

Sea intertwined city.
Interpretation and Design of Portuguese Seashore Streets vulnerable to sea level rise.

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Keywords

Seashore Streets; Urban Morphology;
Climate Change Adaptation; Research by Design

Partner Institutions

FCiências.ID/IDL - Instituto Dom Luiz; FCiências.ID/cE3c - Centre for Ecology, Evolution and Environmental Changes; Câmara Municipal de Loulé (Loulé Municipality)

Expected Future Partner Institutions

OBJECTIVES

The main idea of the full grown research is to build a reference framework for the design of waterfronts adapted to climate change effects, based in a descriptive and objective morphological interpretation and in sea-level rise models, addressing an urban space typology that plays a lead role in the mediation between city and sea: Portuguese Seashore Streets.

Integrated in this aim, the embryo project goal is to develop the second pilot case study, Quarteira (Loulé) in the Algarve region, in all its research phases, establishing a comparative perspective with the initial case of Sesimbra and testing a recent hypothesis. Namely, the shifting boundary between the urban space and the dynamic body of water reveals a thick space where the urban form is made of fixed and ephemeral, seasonal elements, determined by the sea cycles, and this is the key for urban adaptation to sea level rise.

The research aims to enable the shifting of paradigm from the city by the sea to the "entramar" - the urban form intertwined with the sea. Conferring the Architecture and Urbanism discipline a lead role in the agreement of nature, infrastructure and man.

BIBLIOGRAPHIC REFERENCES

ANTUNES, C.; ROCHA, C.; CATITA, C. (2019) "Coastal Flood Assessment due to Sea Level Rise and Extreme Storm Events: A Case Study of the Atlantic Coast of Portugal's Mainland." *Geosciences*, 9, 239.

DIAS COELHO, Carlos (coord.) et al. (2014) *Cadernos de Morfologia Urbana: O Tempo e a Forma*, n.º2. Lisboa: Argumentum.

DIAS COELHO, Carlos; COSTA, João Pedro T. A.; PROENÇA, Sérgio Barreiros; SERPA, Filipa (2016) "12. Appendix. Urban design essays for the Lisbon Estuary on extreme climate change scenarios" in *Climate Change Adaptation in Urbanized Estuaries, Contributions to the Lisbon Case*. Lisboa. 257-296.

GARCÍA GARCÍA, Miriam (2017) *Hacia la metamorfosis sintética de la costa diseñando paisajes resilientes*. PhD Thesis, E.T.S. Arquitectura (UPM).

PROENÇA, Sérgio Barreiros (2018) "Reading and Interpreting Portuguese Atlantic Seashore Streets in Sea Level Rise Context" in WINGERT-PLAYDON, Kate; RASHED-ALI, Hazem (eds.) *Happiness. The Built Environment: Shaping the Quality of Life*, Vol. 1. ARCC-EAAE 2018 International Conference. Philadelphia: ARCC. 65-73.

ABSTRACT + IMAGES

When I return from the sea, I always return dizzy and filled with light that pierces me. I then take quick notes – six lines – a type – a landscape.

Raul Brandão

The research develops from previous participation in international conferences and seminars, publication of articles and applications for FCT grants (PTDC/ART-DAC/5492/2020 evaluated 8,15/9,00, not funded, and PTDC/ART-DAQ/3164/2021, pending evaluation). The outcomes of the 2020/21 fourth year Project Laboratory units, addressing the first pilot case study, Sesimbra (near Lisboa), perfected the scope of this ongoing research, which aims to provide typo-morphological tools to interpret and design the adaptation of vulnerable spaces between the city and the sea.

The Portuguese coast has about 943 km in mainland Portugal, 667 km in the Azores and 250 km in Madeira, totaling an Atlantic margin of more than 1800 km. 35 coastal settlements dot the mainland mediation line between land and water, which defines and limits one side of the coastal strip where 80% of the Portuguese population lives.

In these urban fabrics, the relation with the sea is structuring from the primordial choice of the founding site of each settlement and it is easily recognized the lead role of streets, avenues and seashore drives in the conformation of the articulation space between the city and the water. The correlation with the site, the periods of formation and transformation, but also the dynamics of the occupation and use may explain the acknowledged typo-morphological diversity of Portuguese seashore streets.

In the current context, in which climate change promotes a gradual but inevitable sea-level rise, it is necessary to reformulate the conceptual framework which bases the conception and design of waterfronts. Therefore, it is essential to know the diversity of this type of urban element - the seashore street - as well as to develop extreme flood models in order to define measures and design their formal adaptation to climate change, coordinated both with the cultural heritage of the urban spaces and the population needs and aspirations of the, who consider them as references in their daily lives, places of societal representation.

This interdisciplinary project, made possible by the convergence of *formaurbis* LAB (CIAUD/FAUL) and cE3c together with IDL (FCiências.ID), allows for innovative urban flood adaptation solutions and measures by cross-reading morphological data (provided by *formaurbis* LAB) with sea level rise data (provided by IDL) and participatory adaptation (provided by cE3c).

The research also benefits from the international support provided by an international team of consultants from different European universities, whose know-how contributes to the interpretation and design of effective architectural and urban responses.

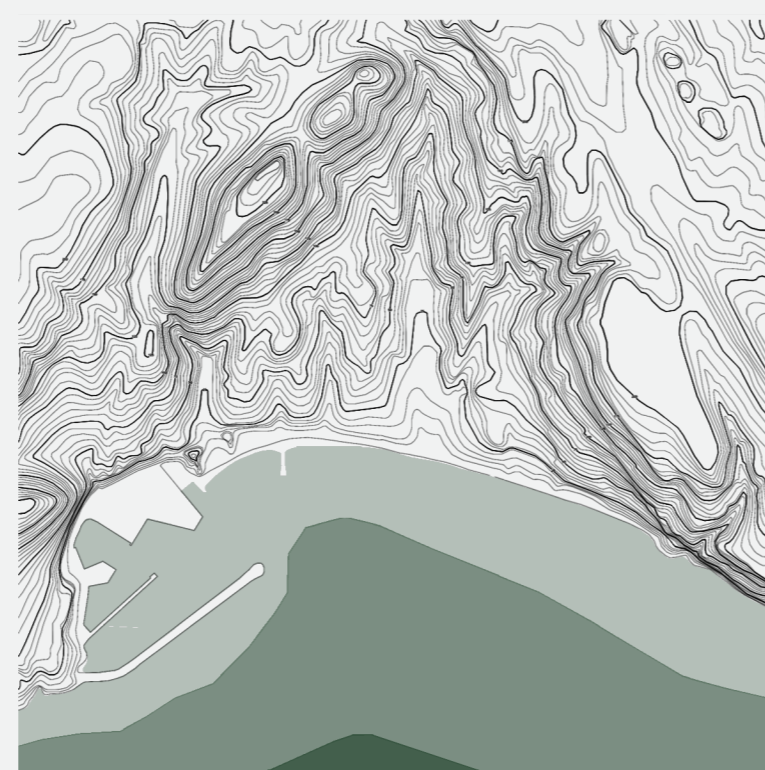
The research unfolds in 5 phases: 1) Morphological Interpretation of Portuguese Seashore Streets; 2) Sea-level rise scenarios; 3) Participatory Adaptation Pathways; 4) Research by design; 5) Research results dissemination.

Thus, [ENTRA]MAR responds to the contemporary and future need for interpretation and design of complex and dynamic landscapes. The necessary adaptation must be based on meaningful relationships between apparently divergent natural and anthropic processes: the rise in the average sea level and the permanence of the city. On one hand, the dynamic of the sea; on the other hand, the architectural and urban elements, endowed with historical-patrimonial and cultural value, both fixed and temporary, that compose each street by the sea.

The result of this original intersection of fields of research is an elementary vocabulary with which to build an essential reference framework for the conception and design of the urban edge, considering the dynamic nature of water as evidenced by urban flooding models (SLR + extreme events).

[ENTRA]MAR combines post-grad research with the second cycle master's programme design studio labs and final master projects, materializing integrated, architectural and urban projects, with a multi-scalar approach, from the territory to the built material detail. The wide range of answers expected from a design process that articulates Reading, Concept and Design, supported by previous research phases results, allows the identification of elements and transformation processes.

Furthermore, the development and dissemination of the Quarteira pilot case study, [ENTRA]MAR allows us to compare its outcomes with the results produced so far in the pilot case of Sesimbra, adding up a case to the corpus of the morphological atlas. One more step in the construction of the essential typological framework of elements and transformation processes, providing useful solutions for the definition of an open lexicon of possibilities for the design of the spaces that mediate city and sea, based on their memory and on the adaptation to an inevitable becoming.



site topography



urban layout

Sesimbra Pilot Case Study Benchmark Elements



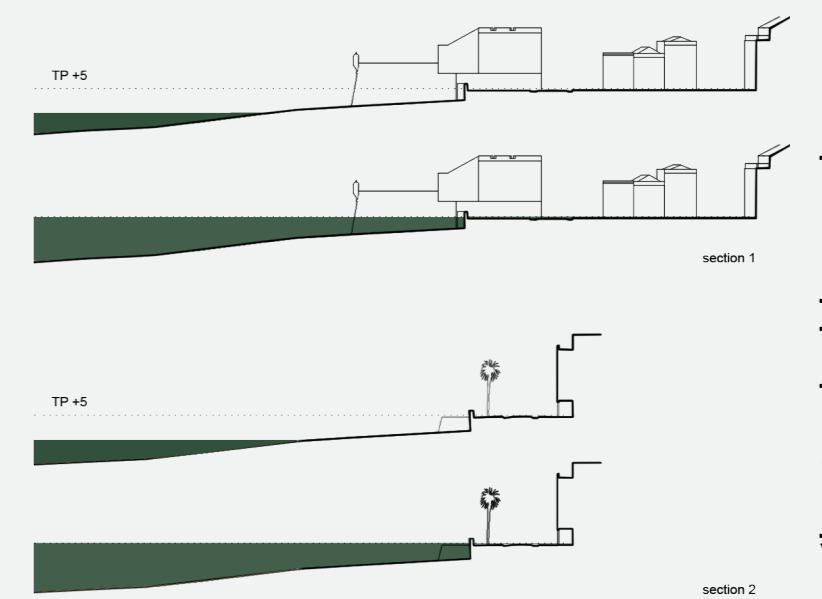
urban fabric + sea level rise scenario



detail plan



detail plan + sea level rise scenario



sections + sea level rise scenario



Sesimbra entramar metaphor

SCIENTIFIC RELEVANCE FOR THE DISCIPLINE

Cities adaptation to climate change has become the focus of international scientific debate in recent years, as increasing urban vulnerability requires informed risk management and the development of effective models and planning measures.

The construction of the Portuguese territory in contact with the sea raised interest in the last years, such as “O Mar é a Nossa Terra” (*Fishing Architecture* research project) or the creation of the “Bauhaus of the Seas”. However, with reference to the urban characterization of coastal settlements, the state of the art consists of local historic-geographical analyses, lacking an architectural and urban morphological approach.

We consider that for a complete morphological characterization of the space between the city and the sea, the innovative and tested approach of *formaurbis* LAB - developed in the project “A Rua em Portugal. Inventário Morfológico” (PTDC/AUR/65532/2006) and in the PI doctoral thesis, “A Diversidade da Rua na cidade de Lisboa. Morfologia e morfogénese.” - can provide methodological tools to contemporary research and practice. Furthermore, giving architecture a leading role in the synthetic metamorphosis of the coastal urban landscape.

EXPECTED ECONOMIC AND SOCIAL IMPACT

Quarteira, as pilot case study, makes it possible to test the adaptation measures decoded in the “Plano Intermunicipal de Adaptação às Alterações Climáticas do Algarve” (PIAAC-AMAL). In RCP8.5, in fact, two urban relocation actions of the first and second housing lines are foreseen from 2040 onwards. This stakeholder choice implies a high economic and social impact given the urban functions and density present in these vulnerable spaces.

[ENTRA]MAR, research by design, will also experiment alternative solutions that contemplate urban forms of adaptation, including amphibious and seasonal construction that provide perspectives other than retreat. Solutions that can thus influence, through the dissemination of results, the drafting of urban plans and architectural designs, by different actors. Aiming at meeting societal objectives defined by the United Nations 2030 Agenda and the development of Integrated Coastal Zone Management (ICZM). Such as the definition of national adaptation plans and actions that are effective in protecting people and tangible and intangible assets (UN 2030 11.5) from the effects of extreme climate events (UN 2030 11.1; UN 2030 13.1).

RESEARCH PLAN AND TASKS

The project [ENTRA]MAR's research plan and tasks is based on the convergence of two areas of knowledge, urban morphology and climate change, combining and providing know-how for effective and innovative urban adaptation solutions. The aim is to draw up a typo-morphological reference framework, a necessary tool for the design of the mediating space between the city and the sea, which enables to establish a dialogue between memory and adaptation to an inevitable future.

The concept of embryo, *conceptus* from Latin, is the definition of the distant but certain premise. Nevertheless, in this project, the premise, what comes first, is the work developed in recent years by the *formaurbis* LAB research group (PROENÇA, 2018).

MAR (main project) considers a *corpus* of 35 coastal settlements and frames [ENTRA]MAR, which provides the possibility to test in the pilot case of Quarteira (Algarve) the hypothesis that in the urban fabric there are morpho-spatial relations with the sea more complex than the waterfront or seashore street concept. Quarteira is the best case study because of its extreme vulnerability to flooding; and also, because mean sea level rise scenarios and participatory adaptation paths have already been drawn up by our partner institutions in the scope of the PIAAC-AMAL (Algarve Intermunicipal Climate Change Adaptation Plan).

[ENTRA]MAR is based on the MAR methodology; thus, it is structured in 5 phases: 1) Morphological interpretation of Portuguese seashore street; 2) Sea level rise scenarios; 3) Participatory adaptation paths; 4) Research by design; 5) Research results dissemination. It's foreseen it will take 13 months (overlapping phase 1 with the start of phase 4).

Phase 1: Morphological interpretation of Portuguese seashore street

duration: 3 months [sep. - nov. 2022]

Morphological interpretation is made in the present moment, understood as the result of successive sedimentation and transformation processes, therefore it resorts to theoretical recompositing of time in space (DIAS COELHO *et al.*, 2014). A collection of cartography, iconography and historical photographs must be composed for the reconstitution of the past moments that allow its critical description since the origin.

Task 1 consists in the initial fieldwork and archive research in local archives and libraries. **Task 2**, morphological interpretation, comprises the case characterization by producing a set of original elements representing the current state regarding form, function and role in relation to site, urban fabric and the sea. Namely: aerial photography, topography and urban layout [1:5000]; seashore street *Nolli* plan and functional occupation diagram [1:2000]; seashore street detail plan [1:1000]; cross-sections [1:500]; uses and occupation photographs; and a synthesis text on the origin, evolution, current state and significant features.

The common criteria and scale for the representation drawings coding is necessary in order to compare Quarteira with the other cases of the *corpus* and the development of a database on the forms of the urban built environment in contact with the water body.

An elementary and systemic decomposition approach to the complex nature of the urban object allows its decoding and reveals otherwise hidden patterns and constellations. Six different layers are therefore considered for the morphological interpretative reading: *territory; time and layout; singular forms; incisions; overlap; and entramar* (a neologism that combines the meanings of the Portuguese words for weaving, grid and sea).

Phase 2: Sea level rise scenarios + Phase 3: Participatory adaptation pathways

duration: 0 months [ready].

Regarding this pilot case study, Phase 2 and Phase 3 have already been drafted, producing for Quarteira, respectively, the outcomes of: **task 3**, models of extreme flooding in periods of equinoctial high tide for 2050 and 2100 from SLR projections, storm surge and extreme sea waves (IDL/FClências.ID partners), responding to the assumptions of the European Directive 2007/60/EC; and **task 4**, participatory adaptation pathways that compile and select a set of adaptation measures that respond to projected joint effects of storm surge and sea-level rise in climate change scenarios. Identification of adaptation measures carried out considering benchmarking, best practices and European climate change adaptation projects led by our cE3c/FClências.ID partners, yielded the parameters used in PIAAC-AMAL.

Phase 4: Research by design

duration: 10 months [sep. 2021- jun. 2022]

Task 5 congregates experienced research team members' and design studio lab master students' efforts into the development of an integrated architecture and urban research by design program according to previous experiences (DIAS COELHO *et al.*, 2016).

The sequent Reading, Concept and Design, in which the lab program develops, entail to devise divergent, alternative, solutions based but not limited to the adaptation pathways defined in phase 3, considering the sea-level rise scenarios produced in phase 2. Prior to design development, it considers thematic research, referring to international case studies and site characterization, informing the conceptual approach.

This task was tested and perfected during 2020/21 fourth year design studio labs of the master in Architecture + Urbanism course at FAUL (addressing the pilot case study of Sesimbra). In the next academic year, when the case of Quarteira will be addressed, it will be possible to contribute with the know-how built up together with the master students.

Task 6 considers a selection of the design studio lab best results, enabling the assemblage of a reference framework for interventions, site specific, with attention to the cultural and patrimonial values identified in phase 1, but with potential to define a methodology of approach and typify elements and operations.

The outcome is a typological framework of elements and transformation processes, a *lexicon* based on existing and proposed natural and anthropic adaptation elements and systems, both fixed and seasonal, that can be used as a reference for the conception and transformation of vulnerable coastal urban areas (GARCÍA, 2017).

[ENTRA]MAR adds the pedagogical possibility of having the students of the course dialogue with research members, partner institutions and international consultants external to the faculty. These relations between research and pedagogical aspects allow us a double approach: between post-grad research and grad-level design studios; and between the academy and the society.

Phase 5: Research results dissemination.

duration: 3 months [jul. - sep. 2022]

Task 7 entails the production and realization of an exhibition and catalog of achieved outcomes for the pilot case of Quarteira in comparison with the previously developed pilot case of Sesimbra.

The MSc scholarship holder will support the graphic systematization and content layout composition of the outcomes of both the morphological interpretation (from task 2) and the selection of results from the research by design (from phase 4 tasks). The aim is to bring the results to a non-academic public, so as to raise awareness and reach stakeholders in the definition and delineation of public policy decisions for urban design in the context of climate change. At the same time, communities gain a better understanding of the decision-making process and how they can participate and contribute.

Moreover, according to the embryo projects call, it is foreseen that the method and results discussion of [ENTRA]MAR will be published in an indexed (ISI or Scopus) Journal within six months of its closure. In addition, it is expected to be discussed at an international academy level thanks to the perspective that our team of foreign consultants bring.

I went to trace the contours of an island and instead I discovered the borders of the ocean.

Ludwig Wittgenstein

EXPECTED SCIENTIFIC RESULTS

The realization of [ENTRA]MAR, developing an important pilot case study, will boost the MAR research. The morphological characterization and interpretation elements of the Quarteira case study (task 2 results) will be drawn up and systematized, allowing its testing and comparison with the previously developed Sesimbra pilot case study.

The research by design will produce speculative transformations of the case study, firmly grounded on climate change data and best practices informed by our international consultants team (task 5 results).

The selection and typification of the research by design outcomes for Quarteira (task 6 results) will contribute for the composition of the typological framework of elements and processes.

Furthermore, bringing a new interdisciplinary perspective into the academic and architectural debate, combining urban morphology with climate data, allows us to move beyond debates on the “why” of transforming the city, shifting the focus of research to the “how”, contributing to claim for Architecture and Urbanism a lead role designing the *entramar*.

BUDGET: € 7.500,00

For the [ENTRA]MAR project, a three-month MSc scholarship (B11) is envisaged (Human resources – 2.867,61 €). The MSc scholarship holder, in task 7, will support graphical systematization of the morphological characterization and interpretation, and also the graphic treatment of the selection of outcomes from the master design studios. These elements are necessary both for the realization of a conclusive exhibition and for the subsequent publication of an indexed scientific article (ISI or Scopus) – not included in the [ENTRA]MAR budget.

The remaining value is earmarked for the testing and printing of the exhibition in up to 50 plates on photographic paper (600x600mm) with 1mm PVC backing lamination (Demonstration, Promotion and Dissemination – 1.300,00 €); and 500 copies of the catalogue, up to 100 pages, 20 cm x 20 cm, 150 g paper (Demonstration, Promotion and Dissemination - 3.000,00 €).

The remaining is destined to the survey mission (Missions - 332,39 €), considering transportation and accommodation expenses for a two/three-day mission to the case study departing from Lisbon, or as a reserve for unforeseen expenditures.