend to leave the region in search of better job offers (Ventura, 2019).

SWOT Analysis - Opportunities - As opportunities, we highlight the central location in the geographic triangle (Leiria, Coimbra, Aveiro), the high territorial biodiversity (fauna, flora and habitats), and an incredible potential combined with sea and river sports. At a legislative level in the domain area, it presents a more permissive nature to the implementation of nautical sports infrastructures, than in other areas, whose constraints are much more limiting, such as in protected natural areas. The territory (DPM) is unique in terms of the existing area and territorial dimension, translating into a potential territory for local development. The location of the recreational marina in the prime area of the city of Figueira da Foz translates into a pearl of the city in terms of attracting new tourist flows combined with recreational boating and yacht tourism. The beaches stand out for their crystal-clear white sand and the quality of their world-class waves. Increasingly, efforts are being made to use and enhance local vernacular materials, which are ecological and sustainable, with emphasis on marine plywood, prefabricated modular structures and composite material. Experiencing the sea from a leisure and recreational boating perspective associated with the enjoyment of superior quality sports spaces, encouraged by the multiplicity of investment incentive programs, is one of the region's premises. At a tourist level, the valorisation of existing natural heritage through marketing methodologies is highlighted. Figueira da Foz has capacity for growth in terms of the increase in higher quality hotel units, as well as associated equipment and infrastructure, with a view to attracting new tourist flows, whether national or international, highlighting the recreational boating aspect, with the objective of placing the city as an icon of nautical tourism in the central coastal region of Portugal. An exceptional domain territory for the practice of water sports, with the candidacy for "World Surfing Reserve" and the creation of the "Sea Village", it tends to make up for the delay in the development of recreational boating. The creation of excellent and superior quality equipment to support sport, particularly linked to recreational boating, can meet the needs for quality infrastructure linked to sport. The sand with unique characteristics stands out for the temporary or non-temporary implementation of quality equipment linked to sports practice, meaning that the creation of architectural, differentiating, sustainable equipment can enhance and boost high-competition sporting activities and training. There is also the possibility of creating a high-performance center (CAR) that meets the needs of nautical tourism, as well as the creation of an integrated plan to support the development of adventure and water sports. At a technological level. On another note, the possibility arises of carrying out studies that make it possible to deepen the channel bar of the port of Figueira da Foz, which simultaneously prevents continued silting and coastal erosion to the south, so as not to reduce the tourist potential of Cabedelo beach. and the existing "wave". The environmental quality, the landscape, the tranquillity, the enjoyment of sports equipment combined with the practice of sports by the sea, translate into explosive factors of opportunities for those who want to experience this territory.

Chapter 6

SPECIFICITIES OF RECREATIONAL BOATING COMBINED WITH SUSTAINABILITY

6.1. Nautical Tourism and Issuing Markets

In recent years, Portugal has focused its main tourist activity on the Sun, Sea and Beach product, better known as the 3 "S" tourism - Sun, Sea and Sand. Nautical tourism is characterized by mass tourism and is based on the seasonality that the product itself entails, assuming itself as an example of the Fordist model of tourist development. In an increasingly difficult era for tourism, efforts have been made to diversify the product offering in order to, on the one hand, combat the extreme dependence on Sol e Praia tourism, meaning Sun and Sea, insofar as it is a tourist product which best responds to the strongest portion of global tourist flows, this is because, it began in the mid-19th century in the seaside resorts of Northwest Europe, later moving further south, especially, from the mid-20th century, transforming the bathed area across the Mediterranean in the largest tourist destination worldwide; Even so, at present the search for sun and sea is also directed towards other parts of the globe, namely the Caribbean and the Pacific. Since its development, the so-called Sun and Sea tourism has recorded a constant growth in visitor flows, reaching in many tourist destinations a phase of maturation; however, in other coastal destinations saturation phase is

already evident, according to life cycle of tourism products. Several reasons are associated with this continuous growth, namely the fact that Sol e Mar tourism is one of the oldest in the tourism sector. Tourism; and taking into account the high demand and/or consumer preferences, sun and sea was heavily promoted by the public and private sector in destinations. Despite the interest expressed in Sun and Sea tourism by several actors in the sector, this did not necessarily translate into management and Territorial Planning effective for these destinations, but in some cases it ended up enhancing the negative impacts originating from tourism, that is, the vast majority of sun and sea destinations present high levels of impacts, a high degree of seasonality, environmental and landscape deterioration of much of the coastal areas (especially due to excessive construction), mass tourism that has led to a lower quality tourist service. Derived from progress and innovation, which in many cases prevented the decline of destinations solely dedicated to sun and sea tourism, leading to requalification, territorial reorganization and the joining of tourist products complementary activities, namely nautical tourism, still maintaining the sun and sea as the tourist product main. At a national level, there are several resources available for the development of Sun and Sea and Nautical tourism, which are found along the Portuguese coast, covering a length of more than 850km. The south of Portugal, especially the Algarve region, receives the most visitors in these segments and has approximately 200 km of coastline, with white sand beaches, crystal clear waters, cliffs, dunes and a mild climate throughout almost the entire year.

The Alentejo and Vicentina coastline stretches for more than 180km, they are destinations that are still little sought after by tourists in this market and therefore have a well-preserved coastline of environmental excellence. In this context, nautical tourism aims to provide active travel in direct contact with water (sea, river, lake, reservoir, dam, etc.), with a view to carrying out and enjoying nautical activities, whether for leisure or competition. Of the various nautical activities, the following stand out: surfing, windsurfing, kitesurfing, bodyboarding, sailing, canoeing, paddleboarding, rowing, diving, cruises, motorboating, water skiing, among others (Turismo de Portugal, 2006). Nautical tourism is a complex concept, which continues to not be properly defined or clarified, due to the fact that it assumes different and non-consensual designations. However, it is understood as a segment, or a subtype of tourism, which combines two words: tourism and nautical (Lukovic, 2013). It can be inferred from the state of the art surrounding the nautical tourism dimension that it results from general tourism already with a certain level of development, whether social or economic. Different types of tourism emerge at different levels of economic development. Depending on the variables time and development, it appears that nautical tourism arises from the intersection of these two components, with hotel tourism emerging as one of the first basic forms at the beginning of the development of tourist activity in certain destinations, largely due to the height of tourist and economic development (Lukovic, 2013). Thus, nautical tourism is characterized by the intersection of several concepts on the subject of water. The lack of international definitions makes it difficult for authors to interpret terminologies such as: nautical tourism, marine tourism, sailing tourism, yacht tourism, among others. Some authors use nautical tourism in the context of yacht tourism, whether motor or sail. Tourism depends on the general definition, as the term nautical derives from the Greek word naus which refers to boats. Nautical science or navigation concerns a set of practical and theoretical knowledge that a ship's captain needs to know for navigation, from its origin to its destination (Marusic, Ivandic & Horak, 2014). With regard to markets, the “Hypercluster” of the Sea Economy is divided into two large groups: a) Recreational Nautical, which is based on a varied set of experiences related to the practice of water sports as a form of leisure and entertainment, corresponding to 85% of nautical trips throughout Europe, out of a universe of 245,000, and includes a great diversity sport: sailing, windsurfing, surfing, among others (Thr, 2006); b) Sports Nautical, which encompasses experiences with the aim of participating in sports competitions, corresponding to 15% of trips, whose motivation is related to sports nautical, out of a universe of 245,000 trips across European countries (Thr, 2006). Nautical tourism is based on an activity that is related to the use of nautical equipment, nautical vessels (water scooters and others) with the aim of enjoying nature, using the water mirror, whether these are still waters or not. Integrated into the coastal tourism practice segment, directly related to sports and leisure activities in contact with the water mirror, whether sea, river, reservoir, lake, as previously demonstrated, it allows for a bridge with the product Sol & Mar, thus enabling the visitor to list attractive possibilities in the context of enjoying other activities (Duarte, 2017). In this regard, it is important to understand the concept of visitor that incorporates the tourist (who spends the night in the place visited) and the excursionist

(who visits the place, but who does not spend the night in the place visited).

6.2. National Territorial Occupation of Marinas and Recreational Ports

With regard to national marinas and recreational ports, those with greater territorial representation are explained based on the sustainability factors correlated with our study and the number of mooring posts and a detailed characterization of each of the marinas based on the main sustainability vectors. **Póvoa de Varzim Marina** - Póvoa de Varzim is located 21 miles south of Viana do Castelo. The port entrance faces south and is protected by a north pier with SSW orientation; holds a red lightning flashlight and siren. The south jetty facing NNW has a lighthouse with long green lightning at its end. Despite being well protected from the northwest, entry can be difficult due to the strong swell; even with moderate swells, it starts at the end of the breakwater. The south coast is made up of sand and rock; Given the existence of dangers offshore, navigation must be carried out outside the 20m bathymetric range. Latitude: 41º22'0´N; Longitude: 08º46'0"W; Ties: 241. **Porto Atlântico Marina - Leixões** - The port of Leixões is located 2.5 miles north of the mouth of the Douro River, between Leça da Palmeira and Matosinhos. The best references are the Leça lighthouse and the chimneys of the Petrogal refinery. The marina is located in the northwest part of the dock. Navigation must be carried out with care due to the ships anchored off the port, especially during periods of fog. Latitude: 41º'11'0"N; Longitude: 08º42'3"W; Ties: 240. **Viana do Castelo Marina** - The Viana do Castelo marina is located next to the mouth of the Lima River and within the port of Viana do Castelo, presenting a high level of protection. It consists of two docks, one downstream of the metal bridge (vessels up to 18m) and the other upstream for smaller vessels. The main landmarks are the Montedor lighthouse 4 miles north of the port and Monte de Santa Luzia. Whether north or south, there are dangers along the coast. As a precaution, you should not go within the 20m bathymetric area. The entrance channel is dredged 8m to the commercial pier. Access to the marina is dredged at 3m. Due to the strong transverse currents, both flood and ebb, it is prohibited to anchor the vessel in the river. Latitude: 41º'40.5'0"N; Longitude: 08º50'3"W; Ties: 307. **Figueira da Foz Marina** - The Figueira da Foz marina is located 2.5 miles south of Cape Mondego, an important reference is its port which is located at the mouth of the Mondego River. The marina is located approximately 0.7 miles from the breakwaters or jetties at the entrance to the bar, also known as the north jetty and the south jetty, on the port side. This is the marina portrayed in our case study, which highlights important issues linked to sustainability, such as the constant silting of the access channel as the most significant and important for the sustainability of the commercial activity of the port of Figueira da Foz. Latitude: 40º09'0´N; Longitude: 08º52'0"W; Ties: 330. **Alcântara Recreational Dock Marina** - The dock is located inside the Alcântara port structure, 1 mile upstream from the 25 de Abril bridge. The entrance is protected from currents by a small basin. Latitude: 38º42'0´N; Longitude: 09º12'0"W; Ties: 442. **Freixo Marina** - *Porto* - Located on the right bank of the Douro River, 3 km from its mouth, the Freixo marina seeks to serve all those who use the Douro River, whether for leisure, work, tourism, sport or simply contemplation. Located in the first part of the waters of this river, the marina has a winch of up to 10 tons, a ramp to access the water, space for 76 boats up to 16 meters in length, and docking for boats up to 100 meters. Latitude: 38º42'0´N; Longitude: 09º12'0"W; Ties: 442. **Marina Quinta da Barca - Esposende** - Quinta da Barca has at its disposal a Marina with capacity for 80 boats, particularly aimed at the tourist component. It has two restaurants, an Aparthotel with 30 apartments (T0 and T1 typology), with Gym and Meeting and Games Rooms. In July 2005, the second Aparthotel was opened with 50 apartments (type T0, T1 and T2), covered and heated swimming pool and Health Club. Latitude: 38º42'0´N; Longitude: 09º12'0"W; Ties: 80. **Marina Porto de Sines** - The marina port of Sines is located next to Praia Vasco da Gama, also called Baia de Sines. An obligatory stopping point for pleasure boats traveling along the Portuguese coast on national or international routes, this port opens up new perspectives for the tourist exploration of Sines and the entire Coast of the Southwest Alentejo and Costa Vicentina Natural Park. It is the only recreational port on the sea coast between Setúbal and the Algarve, in an area where recreational navigation is intense throughout the year. The Sines Recreational Port consists of a shelter jetty, landing pier, dock ramp, mobile crane, marginal retention, embankments, and walkways and floating "fingers" for docking vessels. Latitude: 37º57'0´N; Longitude: 08º52'0"W; Ties: 230. **Marina Parque das Nações** -Lisbon's marina with an urban, central and cosmopolitan nature. Located in Parque das Nações, an area that offers a new dynamic of conviviality and cultural entertainment in the city of Lisbon, which combines nautical tourism with attractions resulting from Expo 98, such as the Oceanarium, Casino Lisboa, MEO Arena, green and relaxing spaces riverside walks. Integrated into the

Tagus Estuary Natural Reserve, considered one of the ten most important estuarine areas in Europe and excellent for bird watching. It currently presents several constraints to navigability: siltation and the existence of silt that affect the navigability and anchoring of vessels. Latitude: 38º45'21´´N; Longitude: 09º05'33"W; Ties: 600. **Lugar de Baixo Marina** - Madeira Island - It is a marina located on the west coast of Madeira Island, in the municipality of Ponta Delgada. It has a waiting pier, a loading ramp for smaller vessels, parking and some complementary services. Latitude: 32º40'47´´N; Longitude: 17º05'15"W; Ties: 297. **Nazaré Marina** - Marina located next to an artificial fishing port, well sheltered and without dangers on its approach. It is located 1M SSE of Pontal da Nazaré; although the Recreation Center is quite pleasant, it is located 2 km from the center of the village. Latitude: 39º35.5'0´´N; Longitude: 09º4.5'0"W; Ties: 52. **Ribeira Marina - Peniche** - It is a marina located inside the western jetty of the Port of Peniche. In addition to the usual support structures (pollutant and waste collection, changing rooms, laundry, fuel pump), it has a ramp and support crane. Due to the proximity of Berlengas, this marina is a very attractive place. Latitude: 39º21'0´´N; Longitude: 09º22'0"W; Ties: 140. **Cascais Marina** - Marina de Cascais is an ambitious project for the 21st Century, allied with the Environment and New Technologies. With a wind with a reliable and constant orientation, and a regular breeze, numerous places for spectators to enjoy the action from very close range, it becomes a unique place to host a Sailing Event. And the choice of the America's Cup to be the venue for the opening of the World Series reaffirms the reputation of the Cascais Marina at a global level, which is proud to have first received the best crews in the world and the fastest sailing boats in the world, with Cascais and its Marina as a milestone in the historic change in the format of the prestigious America's Cup. With capacity for 650 vessels, the Cascais Marina has been permanently improving its facilities and services so that its exceptional conditions, both on land and at sea, to be enjoyed by all who attend. Latitude: 38º42'0´´N; Longitude: 09º25'0"W; Ties: 650. **Marina (Port of Shelter) of Oeiras** - It is a marina located next to the mouth of the Tagus River, taking as its mouth the line defined by the two towers: Torre do Bugio, located on an artificial islet, in the middle of the mouth, and Torre de S. Julião, on the bank. right. The port is sheltered by two jetties, the main jetty, from the west, and the counter jetty, from the east. Latitude: 38º40'32´´N; Longitude: 09º19'11"W; Ties: 274. **Marina Dock of Santo Amaro** - It is a marina located close to the 25 de Abril bridge, benefiting from various services: floating walkways, reception station, water, electricity, water on the pier, collection of waste and used oil, security systems, communication systems, bathhouses. Even so, some problems are detected, of which we highlight the release of metallic sparks from the bridge, which fall and are deposited on the boats and the surrounding area without disappearing. Resulting in an environmental problem, with no end in sight. Latitude: 38º42'0´´N; Longitude: 09º12'0"W; Ties: 178. **Marina Dock of Bom Sucesso** - It is a marina located in a privileged area of the city of Lisbon. It benefits from several services, namely: floating walkways, reception station, water, electricity on the walkways, water on the docks, fuel station on the docks, waste and oil collection, security system, communication systems, changing rooms and weather forecast. Latitude: 38º41'0´´N; Longitude: 09º13'0"W; Ties: 141. **Belém Dock Marina** - It is a marina located in Belém, with dry maintenance and repair facilities (gantry, tidal grid, electro-hydraulic crane. On the other hand, it assumes a symbolic link for sailors around the world, from where the Portuguese ships departed which in the 15th and 16th centuries were pioneers in discoveries. Located in the middle of Praça do Império, with emphasis on the monuments Mosteiro dos Jerónimos and Torre de Belém. Latitude: 38º41'0´´N; Longitude: 09º13'0"W; Ties: 170. **Guadiana Marina (Recreational Port)** - It is a marina located in Vila Real de Santo António,sandy plain on the right bank of one of the largest navigable rivers, the Guadiana, close to its mouth, occupying the eastern end of the Algarve. It borders Ayamonte, Spain. Just a few minutes from the Vila Real de Santo António Sports Complex, a large sports center - and about 3 km from Monte Gordo Bay, its beaches and Casino. Latitude: 37º11.5'0"N; Longitude: 07º24.7'0"W; Ties: 378. **Marina (Recreational Port) of Olhão** - It is a marina located in Olhão. It is defined as a state-of-the-art Recreational Port, environmentally friendly and which does not conflict with traditional fishing, integrated into the city's riverfront redevelopment plan. In a first phase, the port's capacity, currently estimated at 299 places, tended to grow to 340 places. With the additional expansion that is intended, the goal is to reach 500 mooring posts, with the installation of three to five more walkways in the eastern area, next to the current artisanal fishing sector, and the dredging of bottoms throughout the area concession. The project also foresees the construction of support infrastructure, service and commercial areas, in a dry area of 25,474 m² and a wet area of 50,800 m². Latitude: 37º01.25.9"N; Longitude: 07º50.27'3"W; Ties: 340. **Vilamoura Marina** - This is the first marina to be built in the country,

located on the Algarve Coast, south of Portugal, in the city of Vila Moura. According to data from the Algarve Tourism Portal, its activity began in 1974, and it was one of the first Portuguese marinas to obtain Quality and Environment certification by ISO 14001 and ISO 9001, together with the European Blue Flag certification for Marinas and the distribution of 5 Anchors by the Yacht Harbor Association. In the period between 2015/2017, 2019 and 2020, it was elected the best international marina by TYHA and won the gold medal from Algarve Regional Tourism. In 2020, for the 10th consecutive year, it was awarded the distinction of the best Marina in Portugal, by the Publituris Portugal Trade Awards. Latitude: 37º.04'4"N; Longitude: 08º,07'3"W; Ties: 1300. **Albufeira Marina** - Albufeira Marina located in the Algarve, according to data from Algarve Tourism, is characterized as being the safest and most sheltered marina in the country. It has been open to sailors and all visitors for over 10 years. The marina offers sophisticated means of support, as well as personalized service. It is surrounded by a high-quality tourist complex, where green spaces predominate and only 29% of the area is intended for construction (hotels, restaurants, bars, shops, swimming pools, apartments, villas and entertainment and leisure centers. It is 40km from the Faro International Airport. In 2008, it obtained Environmental Certification according to ISO 14001; Blue Flag in 2020 and the distinction of 5 gold anchors by TYHA/ British Marine Federation. Latitude: 37º.05'0"N. **Portimão Marina** - Portimão Marina located in the Algarve, according to data from Turismo do Algarve, has assumed a preferential position for mega-yachts up to 50m.Located in the safest place in the country, in the wide estuary of the Arade River, it extends over an area of around 25 ha, framed by the forts of Santa Catarina and S. João, equipped with magnificent support facilities. The marina has deep water; wide entrance and spacious maneuvering areas, sheltered from the prevailing winds. Stage of numerous international competitions. In 2019, it received the Clipper Round the World fleet, the first stopover of the Round the World Odyssey. Portuguese Marina awarded with the Jack Nichols Award, Portimão Marina also receives the maximum score, out of 5 anchors, in the international classification "Gold Anchor Awards" awarded by the prestigious "The Yacht Horbour Association, British Marine Federation. Latitude: 37º.08'0"N; Longitude: 08º,20'0"W; Ties: 620. **Lagos Marina** - Marina de Lagos located in the Algarve, in the Bay of Lagos, according to data from Turismo do Algarve, since its opening in 1994, the different crews of different nationalities define themselves as the best ambassadors. Lagos Marina was distinguished with the Euro marina Anchor Award, the Blue Flag of Europe, the 5 Gold Anchors of the Gold Anchor Award, and the 5-star Blue Star Marina, awarded by IMCI. Prioritizes the comfort and safety of the facilities. Latitude: 37º.06'0"N; Longitude: 08º,40'0"W; Ties: 462. **Marina Pêro de Teive** - Azores - Marina Pêro de Teive, is located in Ponta Delgada, in the Azores, on the south side of the island of São Miguel, 500 meters from the city center of Ponta Delgada. Its recent expansion from 140 to 640 berths divided it into two zones, the East (former Marina de Pêro de Teive) and the West (also known as the Marina das Portas do Mar). Awarded with the Blue Flag and with the flag Quality Coast, the Ponta Delgada Marina is an important infrastructure for the development of tourism in the Azores, playing a supporting role for all sailors. Latitude: 37º,22,1'0"N; Longitude: 25º,39,4'0"W; Ties: 640. **Horta Marina - Azores - Marina da Horta**, located in the city of Faial, in the Azores, opened in 1986 and is one of the busiest in the world, largely due to its geographical location in the middle of the Atlantic Ocean. Therefore, the tradition of yachtsmen who leave paintings alluding to their vessels on the Marina walls is well known. According to legend, this act will take the boat safely to its destination. Latitude: 38º,35'0"N; Longitude: 28º,42'0"W; Ties: 240. **Angra do Heroísmo Marina - Azores** - Angra do Heroísmo Marina, located on the south coast of Terceira Island, in the Azores. During the day, Monte Brasil is a reference. At night, if the approach is from the W, the Monte Brasil lighthouse is only visible from the 57º mark. The marina is located in the eastern part of the bay protected by a breakwater. The approach is made on the 342º line formed by the anterior and posterior lighthouses of Angra do Heroísmo. After the jetty's light has passed the starboard beam, it should turn to starboard and head towards the marina entrance. Latitude: 38º,39'1"N; Longitude: 27º,13'0"W; Ties: 260. **Funchal Marina - Madeira Island** - Funchal Marina, located on Madeira Island. Opened around 20 years ago, it is located in a sheltered area within the main port of Madeira, 530 nautical miles from Lisbon and 36 nautical miles from Porto Santo. This infrastructure has 210 spaces for yachts and a berthing area for boats for nautical and tourist activities. The Funchal marina offers multiple support services that include water and electricity connections, fuel stations, etc. Latitude: 32º,38'3"N; Longitude: 16º,54'2"W; Ties: 210. **Calheta Marina** - Madeira Island - The Calheta recreational port located in Vila da Calheta, Madeira Island, is the shelter port in the westernmost part of the island. With more than 300 days of sun

exposure, it is an excellent place for carrying out activities related to the sea, with the calm and tranquillity that the western part of the island of Madeira provides. Next to an artificial sand beach, making it an ideal complement throughout the year, the Calheta recreational port is defined as a development of excellence. Latitude: 32º,43'04"N; Longitude: 17º,10'19"W; Ties: 300. **Sesimbra Marina** - The Sesimbra marina is located equidistant between two of the main cities in Portugal, 32 km south of Lisbon (the country's capital and international port), and 32 km west of Setúbal (international port), and distant 147 km to North of Sines (International port and petrochemical complex). It is located approximately halfway between the Setúbal bar and Cabo Espichel, in the area of steep cliffs of Serra da Arrabida, in a small cove with sandy beaches and almost entirely sandy bottoms, even with some fog, any small boat provided radar makes docking at the port without difficulty. Latitude: 38º,26'2"N; Longitude: 09º,06'7"W; Ties: 213. **Troia Marina** - Between the Atlantic Ocean and the Sado Estuary, there is one of the most beautiful bays in the world, Setúbal Bay. Known for its resident population of bottlenose dolphins, considered an idyllic spot for sailing or windsurfing. With space for 180 boats, the Troia Marina is part of the Troia Resort tourist complex and is one of the best examples of marinas in our country. Troia Marina has a perfect location for water sports. With a privileged location in the middle of the Arrábida Natural Park, it holds environmental certification by ISO 14001, registered with EMAS and awarded the blue flag. Latitude: 38º,29'40.09"N; Longitude: 08º,54'4,29"W; Ties: 180.

6.3. Territorial Relationship between Figueira Da Foz and Recreational Boating

In the context of the territorial relationship with recreational boating, it is argued that territorial growth must be viewed from a multifaceted perspective that includes economic, social, cultural, institutional, and environmental factors. Recreational boating unifies these disparate locations in their essence. The relationship between recreational boating and the areas covered must be formed in accordance with environmental sustainability, and this component must be considered in the planning of recreational boating infrastructure. In navigation activities and nautist conduct (requires respect and the adoption of behaviours consistent with an environmental code of conduct). In terms of space requalification, the promotion of recreational boating infrastructure should take place in close coordination with riverfront requalification projects, resulting in synergies that favour integrated urban requalification and revitalization processes. In terms of the resuscitation of historical and cultural assets, it is emphasised that the navigation of recreational vessels must be improved by the presence of a network of support facilities. Regarding economic and social dynamism, the promotion of recreational boating must not overlook the impacts of stimulating and reinforcing the competitiveness of recreational boating firms, so supporting the formation of a cluster logic. Nautical infrastructures serve as a point of connection between the city and the port area, showing programmatic convergence. In the framework of urban rehabilitation, it is difficult to reconcile fishing, leisure, maritime trade, and water sports in a port city like Figueira do Foz. Figueira da Foz, due to its geographical uniqueness, is able to bring together activities such as fishing and wave sports on the city's south bank, known as Ilha da Morraceira. Recreational sailing sports activities take place in the marina area and estuary at the entrance of the Mondego River, which can sometimes interfere with the movement of ships into the commercial port (Silveira 2016). In the same context, within the area closest to the river and the marina and, relation to the Figueira da Foz Port Administration area, three urban areas of great importance for the city were reclassified, namely: the area next to the sea at the top west (for recreational sports activities); the central area, corresponding to a multipurpose square with hotel and commercial facilities, and a covered car park; the recreational port area, through the installation of current associative structures existing there and businesses linked to sports boating and fishing (Silveira, 2016).

6.4. Recreational Boating and Associated Infrastructure

Portugal considers itself to be a maritime country par excellence associated with a historical and cultural past that it holds with its people linked to the sea, it reveals itself to have a strong nautical tradition and an extensive coastline, with favorable conditions for the practice of various activities. sporting activities linked to nautical activities (Association for the Knowledge and Economy of the Sea, 2009). For Costa (2012), a recreational infrastructure consists of a shipyard area, dedicated to basic support services for vessels, including an area for administrative and reception services for users and certain special posts, which can add value to the infrastructure. referred to. According to the same author, construction site areas must include: ramps; workshops; vertical piers; shipyard embankment; docks for the gantry, as well as some special

stations, reception; administrative services, fuel supply area; wastewater pumping; rental boats. The construction of recreational infrastructures, such as ports and marinas, as well as the installation of high-performance centres dedicated to sports practices, require the necessary adaptation with fixed and removable piers, access fingers, depth beacons, surveillance and security systems (Regional Tourism Entity of Alentejo & Ribatejo, 2015).

6.5. Access to Nautical Infrastructures

With regard to access to nautical infrastructures, two factors of relevant importance in planning a recreational infrastructure can be inferred: having easy access by land and safe access for vessels to navigable waters. The nautical infrastructure must be provided by good transport networks in order to create less pressure on the demand for parking. The connection of the recreational infrastructure to the territorial surroundings is extremely important, as it allows its users access to a greater range of services and has proven to be crucial throughout the world, contributing decisively to the profitability of the recreational infrastructure, as well as for the enhancement of the territory. On the other hand, it must also guarantee safe entry into the infrastructure, regardless of the weather and/or tide (Costa, 2012).

6.6. Sustainability of Floating Equipment and Mooring Posts

In the context of sustainability of floating equipment and mooring posts, it is inferred that they must be built using vernacular, robust, sustainable and long-lasting materials. These are essential principles of a project in a maritime environment, yet it is difficult to know exactly the behaviour of structures and mooring systems when subjected to various adversities, namely: waves, currents and wind, salt, acids from seagull waste, etc. However, it is mandatory, and attention must be paid to the characteristics of the location, as well as the direction, intensity and frequency of predominant and adverse winds; shelter protection; chains; depths; tidal regime and respective bottoms. Sustainability combined with durability and safe use of the infrastructure is high and should be a key factor in its installation and use. The use may vary, be it recreational, maritime-tourist, fishing (light or heavy) or naval work. Depending on the type of use, the choice of the type of floating equipment to be installed will be determined. In this context we have:

The piles - for example, are placed and buried in the sedimentary bottoms or "sunk" in open cavities in the rocky bottoms, having an aligned arrangement and in accordance with how the pontoons and fingers are intended to be placed, which are connected and attached to the piles. **Chain systems** - have metallic characteristics that are secured to "docks" or other elements positioned at the bottom or on the docks. The so-called poitas are nothing more than massive concrete blocks strategically positioned on the bottom, functioning as anchor systems. **Metal stays and locking cables** - connect the floating equipment to a fixed location, that is, a pier or shore. At the same time, this connection will prevent unwanted movement of the equipment, securing it and maintaining the desired distance from the edge. The necessary oscillation of the equipment to follow the water level is possible thanks to the ability to rotate the support of the risers on the bank. **Metal wall beams** - these beams are fixed and positioned vertically next to a wall and allow the fitting of fingers or walkways, as well as their oscillation with the variation of tides. **Seaflex type elastic systems** - this is the most complex of the types of mooring presented. The floating equipment is fixed with the help of flexible cables and weight elements, which are placed on the bottom. Floating structures can be of different types, depending on the construction material. They can be made of concrete, steel, aluminium, wood or composites and polymers. **Anchoring** - It is a simple system that can be used regardless of the tidal range. There is the possibility for the vessel to use its own cables and anchor or to take advantage of available chains. For the system to operate safely, it is advisable to provide good information regarding tides, currents and depths available in accordance with expected tide levels. As disadvantages, anchorages require considerable space per boat, due to the variation in their position, as well as the environmental problem of the destructive effects of anchors on the bottom. **Buoy mooring** - This type of mooring can work at greater depths compared to anchorages, as long as there is no excessive tidal range. It can work with mooring at just one point, requiring considerable space per boat thanks to changes in position, or with double mooring, with better use of space and greater safety. This system requires good information in terms of tides, winds and depths, such as marking buoys with identifying numbers and indicating the size of boat they can handle. It is advisable that users are informed about the use of buoys so that they act accordingly. Maintenance of the system is relatively easy, and special attention must be paid to the conditions and changes in the bottom, particularly sludge

concentrations. Normally, temporary inspections are mandatory, such as replacing buoys, (Costa, 2012). **Mooring to a pillar** - You can make a simple mooring to a pillar or use two pillars, which must have a structure that facilitates mooring, depending on the type of boat you are expecting. With this double mooring, it is possible to moor more than one boat in parallel, to the same set of pillars. It is important that users know how to perform arrival or departure maneuvers. There is also the possibility of combining pillars with banks, piers or jetties. It is a system that can exist within and along navigable channels and requires studied positioning, according to wind, tide, current, wave and channel conditions. On the other hand, mooring to pillars involves even higher initial costs compared to mooring to buoys. No less important, and in a context allied to sustainability, it is inferred that this type of mooring has simple maintenance and periodic inspections, (Costa, 2012). **Mooring to pontoons** - Docking to pontoons can be carried out in all types of locations, as long as it is not in the open sea. In the past, they were closely associated with large marinas, but nowadays they are widely publicized, as a result of the versatility that is increasingly characteristic of them. The technique provides the easiest and safest mooring, and is consequently the first choice of sailors. Pontoons can be connected to piles, anchors, chains or even walls and have good quality operation for 20 or 30 years, on average. They are structures that are easy to move, in order to adapt their positions according to the dynamics and need for docking at the location. The structure of the pontoons can vary, as can the constituent materials, which range from wood, steel, iron, aluminium, concrete or plastics. **In dry conditions** - This type of place applies to estuaries with considerable tidal range and, sometimes, in bays with good conditions. They work in conjunction with buoys, or even along jetties and walls. During high tide, the vessel floats and when the tide goes out, the boat rests on the bottom, and must be prepared for this, without causing damage to it. In the past, wooden fittings were built into the bottom. Nowadays, it is common to have some supports on the boat itself. It is mandatory to have information regarding the tidal range of the location, as well as other meteorological factors. It has the advantage of being a cheap technique if it works well and the disadvantages of being considered one of the most unsafe methods of docking and often causing problems with silt accumulated at the bottom. **Jetties** - This is a traditional system with some tendency to problems resulting from the lack of maintenance of the material. It can only exist in places where the tidal range does not exceed one meter. The size of the boat takes on greater importance, as the rigid structure is designed to resist the impacts of the boats and the forces of the mooring cables during maneuvers. In relation to jetties, it has the advantage that legislation allows higher loadings, taking into account the possibility of general public access to jetties. **Opportunist Moorings** - Type of mooring most commonly used in inland waters, being especially effective for short stays. It is possible to convert seawalls on the banks into mooring areas, as well as the reuse and regeneration of little-used piers and docks with low construction costs. The seats are generally arranged in linear alignments, with the vessels occupying 80% of the space, with the remaining 20% allocated to a safe distance between them. In order to provide support to a greater number of vessels, they can be paired together, as happens in Poole Harbour, Great Yarmouth or Norfolk Broads, England. It is essential to study the possibility of silting of the channel if it is narrow and ensure a minimum depth. In urban areas close to local attractions, it makes sense to ensure that there are no vessels taking over the location as a permanent location, thus promoting more visits to the location. **Marina places** - Regarding marina places, they are expensive, especially those that offer the best conditions to their users. They are subject to different operating regimes, thanks to variation in demand, as a result of different climatic seasons. During high season, there are often places available due to the lack of boats staying permanently in the marina and it is also an option to take advantage of the remaining sheltered space to create temporary places, with moorings on buoys and pillars. This type of place can be uncomfortable if the area is unprotected or adjacent to main navigation channels (Costa, 2012). **Stern to pier** - Consists of docking in which the boat has its stern facing the place where it is moored, pier, wall, jetty or walkway. Vessels use their own mooring lines and anchor, or mooring buoy attached to the bottom in the direction away from land. It only works in places with little or no tidal range and is, therefore, a very well-known and typical type of docking in the Mediterranean Sea. It is a type of mooring that is limited in terms of the type of boats that can use it, and on the other hand, it requires some practice from navigators. Boats with little mobility are unable to maneuver in order to dock correctly and it is advisable that they have a cockpit or space, preferably with a ramp, to guarantee easy access to land. There are cases where there are mini-fingers with the sole purpose of facilitating the same access already mentioned. In short, it is a system that allows a high density of boats. **Along mooring** - It is normally associated with navigable rivers and canals. Banks, walls, piers,

jetties or any other structure that allows parallel docking are used. It is mandatory to guarantee a minimum safe depth and bollards, rings or bollards can be built. During work on the banks, warnings are essential to avoid damage. Margin protection measures are always favorable, increasing the availability of seats.

6.7. Role of Complementary Facilities in Nautical Sustainability

Regarding the role of complementary facilities in nautical sustainability, a recreational infrastructure dedicated to nautical activities necessarily requires refuge conditions that offer nauts and their vessels the necessary protection. Depending on several factors such as location (estuary, sea coast, reservoir, commercial or fishing port, among others), infrastructure involves the construction or not of shelter structures. Normally, on a coast exposed to sea disturbances, breakwaters are required that can withstand it, ensuring a certain level of safety. Breakwaters may have to be built from scratch or, as often happens, existing breakwaters from commercial or fishing ports can be used, within which the infrastructure is inserted. Floating breakwaters are most common in reservoirs and estuaries (Costa, 2012). The area surrounding the pier can be simple or difficult, depending on the type of recreational infrastructure that exists or is to be installed. The surrounding structures serve as a platform, enabling the operation of services that can be provided to infrastructure users. These structures can be water access ramps, embankments intended for car parking areas, commercial, housing, hotel areas or areas dedicated to shipyards or dry boat parking. From a service provision perspective, a stay in a recreational infrastructure requires a series of services that can be provided to customers. They contribute significantly to the quality of the infrastructure and user satisfaction and must therefore be treated with special attention to their needs. According to studies carried out (PIANC, 1997) with a universe of nauts, the varied services that a nautical infrastructure can offer were grouped taking into account customer preferences and according to the priority they believe each service should give, highlighting: Sanitary facilities and showers as a supply of drinking water; waste collection area (liquid and solid) and safety equipment; firefighting equipment; electrical energy supply; fuel filling station; car parking; infrastructure for placing and removing vessels from the water (Travel-Lift); outdoor lighting; guidance signs inside the marina; shipyards; restaurant and bar; wastewater pumping; communications; radio assistance; business; dry storage of vessels; reception; TV and telephone at berths (Costa, 2012).

6.8. Sustainability Combined with the Storage and Storage of Vessels

In the context of sustainability combined with the storage and storage of vessels, dry shipyards stand out. These are boat storage systems, widely used when there are large climate variations that lead to a long period of time without conditions for recreational navigation. Boats spend most of the year on dry land, or supported on support structures, sometimes requiring additional facilities in order to satisfy as many vessels as possible. For example, floating rafts in plastic modules can be used to guarantee a greater number of places (Costa, 2012). For sailors, it proves to be a sustainable, environmentally friendly system supported by four principles: reducing the need for anti-fouling paint; avoids purchasing trailers and parking at home; lower fees; It avoids the urgency of choosing a car based on its towing capacity. From 1990 onwards, the sector established standardization of manufacturing processes, quality and international recognition through the implementation of technologies and differentiated design in relation to products in the same category of European and North American origin, gaining strength and worldwide recognition, opening paths for export and competitiveness for imported products (Sebrae, 2014). With the large number of shipyards and vessels produced every year, there is a tendency for environmental impacts to worsen, in addition to the difficulty in controlling raw materials, increasing waste throughout the production chain, since the manufacture of vessels is artisanal and with little process automation. It is observed that the impact generated by the nautical industry encompasses its entire life cycle. Regarding use, motor boats use a lot of fossil fuels, polluting the air and water. At the end of the vessel's life, despite being a product with a long useful life, the fiberglass composite material that makes up the wide range of vessels cannot be recycled, despite the fact that boats are normally abandoned in vacant lots and sent to landfills. . According to Manzini and Vezzoli (2005), eco design is seen as a project model (design), guided by sustainability criteria that were introduced into the industry in the 1990s. It is highlighted that, even with the application of ecological criteria in the product development, there is no such thing as a completely ecological product, as any process will produce some type of impact. According to the same author, eco design is inferred as a

continuous improvement approach, which aims at "a cycle of flows, of actor synergies", addressed in ISO programs.

6.9. Modularization as a Sustainability System in Recreational Boating

According to Schmidt (2017), developing a modular platform system for the maritime industry is a viable option for increasing operational efficiency, productivity, and reducing waste because it allows the same product to be used in many market segments. On the other hand, the modular design indicates a reduction in manufacturing costs, which may be passed on to the end user, helping to overcome the myth that nautical products are only available in the luxury market. Because of the artisanal manufacturing character of vessels, there is significant waste throughout the production chain of materials and inputs, which has an impact on the environment and society. As an answer to this challenge, product modularization and serial production, inspired by automobile production systems, provide for higher process control and operational efficiency gains over the product's full manufacturing cycle and useful life. The modularization of the product allows for a rise in the vessel's usable life over time, an increase in its market value, and a reduction in environmental effect (Schmidt, 2017).

6.10. Benefits of Recreational Boating in the Economic, Social and Environmental Context

In terms of the economic, social, and environmental benefits of recreational boating, it is important to note that any action to capitalise on the sea's tourist potential must not contradict the following definition of sustainability: we are capable of meeting the needs of generations without compromising or jeopardising future generations' ability to meet their own. It is critical to implement actions on the ground that aim to develop recreational boating, in general, and in particular the marina sector, sailing, and other nautical activities, with the vision of recreational boating as a relevant economic activity for the country, capable of leveraging local development and the sea economy in a so-called sustainable way (Guerreiro, 2016). The development of nautical activities generates a variety of economic and social benefits, such as boosting economic activity in coastal communities, improving citizens' quality of life, increasing tourism revenue, and creating industrial, commercial, and service jobs related to recreational nautical activities. In the economic context, it is possible to identify a set of impacts directly or indirectly related to nautical tourism, namely: value-added employment; greater tourist attraction, greater entertainment; real estate valuation; the creation of jobs in companies surrounding the recreational infrastructure; the creation of jobs in other businesses, dependent on recreational infrastructure, but based outside the infrastructure's area of influence; increase the quality of the tourist destination; improve the quality of life of residents; boost the nautical industry and increase boat sales; extension of the tourist season; joint management of complementary services; training of permanent and temporary staff; more regular and continuous trade and, consequently, increased tourist revenue. The main nautical items accessible on the market are marinas, nautical stations, sport fishing, windsurfing, cruises, rowing, nautical charters (rental), schools, and diving centres. To create the most favourable conditions and make nautical tourism a valued possibility in Portugal, the main key factors stand out: high quality services; high number of specialised companies; appropriate legislation; wide range of nautical activities; boat builders; safety in marinas; development of integrated sports and accommodation products (nautical stations); maintenance, repair, sale of materials and equipment; holding sporting events; providing entertainment and complementary services.

6.11. Elements Linked to the Sustainable Practice of Recreational Boating

Among the various elements associated with the sustainable practice of recreational boating, particularly in the territory of Figueira da Foz, we highlight: - the presence of artificial infrastructures, a city with an essentially port character, whose identity is defined by the circulation, entry, and exit of deep draft ships in Figueira da Foz's commercial port. According to Guerreiro (2016), historic ports preserve natural areas, which occasionally permitted the construction of artificial infrastructure with the goal of ensuring the appropriate shelter conditions for vessels and allowing them to dock. During the sailing phase, wind regimes and sea currents influenced routes, and many ports became major stopping sites on national maritime routes due to their geographical location (Sousa, 2004). - Opportunity to develop adaptable infrastructure that promotes walking or other modes of transportation. Similarly, hold frequent events. - The riverfront's use must be phased in order to ensure its public access and free recreational activities. Programmatic convergence between the city and the maritime space, resulting in less intrusive and more economically sustainable initiatives.

The spaces, as well as the economic and social activities that surround them, become natural extensions of urban facilities, continuing a dendritic network of paths embedded in the urban fabric and revitalising the riverfronts' cultural identity. - Sports equipment to support traditional urban spaces while maximising service irradiation to the rest of the urban fabric through closeness to riverbank regions. - Wetlands and other natural and cultural heritage sites that are important in landscaping (Fernandes, 2012). - Good territorial planning, legislation with more concentrated and less distributed powers, effective and operational Maritime and Port Authorities, true recreational boating with monitoring capacity, and well-defined milestones will all make valuable contributions to the creation of more favourable conditions for the development of sustainable recreation. A good pleasure port, on the other hand, does not always have to be close to a city in order to provide cosmopolitan (cultural or recreational) facilities on land. Many recreational boaters enjoy the calm and quiet of an unknown, unpolluted environment. There are numerous locations along our shore that might accommodate tiny recreational ports focused at this segment, known as "nature tourism".

6.12. The Importance of Critical Mass as an Element of Sustainability

The importance of critical mass as an element of sustainability combined with the development of Recreational Nautical in Portugal can be seen on several interconnected fronts, highlighting the expansion of the base of practitioners through the massification and facilitation of access to nautical activities, mentioning whether schools, clubs, associations and federations; the adequacy in quantity and quality of infrastructure (marinas, recreational ports, anchorages, nautical stations, etc.); the professionalization of associated services; the promotion and internationalization of nautical activities through events and their interconnection with tourism products; the Recreational and Professional letters and Professional Courses (Guerreiro, 2016).

6.13. Silting of the Bar - Sustainability Condition for Navigation

The silting of the bar of the entrance channel to the marina and commercial port of Figueira da Foz is caused by the massive volume of solid (inert) transport that flows from north to south along the coast of Figueira da Foz, with a tiny portion remaining north of Molhe Norte. After a few years of building, its sand collection capacity reached its peak (known as saturation). Over time, alluvial movement has caused the construction of a sandbank in the area where the north pier is located, extending from north to south and having a significant impact on the bar's practicality. Although the sand deposit has no significant impact on recreational navigability, given that the recreational vessels that normally dock at the Figueira da Foz marina have drafts of less than 5.0m-5.5m, it remains a serious problem, especially since a commercial pier with large draft ships is located upstream of the marina. These issues are exacerbated by the operating requirements established by the numerous terminals that wish to operate there, which entail that the service of entering ships into the bar and channel with greater draft is guaranteed, necessitating a deeper navigation channel. According to what was learned, the goal of extending the North jetty, which separates Figueira da Foz beach from the South, was to improve navigability conditions in the bar. The construction was finished in 2010. This "siltation" process should have a comparable inverse effect on the beaches south of Cabedelo North Jetty. One of the causes for the long-awaited repair in Figueira da Foz was the bar's silting and navigability issues. The reorientation of the bar also improved sand flow, resulting in lower spending on sanding operations. dredging.

Chapter 7

BENCHMARKING, ORDERING AND PLANNING STRATEGIES

7.1. Benchmarking Combined with Recreational Nautical

Authors such as Watson (1993) infer that Benchmarking represents a process of organizational adaptation in which the focus is not simply copying others, but rather learning how to improve organizational performance. Benchmarking corresponds to a continuous and systematic process to measure and compare the work processes of an organization with those of another competing organization, recognized as a leader or considered a reference on the subject, functioning as a diagnostic and analysis tool for the business, with the aim of identifying functions and processes that require improvement, as well as identifying functions and processes

where it is possible to demonstrate higher levels of performance than other companies (Correia, 2012).

NZ Marine - New Zealand - New Zealand, a country of people linked to the sea, with a smaller population than Portugal, largely due to its geographical location, has developed in recent decades an important industry linked to recreational boating of a superior nature, becoming a global reference (Silveira, 2016). The Tokyo Foundation plays an active role in promoting research among young researchers by creating scholarships aimed at the economy of recreational boating. New Zealand is part of Oceania, along with Australia and other small archipelagos. From a geographical point of view, it is located 1500 km east of Australia and 1000 km south of the area of the islands of New Caledonia, Fiji and Touga. With British influence since 1840, the waitangi treaty was signed between the Maiori and the British crown, making New Zealand official as a colony of this European country. The entire coast is defined by small coves and bays, which makes it more favorable for practicing water sports, such as sailing, for example. As times evolved, small boats began to be used for leisure moments, organizing regattas, giving rise to many naval clubs and sporting events. Auckland, for example, has become a nautical city, where several nautical support services are centralized and in parallel with tourism through international nauts, who travel there for close contact and enjoyment of existing services, namely: restaurants, cafes, museums, shops, hotels, etc. NZ Marine defines itself as a brand representing the various areas of the economy related to the sea. The brand's symbol itself represents a fern, fern (Cyathea dealbata), a species endemic to New Zealand, having symbolic value in the country itself. Associated with quality, good economic practices, environmental sustainability (Silveira, 2016).

IDENTIFICATION OF BEST PRACTICES (01)

Diversified services: conference center, specialized technical assistance, repair, storage of boats at Boat Park (summer and winter); restaurants, cafes, museums, shops, hotels; Creation of a brand with national representation (NZMarine); Concept of Environmental Sustainability, in the valorisation and preservation of existing resources; Organization of global sporting events; Nautical City, diversity of Nautical Clubs.

Troia Marina - Portugal - Between the Atlantic Ocean and the Sado Estuary, there is one of the most beautiful bays in the world, Setúbal Bay. Known for its resident population of bottlenose dolphins, considered an idyllic spot for sailing or windsurfing. With space for 180 boats, Troia Marina, is part of the Troia Resort tourist complex and is one of the best examples of marinas in our country. Troia Marina has a perfect location for water sports. Strongly recognized for its natural beauty, with a privileged location in the middle of the Arrabida Natural Park, it holds environmental certification by ISO 14001, registered with EMAS and which has been awarded the blue flag since its opening. One of the major concerns in the environmental management of infrastructures is the minimization of consumption, with particular emphasis on saving water and electricity. Prioritizing the use of sustainable materials with reduced environmental impact.

IDENTIFICATION OF BEST PRACTICES (02)

Environmental code of conduct: which establishes a set of principles and values in terms of environmental ethics that must be recognized and adopted by all users and workers of marinas and recreational ports; Diversified services: Supermarkets, Shops, Casino, hotels, apartments, villas, specialized technical assistance, repairs, restaurants, cafes; Creation of a brand with national representation (Troia Resort); Use of natural light (changing rooms), using low-consumption "LED" lighting and installation of photovoltaic panels; Ease of access to electricity and water on land, with a view to reducing the use of boat engines for energy production (reducing polluting gases); Installation of flow controllers on hoses at mooring posts, as well as installation of flow reducers in sanitary facilities and administrative support buildings; Installation of double discharge flow meters and reinforcement of operational control; Improvement and efficiency of irrigation of surrounding green spaces; Refurbishment of WWTP, enabling the reuse of effluents for irrigation; Repairs and work without use and release of pollutants must not be carried out at the mooring post, at risk of contaminating the water table; Oil and lubricant collection system (Ecolub); Recycling and reuse reinforced through the provision of awareness information for users and staff. Placement of recycling bins;

Existence of equipment for pumping and suctioning wastewater from vessels (Pump-Out); Blue Flag Marina Registration; EMAS and ISO 14001 Environmental Certification.

Vilamoura Marina - Portugal - The first Marina to be built in the country, it is located on the Algarve Coast, south of Portugal, in the city of Vila Moura. Owner of a brand with an international nature. According to data from the Algarve Tourism Portal, its activity began in 1974, and it was one of the first Portuguese marinas to obtain Quality and Environment certification by ISO 14001 and ISO 9001, along with European Blue Flag certification for Marinas and the distribution of 5 Anchors by the Yacht Harbor Association. In the period between 2015/2017, 2019 and 2020, Vilamoura Marina, ranked 78th, was elected the best international marina by TYHA and won the Algarve Regional Tourism gold medal. In 2020, for the 10th consecutive year, it was awarded the distinction of the best marina in Portugal, by the Publituris Portugal Trade Awards.

IDENTIFICATION OF BEST PRACTICES (03)

Environmental code of conduct: which establishes a set of principles and values in terms of environmental ethics that must be recognized and adopted by all users and workers of marinas and recreational ports; Reception and Marina with 24-hour security, staff circulate continuously in the area surrounding the Marina; Emergency medical services open 24 hours a day. International Medical Service "MEDICAV" with repatriation in case of sudden illness; Diversified services: Supermarkets, shops, casino, hotels, apartments, villas, specialized technical assistance, repairs, restaurants, ice cream shops, pizzerias, cafes; Access Cards: access for Marina users to the various available spaces, such as car parking, changing rooms, laundry facilities, is done using cards available at reception; CIMAV - International sailing club located in the nautical center of Vilamoura Marina, adjacent to the shipyard. CIMAV organizes national and international regattas and holds training courses at its sailing school; Blue Flag Marina Registration; Delivery services - Deliveries of food and other goods directly to vessels; *Yacht Club*- Social club reserved for vessel owners and crew. It has an internet cafe and has a living room, reading rooms and games rooms; Fuel supply dock - located next to the marina reception waiting dock and is open 7 days a week. All fuel is clean and properly filtered; Pump-Out System - The Marina has a "Pump-Out" system, which is located on the fuel dock. It is intended to collect wastewater and oily water that accumulates at the bottom of the vessel. Wastewater is channelled to the Vilamoura WWTP, while oily water is placed in reservoirs and subsequently collected by licensed entities. This is a service that works with its own tokens, and is free; *WI-FI*- Free wireless internet access throughout the Marina.

7.2. Territorial Management Applicable to the Study Area

As Mainland Portugal is a maritime front country, it was quickly determined that the regions integrated into the Water Domain (DH), particularly those included in the Maritime Public Domain (DPM), would face significant urban pressures over time. With the urbanisation of so-called port cities, there was a need to design a proper and long-term urban development policy for these places, such as riverside areas, which have significant economic or environmental significance. The Figueira da Foz Marina is located in the Maritime Public Domain (DPM) territory covered by the applicable dominion legislation, under the jurisdiction of the current Administration of the Port of Figueira da Foz (APFF), Transport Institute (IPTM), and complementary integrated into the Figueira da Foz City Council's Municipal Master Plan (PDM). The execution of works promoted by (IPTM) under its jurisdiction must adhere to the applicable legal and regulatory norms, specifically those included in territorial management documents and technical construction standards. Works sponsored by IPTM/APFF under its jurisdiction that are not related to the performance of its tasks are subject to municipal licencing.

7.3. Guiding Principles to Support Planning

GUIDING PRINCIPLES TO SUPPORT PLANNING

Why?

Due to the need for simple, guiding principles that serve decision-makers towards the implementation of good practices and the offspring of sustainable urban development.

For what?

To define a strategic framework, with the outline of new policies, plans and projects, with the aim of achieving cities and

territories that are more inclusive and integrated with the recreational boating component.

Principle I - Detailed Plan - Specific for the areas of embankment, water surface, marina (Recreation Port of Figueira da Foz), not limited solely to the applicability of PDM indices and the establishment of space transfer protocols and occupation titles with limited periods of time, with high costs for those who intend to invest in these domain areas. On the other hand, requalify the entire space, with a view to achieving excellence, visibility and notoriety in the context of the city.

Principle II - Cultural Heritage - Combined with the creation of a legacy and cultural identity, with spatial representation and local recognition, taking into account the entire history of Figueira da Foz, example Museum.

Principle III - Enhancement of the Spatial Structure - Allied to the safeguarding and value of the natural and built environment.

Principle IV - Sustainability Criteria - Allied to operation, safety, strengthening environmental and socioeconomic resilience, promoting mitigation and adaptation to climate change and implementation of eco-equipment.

Principle V - Monitoring - Carried out on an ongoing basis in order to carry out a careful assessment in favour of correct planning.

Principle VI - Implementation of Allied Strategies New Technologies, Digital Marketing - Based on the promotion of a brand linked to nautical: Target audience segment (allowing us to carry out campaigns aimed at a specific audience segment); Real-time data analysis (Allows you to measure everything in real time, including the people who interacted with the message, who purchased the product or service and/or who expressed some type of interest); Lower cost and more assertive (In digital marketing, the cost of advertising is considerably lower than traditional marketing, with the possibility of being more assertive, advertising to a specific audience in order to obtain better results). Interaction with the public (all campaigns presuppose an interaction between the advertiser and the person receiving the message. It is common to see comments on social media campaigns, content sharing, etc. However, care must be taken with a negative interaction (it is necessary to have a plan contingency and crisis management prepared in a timely manner). Agility in implementing campaigns (It is possible to create, edit and replace any type of campaign in a few minutes and without the need for advanced technical knowledge. With access to the internet, anyone can easily learn how to create digital campaigns and quickly start advertising anywhere in the world).

Chapter 8

FINAL REFLECTION

Approaches to new spaces and times - Humanity is going through one of its greatest challenges, a fight against the "unknown" that puts human survival itself at risk. Society demands quick, urgent solutions that minimize impacts on both health and components: housing, politics, cultural, tourism, economic, sports, social and environmental. Faced with these concerns, and respecting the urgency reflected, there is an increasing need to rethink the "Modus Vivendi" of spaces inherent to sports practice, from a sustainability perspective and in perfect symbiosis with the environment in which they are located. Based on the principles of a sustainable programming paradigm that makes the didactic element essential in an architectural project of new spaces and sports equipment, it elevates us to concepts and forms of life that are duly sustainable and environmentally friendly, we are pleased to comment that among the various canons of architecture that could constitute influential elements in the rethinking of new spaces, highlighting the principles allied to sustainability, in which the recommended solutions respond effectively to current social needs, interests and expectations of fans of sporting activity.

Past References - Under the theme "past references", there was a concern to create a common thread that would guide us on the concepts and their social importance, citing contributions from different expertise. Thus, and in accordance with Vitruvius' narrative, authors such as Garrafoli (2017), infer that theoretical knowledge cannot be dissociated from practice, considering that architecture comes together at the junction of these two forms (technique and theory), acting in an associated and cumulative way. Still from the same author's perspective, he

understood the architect and engineer Vitruvius as being a person with a utilitarian nature, in which his work sought to demonstrate the value of the act of building. Vitruvius decided to write a treatise composed of ten books that to this day are defined as the oldest theorization of architecture, urbanism and construction. Architecture was understood and based on three main vectors, building, gnomonic and mechanics (Maciel, 2015). In the context of buildings, Vitruvius brought up the theme of fortified and religious enclosures, noting that temples were characterized by so-called eternal works. Religious architecture brought together its own orders, influencing different constructive behaviours over generations. In this line of thought, Vitruvius approached the canons of architecture: the origin, proportions, attributes and rules of each composition and component in detail, in order to understand the multiplicity of layout of sacred temples and, on the other hand, the diversity of associated methodologies there is a variety of species and genera. Other canons emerged, following the guidelines written by Vitruvius, namely Alberti, Florentino, Pacioli, Palladio.

Canons of sustainable architecture - In terms of outputs generated by the canons of sustainable architecture combined with the valorisation of nautical tourism and recreational boating, we highlight the hypothesis of creating modular, flexible, artificial installations, adapted to the location, built in sustainable, vernacular materials, whose function can, from a temporal point of view, it must be changeable and adaptable to different needs and uses. Concepts such as the Strategic Environmental Assessment (SEA), defended by Partidário (2007), could serve as an aid to the creation of future scenarios and strategies that exhibit coherent, sustainable solutions that respond to the needs of the region. The territory of Figueira da Foz, due to its particularities, leads us to believe that in the medium and long term the domain area (DH/DPM) existing near the mouth of the Mondego River (downstream from the recreational marina) will evolve urbanistically. towards better territorial occupation, particularly with regard to new and better infrastructure linked to recreational boating. In this way, a new look at the planning of the local domain territory becomes crucial, and particularly for nautical-sports spaces, taking into account this new reality. Without this, it will become difficult to progress in a responsible and assertive way. Sustainability is understood as the ability of an ecosystem to maintain ecological processes and functions, biological diversity and productivity over time. According to the writings of Partidário (2007), the concept of sustainability is understood as that which lasts over time and is directly associated with the concept of sustainable development, namely: what satisfies the needs of the current generation without compromising or jeopardizing the ability of future generations to meet their own needs. Sustainable architecture is based on a set of canons, if properly applied they effectively contribute to the valorisation of materials and preservation of the environment in which they are located, reducing harmful effects on the environment. The so-called sustainable construction also encompasses a diverse set of phases in the life cycle of a building, based on the following canons: construction of energy-efficient buildings; adequate construction planning; conservation and maintenance of buildings; reduction/minimization of waste generated during the construction phase; use of eco-efficient materials; maximizing the reuse of resources; saving the use of energy and water; maximization and durability of buildings; control of the emission of gases responsible for the greenhouse effect and CO2; minimization of impacts associated with construction and rationalization of costs and above all, greater awareness of the rational use of the planet's existing resources, prioritizing the use of natural, vernacular, environmentally friendly and ecologically sustainable materials, highlighting composites, wood, carbon fiber, aramis, as the most expressive.

Materials and sustainability - In the field of action restricted to "materials and sustainability", we were interested in retaining the following considerations: the choice of material would prove to be one of the most important stages in the construction process insofar as compliance with responsibility parameters environmental, preservation and recovery become priorities compared to others of lesser importance. In order to minimize impacts on the environment, it defends the principle of applicability of the 3Rs (reduce, reuse, recycle). The choice of materials must be made in line with certain environmental parameters, benefiting the use of composite, recyclable materials, with low environmental impact during their life cycle. Based on the balance generated between human comfort needs and climatic agents, we highlight the use of materials that adapt to and more easily resist climatic adversities in the context of nautical, we highlight: fiberglass, carbon fiber, aramis, wood and its laminates as a natural material whose properties direct us to its preferred use, much like our ancestors, when the caravels were built during the Portuguese discoveries.

Canons of sustainable architecture - We find ourselves in an era of great change in consumption habits, information and consciousness, as a result of current technology and the current "COVID-19" pandemic crises. There is an increasing need to

rethink spaces and their canons as sustainable construction models, preserving the natural environment in which they are located. In the context of sustainable architecture, authors such as Cunha (2015) infer a set of perspectives that in the future may help to leverage and support the development and preservation of the environment in which we live, namely: raising awareness and training populations; preservation of the planet's natural resources; enhancing the natural balance of existing resources; rational use of the planet's non-renewable resources; implementation of environmental conservation measures in its development plans; compatibility between development and the need to protect the best human environment for the benefit of the community; obtaining integrated benefits (Social, Economic, Environmental); use of science and technology for economic and social development, contributing to the control and combat of risks and threats in the environment; application of the educate and preserve concept; adoption of sustainable practices in architecture that are not harmful to ecosystems (habitats, fauna and flora). On the other hand, we believe that it is an added value to adopt SEA models that can, in the medium/long term, effectively build to: Ensure the integration of environmental, social, economic considerations in the planning, programming and elaboration process in the political context ; Detect risk opportunities, evaluate, compare alternative development actions, design, elaboration, discussion, approval, execution, environmental review and sustainability; Contribute to the establishment of more appropriate development contexts, as well as structure future development proposals.

Site geometry - In the "geometry of the place" context, we are pleased to conclude the following: the geostrategic position made the dominion territory of Figueira da Foz, in addition to the Port of Aveiro, the two main port infrastructures in the central region. Maritime access to port facilities is via the bar, which is delimited by two jetties, north to south, which was extended in 2010, around 400m, with a view to minimizing problems that affected navigability conditions. Among the main problems we highlight the silting of the canal, the bar and the SW sea agitation in the commercial pier area. Based on the plans of the port of Figueira da Foz, it is possible to see the dynamics of the dominion space, as well as the morphology of the two branches of the Mondego River, with the entire dredging process being directed towards the north channel, largely due to the need for navigability of ships in the commercial port area. Among the main vectors associated with the sustainability of the bar, we highlight currents, swells, waves, winds and north/south sandbanks, sea strength and sedimentary dynamics. The Figueira da Foz marina consists of a wet area of 5ha, with walkways and floating fingers, with a maximum capacity of 200 berths for vessels from 6m to 15m and with a maximum draft of 3m. Its geographical location makes the pleasure port not only a shelter for crews to rest and for technical repair and refuelling stops, but also a pleasant choice for holidays with multiple leisure options. Still, it lacks a diversity of services, a brand that is attractive and that serves as a "flag" for the city. In addition, a SWOT analysis was carried out, in order to understand which factors could be improved, in which we highlighted the potential combined with sea sports, namely the possibility of producing licenses or concessions for new structures, new businesses linked to recreational boating; the construction and/or installation of modular, sustainable structures, adaptable to current needs, favouring the use of composite, recyclable materials; valorisation and promotion of natural and cultural heritage through promotion and dissemination methodologies; adoption of a strategy to implement an environmental code of conduct which establishes a set of principles and values in terms of environmental ethics to be adopted by all users of the marina and surrounding embankment.

Specificities of recreational boating combined with sustainability - In terms of the specificities of recreational boating combined with sustainability, we sought to understand in a summarized way, what the countries predicted in the tourist/nautical context, both at a National and International level. With a view to delving deeper into the topic, we took into account an approach to the territorial occupation of the main national marinas and services provided, using the volume of mooring posts as a selection criterion. Among the marinas with the greatest compliance with sustainability criteria, we highlight the Vilamoura marina (a pioneer in Portugal) where the following are of relevant importance: the environmental code of conduct; the sophisticated 24-hour security system; 24-hour medical services; diversity of other services such as international sailing club; blue flag marina registration; Yacht Club; Pop-Out system for collecting wastewater and oily water; Free Wi-Fi and a consolidated brand with territorial projection. On a micro scale, and considering the issue of the territory of Figueira da Foz with recreational boating, we conclude that the requalification of the domain territory must occur in close coordination with the requalification projects for the riverfronts, creating synergies that will tend to favour integrated processes of urban requalification and revitalization, as well as

environmental enhancement of the areas to be intervened. With regard to economic and social dynamism, the promotion of recreational nautical activities must not neglect the effects of stimulating and reinforcing the competitiveness of companies in the nautical sector, encouraging development from a cluster perspective.

Benchmarking, Ordering and Planning Strategies - As a reference, the great examples of Benchmarking combined with recreational boating stand out (in the context of improving efficiency and functionality, competitiveness, market position and communication), focusing on the critical points of success, as well as reducing errors, costs, increased productivity and profit, new forms of evaluation based on customer focus. Countries like New Zealand have developed an important industry linked to recreational boating in recent decades, currently becoming a global reference. Among the main elements to be retained in our study, the consistency of a brand with importance and symbolism for the country, associated with good economic practices, sustainability and the environment, stands out. On the other hand, the diversity of services it offers, namely: a conference center, technical assistance and repair area; "Boat Park" storage combined with a diversity of nautical clubs, make the "Orams Village" marina, in New Zealand, an example of a global reference. In the national context, reference examples also stand out, such as Marina de Troia and Marina de Vilamoura, the first Portuguese marina. In the Troia marina, the environmental code of conduct stands out, which establishes a set of principles and values in terms of environmental ethics that must be recognized and adopted by all users and workers of marinas and recreational ports, as well as , the existence of a representative brand "Troia Resort"; with diversified services, specialized technical assistance; flow control system in hoses at mooring posts and others; reuse of effluents for irrigation, ecolub for collecting used oils, recycling; pum out system for pumping and suctioning waste water from vessels, blue flag marina registration, among other services. The Vilamoura marina, as previously mentioned, also highlights the existence of an environmental code of conduct, which establishes a set of principles and values in terms of environmental ethics; the reception operates 24 hours a day, the existence of emergency medical services available 24 hours a day and also the existence of an international medical service "MEDICAV" with repatriation in the event of sudden illness. The Vilamoura marina also has CIMAV, Clube Internacional de Vela, the marina registration with blue flag, food delivery service on boats, Yacht Club, free "Pump Out" system, which is located at the fuel dock, and intended for to collect waste water and oily water that accumulates at the bottom of the vessel. Wastewater is channelled to the Vilamoura WWTP, while oily water is placed in reservoirs and subsequently collected by licensed entities, among other services. Within the scope of Ordering and Planning Strategies (OEP) for the future, we chose to combine the knowledge and experiences acquired during the period in which he held the position of Head of the Department of Infrastructure and Heritage of the Delegation of Portos do Centro, in Figueira da Foz, in the management of the dominion territory and in this sense, combine it with the specific legislation of this peculiar territory, in order to extract what was most important to us to retain. In this way, we intend to summarize in six principles and/or contributions of a strategy to be taken into account in future planning of these domain areas, namely: elaboration of a specific detailed plan for the embankment, water mirror and marina areas, not limiting solely to the applicability of the PDM and the establishment of transfer protocols; requalify the space with a view to achieving excellence and notoriety in the city context; recognition and creation of a cultural legacy with spatial representation; safeguarding and natural and built environmental value combining sustainability criteria, strengthening environmental and socioeconomic resilience, promoting mitigation and adaptation to climate change with the implementation of eco-equipment, implementation of monitoring strategies towards a careful assessment in favour of a correct and adequate planning, and not least we intend to combine the entire strategy with new technologies with the implementation of digital marketing, focusing on a target audience segment.

SUMMARY OF CONTRIBUTIONS TO THE CREATION OF THE CANON - NAUTICAL CLUSTER IN THE DOMINIAL SPACE - FIGUEIRA DA FOZ

Detailed plan that can integrate the embankment and water surface area as a whole, contemplating the construction of new infrastructure linked to the territorial development of the property. Including the creation of a multipurpose center with a particular focus on nautical activities; superior quality retail

spaces; spaces linked to high competition and training; restoration, maritime museum. Promotion of a legacy of cultural identity, including the creation of a museum, linked to local history. Enhancement of the existing spatial structure, combined with the safeguarding and value of the built environment. Applicability of sustainability criteria, combined with operation, safety, strengthening environmental and socioeconomic resilience. Monitoring, carried out on an ongoing basis in order to carry out a careful assessment in favour of correct planning.

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