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Reading and Interpreting Portuguese Atlantic Seashore Streets in Sea Level Rise Context

Reading and interpreting Portuguese Atlantic seashore streets in sea level rise context.

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ABSTRACT: The lead role and the morphological diversity of streets, avenues and seashore drives that conform the articulation line between city and water on Portuguese coastal settlements is acknowledged. The dynamic inherent to the urban object underlines the fact that the present state is just a transitory moment in the evolution of these elements. In this context, several studies on climate change acknowledge the gradual but inevitable sea level rising, and warn on its effects on urban and humanized areas.
The convergence of research units of the University of Lisbon on urban morphology and on climate change allow stemming from the morphological knowledge on the origin, evolution and current state of the diversity of Portuguese Atlantic Seashore Streets, for the design of innovative solutions of adaptation measures and pathways to an expected and urgent scenario of sea-level rising. The research main goal is building a reference framework for interventions in each case, therefore site specific, with attention to the cultural and patrimonial values that make up each context, but with potential to define a methodology of approach and to typify operations or actions adaptable to similar contexts.
The present state of these elements is understood as the result of a sedimentary evolution process in time. Therefore, the ongoing first phase of the research project on *Portuguese Atlantic Seashore Streets* deals with the interpretative reading through systemic decomposition of layers underlining Form, Function and Role of the state of evolution of each element and its relation to the urban settlement and to the sea.
Departing from a generic characterization of the origin and evolution of these elements, the present paper uses the current pilot case studies of Sesimbra and Cascais to demonstrate the instrumental role of drawing for reading and interpreting the selected seashore streets.

KEYWORDS: seashore streets, climate change adaptation, sea level rise, urban morphology, systemic decomposition.

1.0 FRAMING AND STRUCTURE OF THE RESEARCH

The lead role and the wide morphological diversity of linear urban elements that conform the articulation between city and water on Portuguese coastal settlements was acknowledged by Forma Urbis Lab during the elaboration of the *Morphological Atlas of the Portuguese City*. The genetic relation with the site, the formation and transformation periods and the dynamic of the occupation and use of the place may explain this contemporary morphological diversity.

In the current context in which climate change promotes a gradual but inevitable sea-level rise, it is essential to know the diversity of this type of urban element - the seashore street or *rua marginal* - as well as to develop extreme flood models in order to define adaptation measures to climate change. The design of these measures must be coordinated both with the cultural heritage of the urban spaces and the needs and aspirations of the populations, who understand them as irreplaceable references both in their daily lives and as representation stages of the exceptional events of society.

Therefore, the underlying main idea of the research project is the construction of an essential reference framework for the design of waterfronts based on their memory and adapted to an inevitable becoming, namely to climate change effects from sea-level rise, addressing an urban space typology that plays a lead role in the mediation between city and sea: Portuguese Atlantic Seashore Streets.

1.1 Structure of the research project

The convergence of research units of the University of Lisbon on urban morphology, led by Forma Urbis lab (CIAUD/Faculty of Architecture), and on climate change, led by CCIAM and IDL (Faculty of Sciences), allow stemming from the morphological knowledge on the origin, evolution and current state of the diversity of Portuguese Atlantic Seashore Streets, for the design of innovative solutions of adaptation measures and pathways to an expected and urgent scenario of sea-level rising.

It is considered that only the knowledge of the past allows conceiving the future, therefore the research unfolds into 5 phases: starting with 1) The interpretative reading of Portuguese Seashore Streets through the elaboration of a Morphological Inventory of the diversity of cases; followed by 2) The development of models of extreme flooding based on projections for Sea Level Rise for 2050 and 2100; and 3) The

compilation and selection of a set of adaptation measures for specific case studies to respond to projected sea level rise impacts, creating alternative adaptation pathways with the engagement of key stakeholders using Scenario Workshop and Adaptation Pathways methodology;[1] finally, it will take place 4) A research by design approach of urban and architectural answers on future scenarios materializing sea-level rise adaptation measures in academic projects. This phase will frame a Final Master's Project theme for students who will devise divergent, alternative, design solutions from common adaptation pathways previously defined. 5) The research also contemplates its dissemination through an itinerant exhibition, a synthesis book and a closing seminar.

Given the research current initial state of development, the paper focuses on the role of interpretative and characterization drawing and uses the pilot case studies of Sesimbra and Cascais to exemplify the usefulness of systemic decomposition methodology used in the first phase of the research, as well as tests a scenario of sea level rise for a tipping point of +5m.

2.0 THE LIMIT THAT MEDIATES

The Portuguese coast has about 943 km in mainland Portugal, 667 km in the Azores and 250 km in Madeira, totalling an Atlantic margin with more than 1800 km. Numerous coastal towns and villages dot this line of mediation between land and water, which defines and limits one side of the coastal belt 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. Initially, the sea was used as a productive space or communication infrastructure, the sea supplied fish and seafood and, in the early periods, long distance travels were faster and safer by sea than by land. The mediation between urban space and water was at this early stage played by the beach sand, which supports boats and fishing gear. (Fig. 1)

Figure 1: View of Sesimbra village in the mid XIXth century. The beach mediates the settlement and the sea. Source: (Sesimbra Municipal Archive ref: EFHAMS/D/B/05)

Figure 2: View of Sesimbra seashore street and beach in the mid XXth century. Source: (António Passaporte)

In a second stage of occupation, protection structures such as walls, in some cases fortifications, and mediation structures such as ramps and piers are identified both in iconography and cartography and later in photographs, in the beginning more precarious but progressively these became more permanent and solid. The conformation of the seashore proto-urban spaces often stemmed from the functions that occupied the marginal buildings and the individual use given to the adjacent beach areas.

This lasting reality suffered transformations in most cases during the decades of 1930 / 1940. In that period, in several coastal settlements the construction of a continuous wall supported a horizontal plan in the coastal edge of the urban nucleus, associated to the consolidation of ramps and staircases that fulfilled the role of articulation with the beach and the sea. This surface was the embryo of the “rua marginal”, the ground that the seashore street would occupy.

In the Portuguese context, with the exception of few coastal villages, such as Cascais and Estoril, and restricted to a fringe of society that already had leisure activities connected to the use of the beach and the sea, in the end of the XIXth century, it was essentially from end of the first half of the XXth century, that the fishing related occupations of the urban sea margins began to coexist and overlap with another phenomena

associated to a cultural transformation of the society in which leisure periods and, later on, summer tourism gain widespread prominence. These social changes had a physical impact on the waterfront spaces of coastal Portuguese settlements, which suffered more or less deep transformations: shading elements were placed on the beach, wide sidewalks for strolling and seashore drives were opened, paved and sometimes planted with tree lines, accompanying and redesigning the coastal urban edges aiming at the fruition of the ocean margin. From that moment on, the seashore street or avenue became an evidence. (Fig. 2)

Linear spaces limited by buildings on one side and with the other side opened to the Atlantic Ocean, supporting leisure uses and functions associated to exceptional urban representation spaces, such as squares, replacing the former fishing related buildings. On several of these settlements, seashore streets started to play the multiple roles of public buildings representation space, leisure space, framing space of the ocean view and mediation space between the city and the sea.

These characteristics are common to the wide diversity of cases of seashore streets and the leisure and tourism vocation is nowadays underlined on urban seashores over the early infrastructural and productive roles. Nevertheless, the essential identity representation role of the society on these mediation spaces between land and sea carries on. Seashore streets and avenues remain the main stages for social, political and religious demonstrations, and the specificity of each case seems to lie on how in each context the pre-existence was embraced and preserved, namely the site and the heritage elements.

3.0 TO DRAW IS TO LEARN

The city may be studied from its shape, therefore from the shape of the elements that compose it. With this statement it is not intended to remove the importance of the other essential components of the city's existence, but to acknowledge the importance of the shape of the city, as the cultural product that most persists in time,[2] for the understanding of the most complex human creation.

Furthermore,

> the development of a typo-morphology offers a rich data base on forms and form-making processes. And more importantly, to morphogenetic research grounds this design work in the history of city building. (Moudon 1994)

Framed by this idea, in order to better understand the diversity of cases present in this specific type of space, the aim of the first phase of the research is to build the base for a typo-morphology of Portuguese Atlantic Seashore Streets, the Morphological Inventory.

3.1. Making a morphological inventory

The first question an elaboration of an inventory places is which elements to include and which to exclude. Therefore, it requires the survey of the universe of study, along the Portuguese coastline, from which a representative corpus might be selected. This representativeness of the cases is based on diversity criteria regarding geographic coverage; origin; formal features; and vulnerability to sea-level rise of the urban elements in question - the seashore streets. Seeking representativeness by examples, on the other hand, does not exclude the arbitrariness that is part of any choice, even if a thorough knowledge of the study universe exists. (Fig. 3)

The second question that concerns the built up of an inventory is how to represent or characterize the elements that compose it in a way that is useful for its interpretation. The interpretation of a complex urban object requires its simplification. In this sense, a segmented and decomposed approach of its shape allows to reduce its complexity and reveal qualities and patterns otherwise hidden. As Gandelsonas states, drawing is a process that allows us to see formal configurations that are not perceived in reality and therefore affects how we see the city (Gandelsonas 1991) and in Jacobs work on Great Streets (Jacobs 1993) it is particularly evident the emphasis given to the representation of the limits of the street, the elements that compose the space, the relation between buildings and street or revealing the uses and atmospheres.
The coding of the graphic representation of the seashore street is therefore essential for its morphological analysis, and according to Anne Vernez Moudon, morphological analysis must consider the shape, resolution and time. (Moudon 1997, 3-10)

Regarding *shape*, we are interested in the shape of the seashore street, its limits and the relation between the built fabric and the sea. For this task we choose classical rigorous architectural representation pieces, i.e., plans and cross-sections, grounded on the previous work of the research team in the Morphological Inventory of the Portuguese City.[3]

Regarding *resolution* levels, the question is which are relevant for studying the seashore street. Seashore streets are urban elements, therefore it is possible to elementary decompose them from the surrounding urban fabric. However, the importance of its context requires a wider resolution covering the whole urban area. These two resolution levels allow to study the seashore street on its context in two different framings: one that relates the seashore street with the surrounding private space (plot structure and built fabric) and adjoining public spaces using 1:500 to 1:2000 scale; and another one that relates with the settlement (urban layout) and its support territory (topography) on a wider 1:5000 scale that allows us to read the street on the context of the public space of the city and on the territory it is inscribed.

Figure 3: Samples of urban fabrics of pre-selected seashore streets: Sesimbra; Nazaré; Cascais; Póvoa de Varzim; Ponta Delgada; Quarteira. Source: (Author edition of Google earth satellite images)

Regarding *time*, although the observation of reality is made in the present moment, this moment is understood as the result of successive sedimentation processes. The necessary interpretative reading of the moments that conformed these elements is made through a theoretical recomposition. In order to enable it, a collection of cartography, iconography and historical photographs must be composed for the reconstitution of the past moments that allow its description at the present time since the origin, using three essential two-dimensional strata drawings for its reading: the site (represented by the topography); the urban layout (public space); and the built fabric.

In synthesis, the morphological characterization is made through a set of drawings representing the current state of the selected corpus, particularly regarding form, function and role that it plays in relation to site, urban fabric and the sea. Thus, the selected cases will be treated in the same way and with the same criteria of representation and scale: aerial photography, topography and urban layout [1:5000]; seashore street 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.

In order to test and adjust the graphical coding and scales of representation, pilot study cases are being drawn up, such as the cases of Sesimbra and Cascais, chosen by their proximity to Lisbon and the availability of historical and cartographical material that renders more easy the restitution of the elements that compose the inventory. From these preliminary tests it is already possible to demonstrate their usefulness.

3.2. Using the morphological inventory

The uniformity in scale and criteria for the representation drawings renders possible to compare the elements that compose the corpus. The comparison between cases shows common properties, revealing the essence of the type of urban element, and distinctive ones, allowing identifying variations to the type, being particularly useful for the interpretation and transmission of ordered knowledge.

When looking at the drawn elements of the pilot study cases of the seashores of Sesimbra and Cascais, namely the urban layout and the topography strata or layers at 1:5000 scale, their comparison allow us to acknowledge the coincidence between valley lines and structuring linear elements of the public space, as well as the coincidence between the coast line and the linear seashore street in each case is evident. (Fig. 4 and Fig. 5)

The intersection of these linear elements in both cases corresponds to an important public space that at the same time is also a sensitive area to sea level rise. Therefore, these areas were considered relevant as first choices for the detail characterization and also for the Sea Level Rise scenario tests.

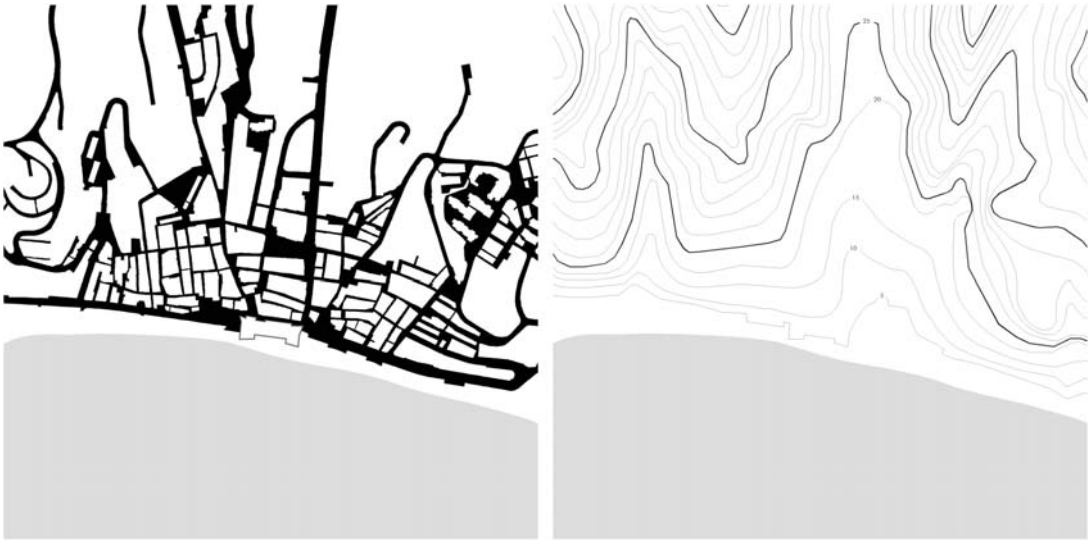

Figure 4: Sesimbra. Urban layout and Topography. Source: (Forma Urbis Lab and Author)

Figure 5: Cascais. Urban layout and Topography. Source: (Forma Urbis Lab and Author)

Several studies on climate change acknowledge the effects of climate change, namely the gradual but inevitable sea level rising, and warn on its effects on urban and humanized areas, such as the research project *Urbanized Estuaries and Deltas. In search for a comprehensive planning and governance. The Lisbon case* or the work developed in the scope of the *FP7 BASE project*,[4] which defines participated adaptation measures to be implemented in medium and long term in 23 European study cases.

The methodology to project Sea Level Rise under climate change that will be used in the research is based on the approach developed by the IDL research team for Portuguese coast studies in the scope of the application of the European Directive 2007/60/CE related to the risk and vulnerability of flooding. The definition of specific scenarios for each case study that can frame the uncertainty inherent to the evolution of climatic conditions and their impacts proves to be doubly relevant to assess their impacts and to plausibly program and design these spaces in a context of adaptation to the inevitable sea level rise. With the definition of these scenarios and based on the topographic information, it is possible to elaborate cartography of the impacts of the floods and extreme sea waves forcing considering two temporal horizons: in the medium and long term, i.e. for 2050 and 2100.

The definition of tipping points allows establishing objective impact levels of sea level rise on the seashore regardless of the combination of factors or events (such as sea level rise projection, storm surges, flash floods, tidal cycle effects, and undulation) defining a critical mark that is not dependent of a date. (Costa, J.P. 2013, 107) In other words, the irreversibility of the process implies that a critical level is reached, regardless the uncertainty of the future moment when it occurs.

In the pilot study cases of the seashores of Sesimbra and Cascais, the rigorous sea level rise models haven't been developed yet. Therefore provisional scenarios for a tipping point of +5m (TP +5m) were tested in both cases. This level is conditioned by available topographical information and informed by one of the scenarios tested by the research team of the project *Urbanized Estuaries and Deltas. In search for a comprehensive planning and governance. The Lisbon case*. The proximity of Lisbon to the present study cases renders this projected sea level rise as a fairly plausible one to be used in this preliminary test.

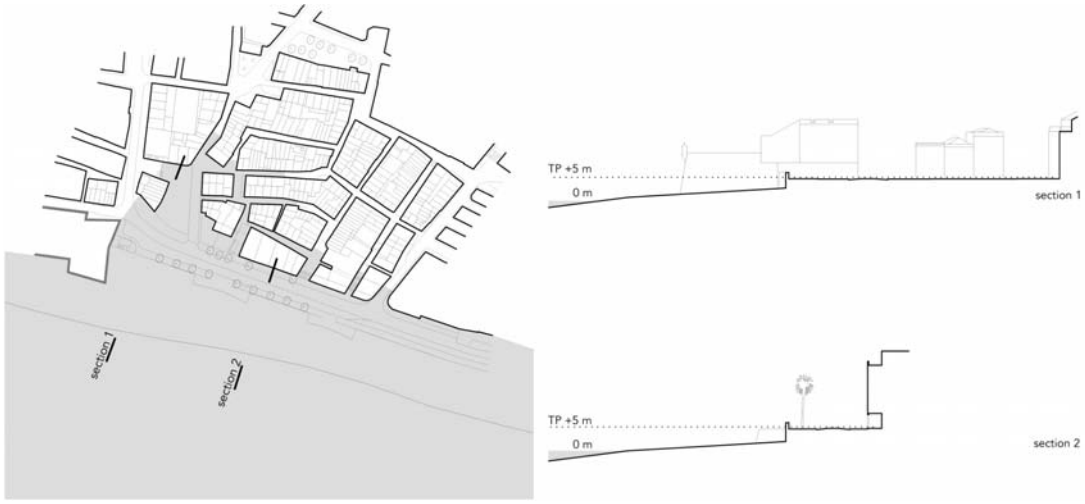

Figure 6: Sesimbra seashore street. Detail plan and cross sections considering a +5m sea level rise. Source: (Forma Urbis Lab and Author)

Representations in plan and cross section are particularly useful when building the sea level rise scenarios. In the case of Sesimbra, the impacts with this tipping point of +5m are clear along the entire seashore avenue but are particularly evident on *Largo de Bombaldes*, east of the Santiago fortress, submerging public space under 1m to 1,5m of water and affecting the surrounding ground floors of the built fabric. (Fig. 6) In the case of Cascais, similar effects occur in public spaces of *Passeio Dom Luís I* and inland along *Alameda dos Combatentes da Grande Guerra*, where the valley bottom configuration promotes a deep inland penetration of water that affects commercial ground floors and important public buildings. (Fig.7)

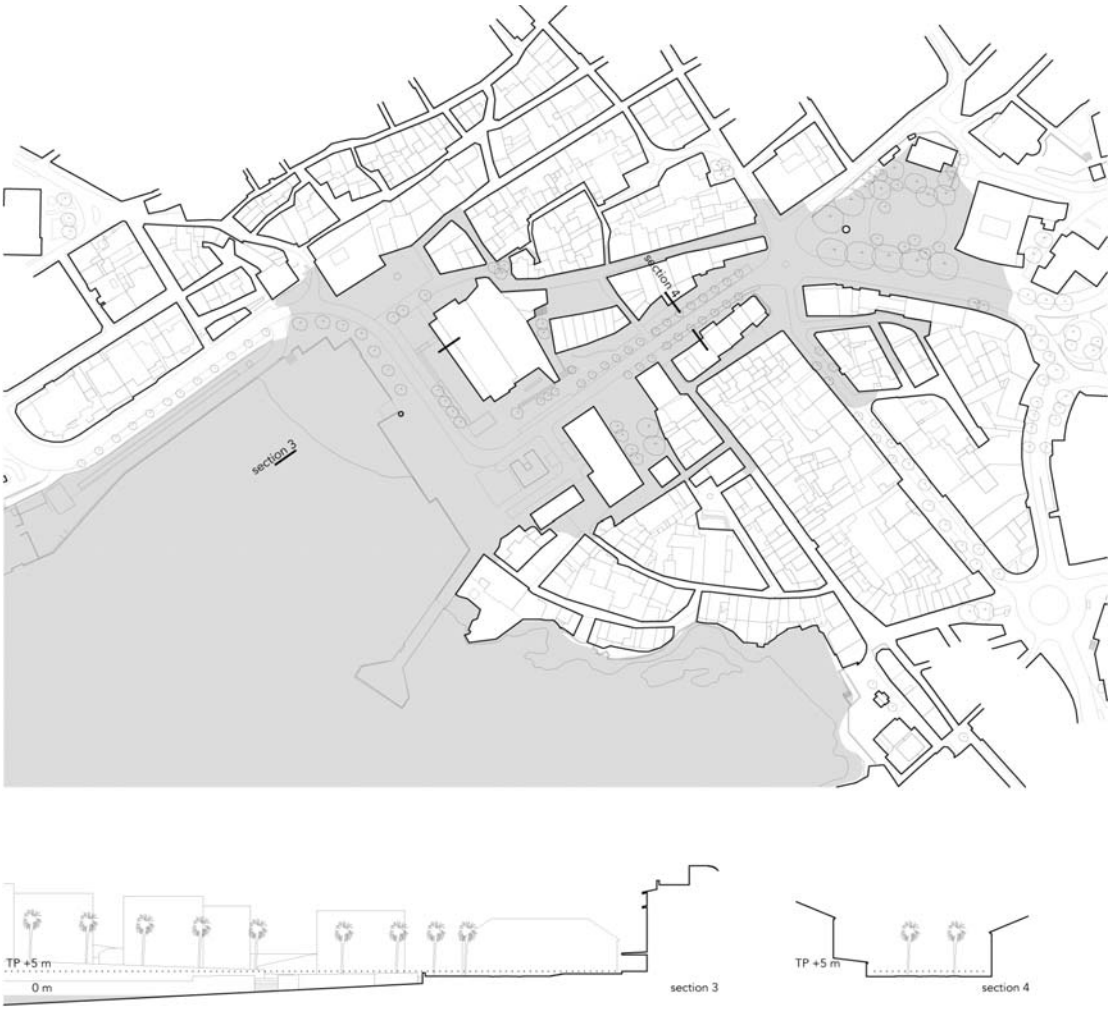

Figure 7: Cascais seashore street. Detail plan (rotated 90ª clockwise) and cross sections considering a +5m sea level rise. Source: (Forma Urbis Lab and Author)

Both scenarios, when first presented, comprehensibly emerge as a shock. Nevertheless, if we recall that these spaces lie in the valley bottoms and confront the scenarios with historical cartography, iconography and even photographs from the first half of the XXth century, we find that in the same areas existed river streams, docks and beaches. Eventually we can even find similarities with the coastal contour, previous to the land filling and construction of the topography that supports the seashore streets and waterfront spaces. Using poetic freedom we could say that water has memory.

4. UNDERSTAND THE PAST TO DRAW THE FUTURE

The dynamic inherent to the urban object underlines the fact that the present state is just a transitory moment in the evolution of these elements. Understandably an urban organism by the very dynamic nature of itself must not crystallize; therefore its harmony must be in constant mutation and reshaping.

Seashore streets are not an exception and often we find answers to future challenges in the past that built our present. Therefore the methodological approach for the characterization of seashore streets that is proposed considers both the knowledge of the site and its evolution. This phase of the research on the significant spaces that mediate land and sea enables a drawn understanding of seashores and the future integration of their own memory in the design of adaptation measures to an inevitable sea level rise.

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ENDNOTES

[1] The adaptation pathways and tipping-points tool (Haasnoot, M., et al. 2013) is one of the available approaches for participatory action research in planning for climate change and was recently integrated with scenario workshop, generating the *Scenario Workshop and Adaptation Pathways* methodology (SWAP) (Campos, I., Vizinho, A., Coelho, C., Alves, F., Truninger, M., Pereira, C., Santos, F.D. & Penha-Lopes, G. 2016). This approach was developed and applied in the FP7 BASE project (in which CCIAM collaborated). It is proposed to apply this methodology in this project, which will require the projection and mapping of sea level rise for the Portuguese coast and subsequent identification of possible adaptation measures for each pilot case that afterwards will be filtered and ordered through participatory workshops with local key stakeholders.

[2] Carlos Dias Coelho considers three distinct times regarding the city longevity: the shorter time of the individual, the intermediate time of the urban uses and behaviors, and the longer time of the built spaces: "The time of spaces and buildings is the third time and this is the one that deciphers the importance of the built city as a physical object, always changing but nonetheless stands out by its resistance and ability to be reinterpreted." (Dias Coelho 2014)

[3] Forma Urbis Lab team, part of CIAUD/FA/UL, began working on the topic of urban morphology roughly sixteen years ago and since then has conducted different pieces of research, both individually and as a group, interlinking the different morphological elements that compose the urban fabric and disseminated the results. Nevertheless, prominence should be given to the *morphological atlas of the Portuguese city*, which was designed to be laid out in two parts, the first regarding public space and for which the phases on *urban layout and squares* have been concluded and published (Dias Coelho, Lamas 2005) (Dias Coelho, Lamas 2007), and for which the phase on *streets* is concluded. The second part, on the private space, approached first from the *urban block* is also concluded and the phase on *building typology* is ongoing.

[4] Ng, K., Campos, I., & Penha-Lopes, G. (Eds.), 2016. *BASE adaptation inspiration book: 23 European cases of climate change adaptation to inspire European decision-makers, practitioners and citizens.* Lisbon: Faculty of Sciences, University of Lisbon, available at http://base-adaptation.eu/base-adaptation-inspiration-book-23-european-cases-climate-change-adaptation