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“LUÍS DE CAMÕES”

CONNECTING LISBON

Mechanical Solutions for Urban Integration

Dissertation to obtain the degree of Master in Architecture

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RESUMO:

Lisboa é uma cidade profundamente marcada pela sua topografia acentuada, e essa característica tem sido determinante para a antropização do seu território. A ocupação inicial da cidade ocorreu ao longo das suas linhas de festo, mas, com o tempo, os seus vales também foram sendo progressivamente ocupados. Contudo, a relação entre as zonas altas e baixas da cidade sempre foi complexa e difícil de gerir. A partir do reconhecimento deste problema, e a partir das grandes invenções tecnológicas que caracterizaram o período da Revolução Industrial, diversos ascensores — elevadores, e funiculares — foram instalados no final do século XIX e início do século XX, suavizando a experiência da cidade. No entanto, com o crescimento da cidade ao longo do século XX, a cidade expandiu-se para além do seu núcleo histórico, ocupando montes e vales que outrora a rodeavam. Apesar dessa expansão, os meios mecânicos de articulação entre as zonas altas e baixas permaneceram circunscritos ao centro histórico. Nos últimos anos, e especialmente após a intervenção de Álvaro Siza no Chiado nos anos 1990, a utilização de soluções mecânicas para articular diferentes áreas da cidade tem vindo a ser recuperada, mas de forma limitada ao centro histórico. Nesta tese propõe-se alargar a abrangência desta acção a outras zonas da cidade, onde esta tipologia de intervenção poderia ser determinante para articular, de um modo mais abrangente, o seu território, especialmente em áreas marginalizadas. A proposta inspira-se no comportamento do micélio — a estrutura vegetativa dos fungos — que se desenvolve de maneira adaptativa, formando uma rede densa e resiliente que se ajusta ao ambiente existente. Aplicando essa lógica de desenvolvimento e adaptação, a tese sugere a criação de um sistema de articulação que se ramifique pela cidade de forma orgânica, utilizando os meios mecânicos de transporte como «filamentos» que ligam diferentes áreas. A partir desta perspectiva, considera-se a zona de Alcântara como caso de estudo, propondo-se uma solução que visa articular esta área com o tecido urbano envolvente — integrando-a tanto com a cidade consolidada como com o Parque de Monsanto —, e incorporando-a de forma eficaz no sistema de transporte metropolitano.

PALAVRAS-CHAVE: Lisboa, Topografia, Sustentabilidade, Transportes Públicos.

ABSTRACT:

Lisbon is a city deeply marked by its steep topography and this characteristic has been a determining factor in the anthropisation of its territory. It was first settled along its railway lines, but over time its valleys were occupied. The relationship between the upper and lower parts of the city, however, has always been difficult. Recognising this problem and the great technological inventions that characterised the period of the Industrial Revolution, various elevators — both lifts and funiculars — were installed at the end of the XIXth and beginning of the XXth centuries to smooth out the experience of the city. However, throughout the XXth century, the city expanded on a large scale, occupying the hills and valleys that once surrounded it. Despite this expansion, the mechanical means of linking the upper and lower zones remained confined to its historic centre. In recent years, and since Álvaro Siza's intervention in Chiado in the 1990s, the hypothesis of using mechanical means has been recovered, articulating areas that needed better connection. However, this action has been limited to the historic centre. This thesis proposes extending the scope of this action to other areas of the city, where this type of intervention could be decisive in articulating its territory more comprehensively, especially in marginalised areas.. The proposal is inspired by the behaviour of the mycelium — the vegetative structure of fungi — which adapts and grows organically, creating dense and resilient networks that respond to the existing environment. Applying this adaptative logic to the urban context, the thesis suggests the creation of an articulated system that organically grows throughout the city, using mechanical transports like “hyphaes” to connect different areas. From this perspective, tha Alcântara area is considered as a case study, proposing a solution that aims to articulate this area with the surrounding urban fabric — integrating it with the solidified city and Monsanto’s park —, and including it in an efficient way in the metropolitan transport system.

KEYWORDS: Lisbon, Topography, Sustainability, Public Transportation.

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The fragmented city

Recognising Lisbon's challenging topography, it is crucial to develop strategies to improve the lives of those affected by the resulting marginalisation. Lisbon's urban development initially followed the crest lines of the seven hills — São Roque, São Vivente, São Jorge, Santo André, Sant'Ana, Chagas and Santa Catarina — and gradually expanded down their slopes. However, several neighbourhoods remain isolated due to these natural topographical barriers.

At the end of the XIXth and the beginning of the XXth centuries, the Industrial Revolution brought mechanical public transportation to Lisbon, most notably in the form of urban lifts. This key moment in the city's history marked the first significant attempt to overcome discontinuities and the marginalisation caused by the city's rugged terrain. Under the guidance of engineer Raoul Mesnier de Ponsard, several lifts were planned and constructed, revolutionising urban mobility by facilitating the movement of goods and people and enhancing overall connectivity within the city.

During this period, all mechanical lifts were concentrated around downtown Lisbon, the core of the metropolis. In recent years, beginning with Álvaro Siza's intervention in Chiado in the 1990s, the use of mechanical transport methods has been revitalised, connecting previously isolated areas and strengthening the existing networks. Today, mechanical lifts are increasingly seen as a practical and effective solution for pedestrian connectivity between different neighbourhoods. This renewed interest is exemplified by architect João Favila from Atelier Bugio, who reactivated the historic Graça Lift and incorporated it into a modernised urban network.

However, it is noteworthy that even recent mechanical interventions continue to focus primarily on the historic city centre. The hypothesis presented in this thesis proposes expanding the use of mechanical vertical transport across a broader area of Lisbon to address connectivity challenges beyond the city centre.

To test this hypothesis, the thesis focuses on the Alcântara Valley, proposing a new mechanical transport route connecting key points: starting from Campo de Ourique, passing through the lower parts of the valley, and finally ascending to Monsanto's Forest, specifically

linking the Alvito´s neighbourhood and the university campus. This plan demonstrates the potential benefits and efficiency of such a system, offering a nuanced and extensive solution to reduce the isolation and marginalisation of neighbourhoods affected by steep topography. The proposed approach is informed by historical city plans, discussions, and research, culminating in the comprehensive solution outlined in this thesis.

The first part of the thesis provides a thorough study of all vertical mechanical transport methods in Lisbon, identifying areas positively impacted by these systems. The second part explores the hypothesis that expanding these systems beyond the city centre can effectively improve connectivity and reduce isolation. Finally, the last section offers a detailed explanation of the proposed project, demonstrating its potential impact on residents and its role in reshaping urban space.

Part I

1.1 The topographic city and its vertical mechanical means

Lisbon's urban expansion has been intricately shaped by its challenging topography. Initially, settlements were established atop the city's seven hills — São Roque, São Vicente, São Jorge, Santo André, Sant'Ana, Chagas, and Santa Catarina — due to the ease of movements along routes unobstructed by rivers. Convents often served as catalysts for this early urban development. Meanwhile, the valleys were predominantly dedicated to agriculture, as seen in the Chelas Valley, which still retains its rural character and contributes to the unique blend within the city's urban fabric. This pattern is evident along the course of Avenida da Liberdade, where remnants of agricultural land have gradually been absorbed by urbanisation. The fertile soil in the valleys facilitated agricultural activity, which thrived due to the natural availability of water sources. Early settlements emerged on the less fertile hilltops, while the fertile valleys fostered productive agricultural communities.[1] [fig.01]

The valleys maintained their unique character, seamlessly integrating rural and urban elements. This created a distinct urban layout, with a central core encompassing Castelo Hill and Baixa, as well as the surrounding areas, expanding outward in various patterns. This development resulted in open spaces between the planned urban areas, and Lisbon's topography facilitated two distinct conditions for its initial settlement, reflecting principles articulated in the Muratorian theory.[2]

From these elevated, densely populated areas, settlements expanded along the crest lines, with olive groves interspersed among the houses. These crests were bordered by fertile floodplains, crisscrossed by country roads that connected the populated hills. At the heart of the city lay a vast valley, the Baixa, which split near *Rossio* into two main routes: Avenida da Liberdade and Rua da Palma/Avenida Almirante Reis. These routes followed natural watercourses that were crucial for irrigating surrounding farmlands. In the late XIVth century, the "Cerca Nova", the most recent defensive wall, was constructed across these two valleys to protect the

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[1] See, on this subject, GRAÇA, João Luís Carrilho da, SEQUEIRA, Marta — "Lisbona: Civiltà e território". *In Rassegna di Architettura e Urbanistica. Lisbona. Transformazioni urbane negli anni della crisi,* Roma: Univestiá de la Sapienza, 2019. pp. 9-15.

[2] MURATONI, S. — "Il processo ciclico di costituzione di un organismo territoriale (sviluppo nello spazio)" *In Civiltà e territorio.* Roma: Centro studi di storia urbanistica, 1967, pp. 499-510.

urban periphery from potential invasions while preserving the fertile, water-rich lands, which were dotted with farms and vegetable gardens. As a result, the hills became densely populated, while the valleys remained primarily agricultural, serving as the city's entry points.[3] [fig.02]

Building upon the analysis by Marta Sequeira and João Luís Carrilho da Graça in the article "Lisbon: Civilisation and Territory",[4] it is evident that as settlers established themselves, they began to shape Lisbon's urban landscape. Over time, the valleys became more populated, blurring the distinction between them and the hills, although the outlines of both ridge and valley lines persisted as fundamental elements of the urban framework. Many historic neighbourhoods are closely tied to the natural topography they occupy. For example, Estrela lies between the Alcântara Valley and Rua de São Bento; Bairro Alto is situated between this area and Baixa; and Colina de Santana is positioned between the valleys of Avenida da Liberdade and Rua da Palma/Avenida Almirante Reis. Further north, newer neighbourhoods expanded into regions characterised by plateaus that gently slope towards the Tagus River, less interrupted by watercourses, allowing for the development of regular grid patterns typical of districts like Avenidas Novas.

These topographical attributes are the primary reasons for urban disconnection. While once a defensive asset, Lisbon's topography has become a barrier to the effective integration and functioning of the city's transport systems. This also highlights the socio-economic disparities among the city's residents. Analysis shows that those living in higher areas often benefit from better connectivity and more affluent neighbourhoods.[5] For instance, in the parish of Campo de Ourique, social housing is primarily located in the lower parts of the Alcântara Valley, areas marked by a lack of community life and central gathering points. Conversely, the plateau of Campo de Ourique, positioned at the top of the valley, offers to its residents a higher quality of life, with easy access to commercial, cultural, and public amenities, fostering a stronger community spirit. [fig.03 and 04]

Another critical issue is flooding, which has worsened due to changes in the city's topography. Residents in the lower parts of the valleys experience frequent flooding during heavy rainfall. [fig.05] The arid summer months prevent the soil from absorbing large

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[3] See, on this subject, GRAÇA, João Luís Carrilho da, SEQUEIRA, Marta — *op. cit.*, pp. 9-15.
[4] *Ibid.*
[5] SANTOS, Sofia — "Who are you calling sub/urban? Socio-spatial inequality and mobility in the Lisbon Metropolitan Area". *In Portuguese Journal of Social Science,* volume XV (2016), pp. 387-407.

volumes of water quickly, causing runoff to descend the slopes and flood the paved streets.[6] Additionally, Lisbon's draining system[7], designed to remove water rapidly and direct it towards the Tagus River, has proven inefficient, especially during severe rainfall events. In Alcântara, for instance, flooding can isolate the area completely, with waterlogged streets obstructing any movement through the city. [fig.06]

To address these disconnection issues, engineers began exploring mechanical transportation options at the end of the XIXth century and into the early XXth century. During the XIXth century, Lisbon underwent a notable transformation driven by economic and urban growth. As one of Europe's oldest cities, Lisbon faced unique challenges posed by its hilly terrain. The demand for efficient transportation solutions increased with urban expansion and industrialisation.

From the second half of the XIXth century, Lisbon expanded beyond its original boundaries, leading to the rise of unplanned neighbourhoods that housed the city's lower socio-economic population. This urban and social shift pushed the working class further away from the city centre, which had already established itself as the hub of economic and political power. This phenomenon was particularly noticeable in Alcântara, where population density increased and even more working-class housing was constructed.[8]

With the advent of modern urbanism and a strategic approach to addressing the challenges of a larger city, Lisbon began to serve diverse functions and purposes. The city had to accommodate and provide for an expanding population, requiring a new approach that saw it as a single entity subdivided into several nuclei with distinct needs. This method of urban organisation allowed for a more comprehensive public transport network that could better meet the needs of each neighbourhood.[9]

By the end of the XIXth century, and unlike many European capitals, Lisbon had a relatively underdeveloped public transport network. To address this, the city needed to innovate quickly and adopt new technologies to improve its connectivity. At this time, public transport was

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[6] MANSO, Pedro Miguel Martinho — *Vivenciar o vale de Alcântara: a água, a natureza e a habitação coletiva*. Lisbon, 2021. Master Thesis in Architecture, presented in Faculdade de Arquitectura da Universidade de Lisboa (polic.ª)

[7] CÂMARA MUNICIPAL LISBOA—- *Lisbon Drainage Master Plan 2016-2030*. Lisbon. Câmara Municipal de Lisboa. [s.d.]

[8] See, on this subject, MARTINS, Nuno Gonçalo Simões — *A Companhia Carris de Ferro de Lisboa (1901-1926). Política, rede de transportes públicos e evolução urbana*. Lisbon, 2018. Master degree in contemporary history presented in University Nova.

[9] *Ibid.*

largely dependent on small, independent operators who lacked capital for large-scale investments. Recognising this, various companies began to implement systems to serve both the industrial areas to the east and west and connect them to the city centre.[10]

Initially, the network was limited to flat or gently sloping areas, as most public transport relied on animal traction. However, with the introduction of the cable car system, the network began to expand significantly. This system, which depended on water for its operation, was primarily introduced in the city centre, where profitability was highest.[11]

Following the abolition of the animal traction system, the “First Area of Intervention”, which stretched from Algés to Santa Apolonia, planned three new lines using the “American system” for carriages. Subsequently, the “Second Area of Intervention”, covering the city’s outskirts beyond the Circunvalação Road, was further developed to extend and harmonise Lisbon’s public transport network. Focusing on the most significant problem faced by the city — its steep topography — the construction of mechanical lifts, such as the iconic Elevador de Santa Justa, emerged as a viable solution to overcome this natural barrier.[12] [fig.07, fig.08 fig.09]

Lisbon's steep hills posed a significant challenge to transportation and urban mobility. Navigating the city's narrow, winding streets was particularly difficult for residents commuting between neighbourhoods at different elevations. The implementation of mechanical lifts provided a practical solution, offering a convenient means of vertical transportation that bypassed the steep gradients.

The rapid industrialisation and economic development of Lisbon during the XIXth century led to the expansion of infrastructure to accommodate a growing population and increased commercial activity. Mechanical lifts played a vital role in facilitating the transportation of goods and people, thereby improving connectivity between different districts and enhancing the efficiency of urban logistics. This investment in infrastructure was crucial for maintaining Lisbon's economic vitality and competitiveness in an increasingly interconnected global landscape.

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[10] See, on this subject, MARTINS, Nuno Gonçalo Simões — *op.cit.*
[11] *Ibid.*
[12] See, on this subject, COSTA, João Manuel Hipólito Firmino da — *Um caso de Património Local : A Tomada de Lisboa pelos Ascensores.* Lisbon, 2008. Master degree thesis in heritage studies presented in University of Aberta.

Furthermore, the rise of tourism as a major economic force also influenced the development of mechanical lifts. Lisbon's unique charm and rich historical heritage attracted a growing number of visitors, but the city's uneven terrain posed significant accessibility hurdles. By providing easy access to panoramic viewpoints and historic sites, such as the observation deck of the Elevador de Santa Justa, mechanical lifts enhanced Lisbon's attractiveness as a tourist destination, thereby bolstering the local economy.[13]

The XIXth century marked a period of significant advancements in engineering and technology, making the construction of mechanical lifts both feasible and economically viable. Innovations in materials, notably the widespread use of steel, along with the refinement of reliable steam and, subsequently, electric power systems, laid the groundwork for implementing vertical transportation solutions.

The construction of mechanical lifts in Lisbon during the XIXth century was driven by a convergence of factors, including the city's rugged topography, burgeoning economic development, urbanisation, the growth of tourism, and technological advancements. Beyond addressing practical transportation needs, these lifts symbolised Lisbon's aspirations to modernise and meet the demands of an increasingly dynamic world.

Initially, as an experimental measure, engineer Raoul Mesnier du Ponsard implemented the Swiss system devised by Niklaus Riggenbach[14] in Lisbon. This system consisted of two parallel tracks laid along a steep incline, interconnected by a central stationary cable, securely anchored at both ends. The funicular was uniquely adapted for Lisbon, using a water counterweight system where water was filled at the upper terminus and released at the lower terminus to facilitate movement. The first of these mechanical lifts, the Ascensor da Calçada da Lavra, was inaugurated in 1884 [fig.10, 11, 12, 13, 14, 15, 16 and 17]. Following its success, similar installations such as the Ascensor da Bica, the Ascensor da Gloria or the Chiado`s Lift were constructed. However, it soon became apparent that the reliance on water counterweights was inefficient due to occasional water shortages. Consequently, the system transitioned to electrical operation, eliminating dependency on the water supply.[15]

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[13] See, on this subject, COSTA, João Manuel Hipólito Firmino da — *op. cit.*

[14] NAGY, Andor, ISTVÁN Lakatos — "Examining the Movement Differences in the Behavior of Normal and Rack Railway Vehicle". *In International Journal of Engineering and Management Sciences* 4 (2019), pp. 96-103.

[15] See, on this subject, COSTA, João Manuel Hipólito Firmino da — *op.cit.*

The other type of system for the funiculars in Lisbon at the beginning of the XXth century was the cable car system. This new system worked with one or more cables suspended between fixed points, typically pylons or towers, along the route. Each cable car carriage was attached to the cables via a grip mechanism, which allowed controlled movement along the path. Unlike the Riggenbach system, where a central cable provided propulsion, the cable car system relied on a continuously moving cable driven by a stationary motor located at one end of the route. Funiculars such as Estrela, São Sebastião, and the first Graça were examples of this system. Subsequently, the newest mechanical lifts incorporated the latest technologies available at the time, namely electrical systems. The first lift to be equipped with this specific system was the Carmo Lift.[16] [fig.18, 19, 20, 21, 22 and 23]

In 1959, Lisbon introduced a new metro system, providing an innovative way to connect different areas of the city. This network has gradually evolved over the decades, continuously expanding to reach its current configuration. The rehabilitation of Chiado in 1998 by the architect Álvaro Siza marked a renaissance in vertical pedestrian movement within the city. Following the 1988 fire, this project aimed to rebuild 18 parcels in the historic centre with a strong urban planning focus. Siza's approach sought to create a connection between the rebuilt urban fabric and the steep topography, re-establishing old links and creating new relationships within the environment. Key measures included improving connections between Baixa Pombalina and the Bairro hill, with Chiado serving as a mediator between these different elevations. The new or reactivated crossings supported the vertical mechanical systems installed in this project. One transformative measure was the decision to divert the metro line exit and design a lower-level opening in the Grandes Armazéns building, creating an exit at Rua do Crucifixo. This modification gave Rua do Crucifixo a more cosmopolitan role, enhancing its connectivity to the rest of the city via the metro. Continuity between Rua Ivens, Rua Nova do Almada and Rua do Crucifixo would thus be ensured.[17] This operation was followed by the Castelo Lift and the most recent Graça funicular, which embraced contemporary technology of their own time. [fig.25, 26 and 27]

By the late XIXth century, all the elevators present and envisioned in Lisbon were concentrated around the flat downtown areas (Sant'Ana, São Roque, Chagas, São Jorge, and São Vicente) due to the city's size at the time. The physical and historical centre was located

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[16] *Ibid.*

[17] See, on this subject, FIGUEIRA, Jorge — "Siza Vieira conta como foi o projeto de recuperação do Chiado". *In Público.* Lisbon. 25 august 2013.

in downtown Lisbon. The most recent interventions that made use of vertical transports continue this tendency.

This focus explains the neglect of areas added to Lisbon due to rural exodus and industrialisation, such as Alcântara, where stark segregation between different socio-economic groups became evident.

1.2 A reflection on the problematics generated by the topography in architecture. A talk with João Luís Carrilho da Graça

João Luís Carrilho da Graça graduated in Architecture from the University of Fine Arts in 1977. Since the 1980s, he has become one of Portugal's most important architects, with works such as the Campo Maior Municipal Swimming Pool and the Escola Superior de Comunicação Social. Over the years, he has developed a critical thinking about the territory and its importance for architecture, influencing many younger Portuguese architects. In 2002 he wrote 'Metamorphosis', a text published in the *Jornal dos Arquitectos*, crystallising the theory that the lines and notable points that characterise the topography are the basis of human routes and settlements and, therefore, of the construction of the city and its architecture. In 2015, an exhibition was held, *Carrilho da Graça: Lisboa*, initially presented at the Centro Cultural de Belém in Lisbon, but whose international itinerancy included cities as diverse as Bogotá, São Paulo, Barcelona, Montevideo, Buenos Aires, Madrid, Paris, Milan and Mexico City between 2015 and 2018 — which, as well as portraying his work, above all expressed his way of observing the territory and the importance of topography. In 2019 he published 'Civiltà e Territorio' in the magazine *Rassegna*, with Marta Sequeira, demonstrating the usefulness of this analytical methodology for understanding cities, but even more so a city like Lisbon, with its pronounced topography. His work was essentially dedicated to following this approach to topography. However, in this interview, as well as reflecting on this possibility of getting it right, you also talk about those projects that seek to correct the problems posed by the topography or by the disconcerting way in which man has sometimes built on this prominent territory.

Inês Pedrosa Vaz (IPV) — Throughout your career you have consistently affirmed — through your projects, but also through your writings, interviews and conferences — the importance of understanding the topography of a territory. How does this understanding define your way of looking at the world?

João Luís Carrilho da Graça (JLCG) — I really value topography and the way cities are built on it. There are two main lines to which I always refer: the water line and the crestline. In the case of Lisbon, the water lines converge on the estuary, while the crest lines correspond to ancestral routes. These lines are still very evident, defining an almost indestructible matrix. From these lines, it is possible to establish cadastral units. Therefore, the entire development

of the city takes place in the space between these lines. Lisbon's city plan may seem chaotic initially, but by marking these main lines, you begin to understand its structure. This is very well illustrated in the catalogue of the exhibition *Carrilho da Graça: Lisboa*, curated by Marta Sequeira and Susana Rato. When you look at the importance of the various urban systems that correspond to these lines, you realise how cadastral units are established, from which orthogonal grids are defined, giving rise to the city. From this reasoning, the logic of each neighbourhood is understood. This analytical process allows immense freedom and serves as an important starting point.

IPV — In 1994, in "A Arquitetura é perigosa", you stated that the territory is seen "with the sense of support, of invariance [it is the] thing that welcomes our presence and is already marked by it". This phrase reflects an ecological awareness that, although not common at the time, coincides with current concerns. To what extent has this ecological awareness moulded your way of designing?

JLCG — I would say that, as far as possible, I always try to enunciate an objective and a path to follow. I defend the city against any initiative that, however interesting, will interact with it. For example, at the Cruise Terminal,[18] we have designed a large park, with trees, and a viewpoint on the roof of the terminal, allowing a view of the Tagus estuary and Alfama, while the building is minimal in size. [figg.29, 30 and 31]

IPV — It is often said that Álvaro Siza's architecture is born from the specific site where it is located, while his approach seems to emerge, in the eyes of critics, from a broader understanding of the territory. How do you assess this distinction? Do you think this observation contains the nuances and differences between the architectural approaches of the two?

JLCG — From my point of view, any territorial issue is automatically linked to the site of intervention. In a conversation transcribed in the catalogue of the *Flashback/ Carrilho da Graça exhibition*, moderated by Marta Sequeira, in which I took part along with Álvaro Siza and Eduardo Souto de Moura, we discussed this topic and concluded that the guidelines of a project are defined by our critical thinking and the way we interpret and observe the site. In

[18] GRAÇA, João Luís Carrilho da — "Lisbon's Cruise Terminal". Lisbon: Carrilho da Graça Arquietos, 2018. Available in: https://www.carrilhodagraca.pt/lisbon_cruise_terminal [Consul. 26/06/2024].

my case, this approach to the territory is a way of getting closer to the site. Instead of simply drawing the things that are there with a pad in hand, as we were taught at school — which can distract us from the essential — I try to look at the site in a more strategic way, without losing sight of the importance of the elements that make it up.

IPV — Lisbon is a city marked by its steep topography, a characteristic that has been a determining factor in the anthropisation of its territory. Initially, the topography was a very positive factor for its implementation, with the first occupations taking place along the festoon lines. However, over time, the valleys were occupied, resulting in a problematic relationship between the upper and lower parts of the city. Recognising the disarticulation between the upper and lower parts of the city, and the great technological inventions that characterised the period of the Industrial Revolution, a number of lifts — lifts and funiculars — were installed during the late XIXth and early XXth centuries to soften the experience of the city. In recent years, especially after Álvaro Siza's intervention in Chiado in the 1990s, the use of mechanical means to connect disjointed areas has been revitalised. How have you observed and evaluated this development in the city? What are your perceptions of the impact of these mechanical solutions on urban cohesion and the inhabitants' experience?

JLCG — There was a big discussion at one point about building a vertical lift that would connect to the castle. This proposal generated a huge reaction, involving Adalberto Dias, who was responsible for the project. In an attempt to clarify the situation, Gonçalo Byrne explained that, in reality, vertical lifts were widely used in the XIXth century in cities, such as the Santa Justa lift. However, when the connection wasn't direct, it was better to opt for an inclined lift. With that explanation, the controversy was settled. However, I think it's really interesting to establish a practical link that many people use. It's very useful, it has a significant content and an obvious urban utility, as in the case of Álvaro Siza's Plan for the Reconstruction of the Blighted Area of Chiado, or in the case of the Graça funicular, designed by João Favila.

IPV — In the context of the Vallis Programme, you were commissioned to design a bridge over Avenida da Liberdade, designed to join the two festoon lines flanking the avenue and flatten the experience of the city centre. However, at the time you preferred to avoid this challenge and thought it more appropriate to reflect on the Colina de Santana, producing one of your most iconic projects (even if it wasn't built).

JLCG — The Valis Programme,[19] which took place in Lisbon in 1991, aimed to study possible interventions in the city that would improve and enhance it. In this context, I was invited to design a bridge over Avenida da Liberdade. At the time, it seemed to me that if the bridge had been built in the XIXth century, we would probably be marvelling at it, walking along it with great enthusiasm, considering it a historic work of great interest. However, at that moment it seemed more pertinent to propose another type of strategy. That's when I suggested a major intervention on the hill of Sant'Ana, or rather along it. At the time, this proposal was seen as extremely daring, because whenever there is talk of the possibility of tall and significant constructions in high areas, there is a great deal of public apprehension. I believe that if this intervention had been proposed for a hidden part of a valley, even if less suitable, it might have been more easily accepted. However, in that particular area, the defence of the project was more complicated. Despite knowing that the plan could be considered radical, I drew up a kind of manifesto, as you are doing to defend your thesis. I believed that, in the XIXth century, building a bridge could make it easier to travel on foot or by horse-drawn carriage, at a time when the streets were chaotic. At that time, crossing the green valley of Avenida da Liberdade was really difficult. However, at the end of the XXth century, with the advent of telephones — and already realising the future impact of the internet on communication — the need to physically cross that valley was not so pressing. I'm fascinated by the topography and the possibilities it suggests. At the same time, I have an enormous enthusiasm for the city and its urban intensity. That's what prompted the study of the hill of Sant'Ana, imagining it as a possible city centre, where there were and are huge areas available. The analysis we did revealed that 90% of the area of the hill of Sant'Ana was made up of public space or state buildings (such as convents and abandoned buildings), many of which were not being properly valued or utilised.

IPV — However, years later you accepted the Polis programme's challenge to join two hills over the Carpinteira valley in Covilhã. What distinguished the two challenges, leading you to refuse one and accept the other? Was it the direct relationship with a historical heritage in the case of the capital, in contrast to the absence of such a direct relationship in Covilhã? Could you explain the reasons that influenced your decisions in each context?

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[19] CEDRU - Valis — *Estudo e plano estratégico de preservação do património e urbanístico de Lisboa*. Lisbon: Comissão das comunidades europeias, 1990. [Consul. 16/06/2024].

JLCG — I'm extremely pragmatic and, although I've taken part in many competitions that I didn't win and projects that didn't materialise, my main objective has always been to build. In Covilhã, Nuno Teotónio Pereira was drawing up a plan with the theory of "flattening the city". Anyone who visits Covilhã realises how complicated the city is, with no clear urban logic and people driving around in cars. In this programme, there was a proposal to install lifts, later designed by a landscape architect, and to build three bridges: two in the university valley and one in the Carpinteira valley, the latter being the only one built. Despite a previous study, the other two bridges didn't go ahead. Nuno Teotónio Pereira recommended me to the City Council and the Polis programme,[20] in a special operation led by João Trindade. The fundamental difference with the Valis programme is that, in Polis, the idea was to actually build, while in Valis the objective was only theoretical. I developed a first project in wood, as suggested by Teotónio Pereira. However, when I visited the valley, I realised that the size was enormous, and that a wooden bridge would be a mastodon, almost impossible to build. I then decided to design a metal truss bridge, similar to the one I had made for Aveiro, but with a wooden start, end and deck, a bit like the ones portrayed in the film "The Bridges of Madison County". After discussing the project with Nuno Teotónio Pereira, I presented the work to the Mayor of Covilhã, accompanied by a young collaborator and an engineer. The mayor looked at the model and the representations of the bridge and told me very briefly that my proposal was too similar to the existing railway bridge. He wanted something that would stand out as an ex-libris for Covilhã, a modern and futuristic bridge — whatever that means. I accepted the challenge and developed a project that I like even more than the previous one. By this I mean to explain that the difference in my attitude towards each of the two projects stems from my pragmatism. If, in the context of the Valis programme, they had made it clear that they really wanted to build a bridge over Avenida da Liberdade, I wouldn't have hesitated. However, as it was a theoretical project, it seemed more interesting to me to propose what, also from a theoretical point of view, seemed more interesting to explore in relation to the city of Lisbon.

IPV — Throughout the XXth century, Lisbon expanded on a large scale, occupying the hills and valleys that had previously surrounded it. Despite this expansion, the mechanical means of articulation between the upper and lower zones remained confined to the historic centre. Could this solution be expanded to other areas of the city, rather than just the historic centre?

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[20] PEREIRA, Nuno Teotónio — *Uma Ideia para a Cidade da Covilhã.* Covilhã: Caleidoscópio, 2006.

What would be the challenges and benefits of implementing these mechanical means in other areas of the city, with the aim of improving urban cohesion and the mobility of inhabitants?

JLCG — I think it could be interesting, but I would warn against turning certain areas of the city into mono-functional zones, instead of densifying them and using them in an open and diverse way. Often, we want to go from a low level to a high level, but there are various ways of doing this (such as using electric bikes or walking). Although lifts have their role to play, you have to be careful that they don't end up creating a disconnection between the two points they connect, rather than intensifying that territory. In Lisbon, for example, we have the Lavra, Glória and Bica lifts. In the Lavra and Bica lifts, this disconnection doesn't occur, but in the Glória lift, if you walk along the route, you'll see a lot of almost abandoned buildings and spaces along the way. Urban intensification is fundamental. Otherwise, we're failing as architects. I've often turned down projects because I didn't believe they could work. I remember, for example, a competition for the Arquipélago Contemporary Arts Centre in the Azores, which was won by João Mendes Ribeiro and the studio Menos é Mais, who won and built a wonderful project. In the context of the competition, I went to see the project site with Paulo Costa, my collaborator at the time. It seemed to me that there was no clear collection or organisation and that the building would look like something planted in a void. I was afraid it would be abandoned, like the fire stations that were built in the Alentejo in towns that didn't even have firemen or buildings. That's why I often turned down projects.

IPV — In a more recent and as yet unrealised plan for the town of Monsaraz, you proposed that cars should no longer drive up to the historic town, except in special cases. Your proposal included building a car park at a lower level, and access to the town would essentially be via a lift, which would comfortably transport people to the upper level. Could you tell us more about this project and how it addresses the challenge of overcoming the topographical difference? What were the main considerations and objectives when developing this proposal, and what impact could it have on the preservation, but also on the experience of the historic village?

JLCG — Athens is a predominantly flat city, but the Acropolis, situated on a high point, dominates the city and is a natural and cultural wonder. Monsaraz is like that too. It is situated on a topographically high point, where the topography itself protects the inhabitants, almost dispensing with walls. What's really sad is seeing Monsaraz full of cars, especially during

events like the annual giant nativity scene and the castle being used for rave parties that leave the place full of rubbish. There are a lot of unnecessary activities that take place there and, with so few inhabitants, it becomes a place with little authentic use. When I was developing this plan with Marta Sequeira, we thought about drilling a small hole to reach the height of the historic centre. The mayor asked us to organise parking in an area that could be wooded and not too intrusive. The idea was that people would park their cars and use a lift to go up to the highest level, although walking was always possible. The sight of a town full of cars is quite unpleasant. We imagined that the entrance would be like a cave carved out of the rock, where the lift would emerge, and on reaching the top, it would offer an incredible view of the Alqueva, which creates a particular microclimate with its mist and vast expanse of water interspersed with the pre-existing relief. I don't know if this project will ever become a reality. However, I believe it could significantly improve the experience of visiting and living in Monsaraz, while preserving its beauty and uniqueness.

IPV — Finally, it is remarkable to note the importance and role that the territory plays in his projects. However, as we've seen here — in cases such as the Pedestrian Bridge over the Ribeira da Carpinteira or the Monsaraz Safeguarding Plan — you also sometimes try to "overcome" the territory, or the conditions dictated by its topography. How do you see these projects in the context of your work and in the context of what is explained in "Metamorphosis"?

JLCG — These projects reflect an approach that, although deeply rooted in analysing the territory, does not limit itself to passively accepting its conditions. They explore the possibilities offered by the topography, adapting to it or transforming it according to the needs and objectives of each intervention. Observing the topography doesn't mean agreeing with it. In fact, it can mean the exact opposite: we can intervene by using it or going against it, always with the aim of finding solutions that improve the functionality and experience of the spaces.

Part II

Manifest

A capital city is the central hub of the country where governmental institutions, cultural landmarks, and other economic activities are generally located. Every big city have different challenges to face because there are so many parameters involved in it.

The urbanistic plan of Athens, capital of Greece, reflects a long old and new history. Over the years, Athens has been affected by various transformations that shaped its urban development and planning. The city was designed around the Acropolis, a front-facing hill on which key temples and buildings for civic uses were constructed. The gridlike pattern of streets and public space acted to express a city committed to democracy and civic life. Nevertheless, during its evolution, its urbanistic plan has been a dynamic, responsive framework — striking a balance between the preservation of its historical identity and the demands of a modern metropolis. The ongoing commitment to sustainable and inclusive urban development shows a forward-looking attitude that respects its rich past while embracing challenges and opportunities of the future.

Istanbul — a city that strides over two continents, with a history of thousands of years — has a complex urbanistic plan reflecting the multifaceted cultural inheritance and rapid modernization. It has been enriched by many different civilisations in the urban structure of the city and mixed architectural styles and models of urban planning. The historic core — labyrinthine streets, historic buildings, vibrant markets — embodies the wealth of a city's past. This section reflects Byzantine and Ottoman models of urban planning that orientate on central squares, grand avenues, and monumental buildings. The Istanbul Masterplan Project targets transport infrastructure, green spaces, and sustainable urban living. In this setting, the careful balance between modernization and preservation of heritage would be at the root of an urbanistic plan.

Berlin, Germany's capital, has a unique urbanistic plan vastly influenced by its history. The city's layout harmoniously fuses historical landmarks with contemporary architecture and a commitment to sustainability. Before World War II, Berlin's urban plan showed wide boulevards at the front of large squares, with historic neighbourhoods. After reunification,

Berlin went for a modern and sustainable urban planning strategy that would ensure green spaces, pedestrian-friendly areas, and good public transport. Berlin's urbanistic plan is resilient, and embodies renewal. How the city blended its rich history with modernity, embraced sustainability practices, and fostered cultural diversity, makes it a vivid European capital with its strong urban identity.

It is epitomised by Lisbon, the capital city of Portugal, which has a long history, a varied culture, and an economic dynamism. However, as it has happened in lots of other capital cities, Lisbon suffers from disconnection among its neighbourhoods. Lisbon is characterised by narrow, winding streets and hills, making difficult the construction and maintenance of transport infraestructure. Setting up effective transportation links between the various neighbourhoods is hampered by difficult topography. This feature has given unequal accessibility, where some areas are linkable and others are left marginalised. The historical aspects in Lisbon interferes with modernity by making it difficult to construct infrastructure that resonates with the original built infrastructures. It is hard to carry out intense road expansion or implement new transportation methods by virtue of the need to conserve old architecture. The challenge to connectivity lies in the delicate balance between the preservation of the city's heritage and meeting all demands of contemporary urban life. Public transport in Lisbon, nevertheless, has capacity, reliability, and coverage issues. Indeed, the current public transit network might not cover all neighbourhoods, some of which are served poorly, leaving very few alternatives to commuting. This lack of full coverage is only adding to traffic congestion since the residents become dependent on using private cars. In addition, it needs some integrated transportation planning so that various modes of transport interlink. Although Lisbon possesses buses, trams, and a metro system, most of these modes run independently, which results in disjoint routes.

A better connected and integrated transport system would improve the overall experience in terms of mobility for residents and visitors alike.

Contrasting these challenges, city planners and policymakers of Lisbon have been looking for innovative solutions to deal with this problem. This has involved investment in sustainable and smart transportation technologies, improving existing public transit networks, and mixed-use development that reduces the need for extensive commutes.

Connectivity challenges in Lisbon's neighbourhoods are deeply rooted in a combination of historical, geographical, and infrastructural factors. This requires an integrated approach with consideration to the peculiarities of the city and embracing innovative solutions toward a more connected and accessible urban environment. In other words, the city of Lisbon is ailing from a disease: an antibiotic is needed. This means connectivity, (un)connectivity.

The basic starting point for this theoretical approach lies in understanding how connections take place between all species and how one can get inspiration from the solutions that a rhizome system has to offer.

The key to a good and functioning nature is the mycelium — like a network of hyphae, which is the underground part of the fruiting body of the mushroom. One can picture them like the roots of the mushroom. This fascinating underground matrix is the vegetative part of fungi and serves as an organism's feeding and nutrient-absorbing system as well as a unique way to allow communication between several species around it. This property is very important to fungi, plants, and trees when establishing mycorrhizal associations with the plant roots. In this symbiosis, the mycelium will extend to coat the plant roots, whereby exchange of nutrients will be facilitated. The plant supplies the mycelium with photosynthetic sugars, while mycelium enhances access of the plant and the trees to water and minerals for a win-win association that ensures health in the ecosystem. Under the right conditions, mycelium will rapidly grow outwards and increase bonding strength. This adaptability will optimise nutrient intake and adjust to the ever-changing conditions. Thus, realising the mycelium is not static underground, but actually a truly dynamic, responsive network, it will feel out changes in its environment, whether it be new nutrients or potential threats to the soil.[21]

One of the biggest examples is the research conducted by Japanese researchers regarding how to design the most optimised urban transportation network in the world. In Tokyo, a group of researchers used slime mould — a single-celled organism that has no nervous system but solves connectivity problems efficiently — to develop a system which predicts how transportation should be configured. Every central point of the city was represented by nutrients for the blob in a rounded shape petri dish. The experiments concluded that this biologically inspired system would prevail over conventional transit engineering strategy groups since Tokyo is believed to be one of the most congested urban areas in the whole

[21] See on this subject, BEBBER, Dan, BODDY Lynne, FRICKER Mark — "Ecology of Saprotrophic Basidiomycetes". *In British Mycological Society Symposia Series*, volume XXVIII, Cambridge, Elsevier (2008), pp.3-372.

world. This can only explain the extent of cellular intelligence and how it can be further used to harness tough problems.[22]

Another application is related to Frei Otto's experiment with soap bubbles. He did develop, to a large extent, his floating roof shapes through playing with models of wires, dipping them in lye — knowing that the soap membrane would span the in between gaps and always take the form which minimises the surface area.

Such an idea, having something to do with parametric minimal paths, may also be considered as a solution to improve the connections of various points within a metropolis. Indeed, the very moment two or a number of soap bubbles touch, they immediately find the shortest way to connect two points.

As Frei Otto had already understood, the immediate reaction for the bubbles is to fill in the gap with a minimum surface required. With this method, we wouldn't need any sort of calculation and would have a better result than expected in most of the cases.[23]

Following nature, observing it and finding out the natural antibiotics are needed for the unconnected cities nowadays. Imagining all the networks of the metropolis as a rhizome system connecting all of the neighbourhoods without any kind of socio-economic hierarchy, enhancing living together, is the ultimate statement of the manifest.

It wants to reconnect humans with nature and provide new values to cities at a time where architecture seems to separate more than ever everybody and everything.

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[22] See on this subject, TERO, Atsushi et al. — "Rules for Biologically Inspired Adaptive Network Design". *In Science*, nr. 5964, Vol. 327, Washington, AAAS (2010), pp. 439-442.
[23] See on this subject, VRACHLIOTIS, Georg — Frei Otto, Thinking by Modeling. Leipzig: Spector Books, 2016.

Part III

3.1 Evolution of Alcântara Valley

The Alcântara Valley in Lisbon has a rich and varied history, reflecting the broader historical shifts experienced by the city and Portugal. Its roots date back to the Roman era when the valley served as a natural route connecting Lisbon to the interior regions via the Alcântara stream.[24] [figg. 32, 33 and 34]

By the XIXth century, the presence of water in Alcântara was essential for accessibility and as a source of energy for industrialisation, not being seen as an obstacle to urban growth anymore. The stream became a source of power for factories, and Alcântara began to lose its character as a distant suburb and emerged as an essential part of the city's expanding boundaries. At the start of the XIXth century, the liberal economic policies promoted industrial development over agriculture, driving economic and population growth in Lisbon's industrial areas. This shift towards a new economic model led to significant social disparities, and industrialisation began to reshape the character of Alcântara. This period saw the creation of an urban network structured around industrial activities, which heavily relied on strong connections between the city centre and its peripheries.[25]

Several key infrastructure projects were undertaken during this century to support this growth, including the construction of the Circunvalação Road in 1852 and the development of two railway stations, Alcântara-Mar and Alcântara-Terra. These changes stimulated the development of Alcântara and transformed the urban landscape of this area. The filling of the basin and the channelling of the Alcântara stream downstream of the bridge were necessary to accommodate the new railway lines. The construction of the Alcântara-Terra train station, built over the stream, symbolised a revolution in accessibility within this industrial neighbourhood. In the XXth century, the construction of major avenues, such as Avenida de Ceuta, further positioned Alcântara as a transportation corridor, facilitating the movement of people and goods throughout the city. This period saw the consolidation of industrial and port activities, establishing the area as a significant industrial hub.[26] [figg. 34, 35 and 36]

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[24] See, on this subject, ALBUQUERQUE, Leonor Cheis de Sousa — *Estudo da Paisagem do Vale de Alcântara.* Évora, 2014. Master degree thesis in landscape architecture presented in University of Évora.
[25] *Ibid.*
[26] *Ibid.*

In the XIXth century, Alcântara transitioned from being on the city's outskirts to becoming a key infrastructure hub and gateway to Lisbon. Landfills were developed to support the construction of major avenues, railways, and the Port of Lisbon, alongside rapid industrial growth, which significantly transformed the valley from its previously pastoral and verdant landscape of the XVIIIth century.

The most profound changes occurred in the 1960s with the construction of the bridge over the Tagus River, now known as the 25 de Abril Bridge. This bridge, which spans 2.277 kilometres and connects Lisbon to Almada, directly disrupted the area, increased transport infrastructure, and led to the demolition of parts of the Jacinto neighbourhood, distancing the Alvito neighbourhood from Alcântara. While the bridge played a crucial role in unifying the Lisbon metropolitan area by connecting both banks, it also caused significant fragmentation within Alcântara and negatively impacted the quality of life for its residents. Avenida de Ceuta evolved into a major access road to the bridge, further intensifying the division between the two sloops of the valley.[27] [fig. 37]

These extensive infrastructure projects created boundary lines and fragmented urban spaces, further highlighting the existing discontinuities in the area. The addition of a train passage on the 25 de Abril Bridge reinforced the Alcântara Valley's role as an infrastructure corridor and a complex traffic node. As industries began relocating to the outskirts of the city in the later half of the XXth century, large urban areas within Alcântara became obsolete. Despite being equipped with infrastructure from its industrial past, these areas were left vacant, occupying prime locations for potential re-use.

The migration of industries, coupled with the expansion of the city towards peripheries, further isolated Alcântara, which was never originally intended to be a central location. The combination of this industrial decline and the valley's steep topography has left Alcântara as a disconnected area, both within itself and in relation to the rest of Lisbon, serving as a barrier rather than a link between the city's outer and central areas.[28]

[27] *Ibid.*
[28] *Ibid.*

3.2 Project, Alcântara as a case study

The hypothesis of this thesis comprises a linear transport element — a tram line, “elétrico” — that connects various points along the Alcântara Valley, extending up to the Monsanto Natural Park. This new linear transport element addresses a significant gap in Lisbon's transport network. It directly connects to the termini of two existing tram routes (25E and 28E) and, as its westernmost point, links with four more planned public transport lines. Vertically, this proposed tram extension integrates itself with the new metro station while also enhancing connectivity to the existing railway. Overall, the project is conceived as a growing element that strengthens the existing public transport system by daring to traverse initially neglected areas. [figg.38 and 39]

The starting point of this new branch of the transport network begins at the termini of two existing tram routes (the 25E and the 28E) located in the Jardim dos Prazeres, near the Prazeres Cemetery. This new square is redesigned to accommodate the tram line, creating a continuous loop around it. From there, the tram follows the Rua dos Prazeres until Meia Laranja, where it diverges from the road and enters into a wide green space, intersected by several pedestrian paths.

The tram route is designed to run parallel to a new student residential building, which serves as a stop for the tram, allowing passengers to embark and disembark. This building follows the curvature of Rua Maria Pia and is intended to embody values of connectivity, equality, and communication between human people and nature. It is strategically positioned within a green area with a 30-metre height difference between its lowest and highest points. The terrain is located within a social housing neighbourhood, currently segregated from the rest of the city and facing significant socio-economic issues. Most of the site consists of trees and vegetation, and it houses a water reservoir connected to the existing drainage system under Avenida de Ceuta and Alcântara-Terra. The two lower floors are dedicated to student accommodation, with shared spaces accessible to the surrounding community. The central space of the building is fully dedicated to the tram stop, serving as a public area for residents of both Campo de Ourique and Alcântara-Terra. The top floor is designed as a viewpoint, aligning with the crest line height of Rua Maria Pia, providing a new communal space that the neighbourhood currently lacks. [fig.40]

The primary material used for the building is MBC (Mycelium Based Composite), which is produced both off-site and on-site. The goal is allow the growth to occur on-site, enabling the blocks that make up the walls and structural elements to interconnect naturally. The same process applies to the retaining wall, which is in direct contact with the soil, allowing the mycelium to grow into it and integrate the building and terrain into a single, cohesive element. [figg.41 and 42]

Continuing along the inclined topography, the tram line stops at a third point on the oriental side of Avenida de Ceuta, the lowest point in the valley. From there, the structure elevates off the ground, transforming into a bridge that crosses the avenue to a stop connected to a park at the same height as Avenida de Ceuta. This point aligns with the planned extension of the metro, which includes a new station in the southern part of the park, providing a new path to connect to the nearby railway halt. [figg.43 and 44]

From this central point, the tram line continues through a borehole into the hilly terrain, achieving an incline of 18%. It emerges from the landscape to follow a secondary road, turning towards the Alvito neighbourhood and continuing to the university campus in the middle of Monsanto. From there, similar to its starting point in Campo de Ourique, the tram line follows existing roads, completing a linear connection between all the points mentioned and returning to its initial starting point at the Jardim dos Prazeres.

The central premise is that the solution to linking different areas effectively can be inspired by a natural model — the slime mould, also known as "Blob." This organism develops by creating a network of branches that find the shortest paths between nutrients. Practically, it involves growing slime mould on a map of Lisbon to observe the pathways it naturally creates. Points that need to be connected are represented by nutrients that favour the growth of the slime mould. As the organism spreads, it forms a network and identifies the most efficient routes through the urban plan. This vertical transportation strategy, inspired by nature, is scalable and versatile, extending beyond Lisbon's central areas. And it demonstrates the potential to provide solutions not only for central neighbourhoods in Lisbon but also for other cities with similar topographies.

Irradiation of a system

Most of Lisbon's history is reflected in its urban development, even when certain plans appear less cohesive in their entirety. The city's unique character is not primarily defined by its buildings but by the interplay and interaction of those structures with its topography and territory. Each area of Lisbon possesses a distinct urban identity that challenges the configuration of a cohesive network of relations, resulting in a complex "patchwork blanket" ("manta de retalhos").[29]

The uncontrolled construction of large tertiary and administrative buildings, mainly concentrated along the central axis and major roads, contributes to several urban problems. This unplanned development exacerbates traffic congestion, erodes the city's unique character, and creates a visually inconsistent and disjointed urban landscape. Simultaneously, residential neighbourhoods are shrinking as residents migrate to the suburbs or relocate outside the city, adding pressure to urban infrastructure and leading to urban sprawl.

Nuno Teotónio Pereira, reflecting on the urban growth of the city of Covilhã, stated, "The bitter truth is that the city has grown in such a way as to destroy its internal cohesion, disfigure its image, and demean its surroundings".[30] This observation is also applicable to Lisbon, where urban planning instruments — focused on zoning, density indices, and subdivisions — have often neglected the specificities of the landscape, topography, and local identity.

These challenges underscore the urgent need for sustainable urban development, particularly reducing private car use in favour of more sustainable modes of transportation. A key strategy to enhance the availability and attractiveness of public transport, particularly in densely populated urban centres. In recent years, Lisbon has seen a concerning trend towards increased reliance on private cars, coupled with a decline in public transport usage. This trend is further compounded by the growing dispersion of facilities, which extends daily travel distances and directions, making public transport less convenient.

To counter this shift, proactive public policies are essential. Recent initiatives, such as the introduction of a new integrated public transport system, represent a significant step towards promoting sustainable mobility. However, pedestrian traffic, which thrives under favourable conditions in small or medium-sized urban areas or central parts of Lisbon, has often been overlooked. In the early XXth century, walking was the predominant mode of travel in Lisbon, but with the rapid expansion, increased distances, and the allure of private vehicles, newer generations have gravitated towards individual transport.

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[29] ASSOCIAÇÃO DOS ARQUITECTOS PORTUGUESES — *Secção Regional do Sul — Guia Urbanístico e Arquitectónico de Lisboa.* 1.st ed. Lisbon: AAP-SRS, 1987.

[30] PEREIRA Nuno Teotónio — *Uma Ideia para a Cidade da Covilhã.* Covilhã: Caleidoscópio, 2006.

The intervention presented in this thesis seeks to promote an urban morphology that adapts building types to the slopes, preserves scenic views, and fills gaps adjacent to the urban core to create a more cohesive city. The aim is to enhance the value of the river valleys and encourage the use of slow-speed public transportation, such as trams and funiculars, which align more closely with pedestrian movement.

Expanding Lisbon’s vertical transportation systems, including lifts, funiculars, and trams, is the main topic of this dissertation. Given Lisbon's steep terrain, enhancing vertical transportation coverage is crucial to improving mobility across the city. Priority should be given to underserved areas characterised by steep hills and elevated topography, such as Alfama, Graça, and Bairro Alto. These areas are particularly beneficial for walking distances, especially for elderly or disabled individuals.

Additionally, areas with poor connectivity to the existing metro or train stations should be targeted for improved access. Implementing funiculars or vertical lifts in these locations could provide seamless transfers and better integrate them into the broader transport network. [figg.45, 46, 47 and 48]

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