URBAN FORM AND LANDSCAPE OF LISBON

FORMA E PAISAGEM URBANA DE LISBOA

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ABSTRACT

This paper describes the application of the Morpho methodology in the analysis of the urban form and landscape of Lisbon. In addition to the morphological assessment of the Portuguese capital, focused on the main elements of urban form (streets, plots and buildings), this paper offers an appraisal of the so-called Plano Diretor Municipal de Lisboa prepared in 2012 and of the Plano de Urbanização do Alto do Lumiar completed in 1998, bearing in mind the internal coherence of the plan proposals, the role of the plan objectives and the relevance of the plan proposals for the capital of the country.
Keywords: Urban morphology. Urban form. Morpho Methodology. Lisbon.

RESUMO

Este artigo descreve a aplicação da metodologia Morpho na análise da forma e paisagem urbana de Lisboa. Para além de uma avaliação morfológica da capital portuguesa, centrada nos principais elementos de forma urbana (ruas, parcelas e edifícios), desenvolve-se neste artigo uma apreciação do Plano Diretor Municipal de Lisboa de 2012 e do Plano de Urbanização do Alto do Lumiar de 1998, tendo em consideração a coerência interna das suas propostas, o papel dos objetivos e a relevância das propostas do plano para a capital do país.
Palavras-chave: Morfologia urbana. Forma urbana. Metodologia Morpho. Lisboa.

1 MORPHO: A METHODOLOGY TO ANALYSE THE URBAN FORM AND LANDSCAPE

This first section on the *Morpho* methodology starts by presenting a number of general principles framing its conception. The first principle is that *Morpho* should deal exclusively with the physical dimension of cities. Although it acknowledges that social and economic drivers influence the form and structure of cities, it only reflects them indirectly. *Morpho* focuses on the essential and specific contributions that urban morphology can make to contemporary societies. The second principle is that *Morpho*, in common with most morphological approaches, involves a selection of a reduced set of physical elements to describe and explain the city in morphological terms: the streets, the plots and the buildings. This is not novel: other examples can be found in the literature.

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Kropf maintains that the urban tissue is an organic whole whose form can be described at a number of levels of resolution, each concerned with different elements of urban form: streets and blocks, or plot series; plots; buildings; rooms or spaces; structures, such as walls or roofs (including details of construction); and finally, materials. *Space syntax* (HILLIER, 1996; HILLIER; HANSON, 1984) provides a number of concepts and methods to assess one single element of urban form, the street system, using one assessment criterion i.e. accessibility. Place syntax (STAHLE et al., 2006) expands the focus of the syntactical approach on the street system to include the plot system.

The third principle is that *Morpho* should quantitatively assess the morphological basis of a given area, framed by a concept of 'urbanity'. This means that the performance of the urban forms of that area would be expressed by a degree of urbanity as part of a continuous rural-to-urban gradient. The use of a concept of urbanity to frame the assessment of urban form has been used by authors such as Duany (2002) and Marcus (2010), in more operational terms; and also by Lees (2010) and Holanda (2011) in more strategic terms. While sharing some aspects of these proposals, a more specific concept of urbanity is argued for here. Urbanity is both a social and spatial construct. It is something that the built environment delivers through the main elements of urban form – the system of streets, the system of plots, and the system of buildings. In relation to these elements, a high degree of urbanity would generally mean high accessibility, high density, high diversity and high continuity. This concept of urbanity acknowledges two important issues. First, urbanity is something that results from both planned and unplanned contributions. Secondly, it is a continuing construction, like knowledge itself.

Finally, *Morpho* should provide sound bases for integrated research and planning practice. This assessment can be both synchronic and diachronic, monitoring the evolution of urban form over the years – it can focus on present cities and on their past. But, *Morpho* can also focus on the future and assess the morphological impact of potential actions or projects on an urban area.

The application of *Morpho* includes four steps. The first involves the consideration of its suitability for a particular urban area and type of study. Matters to be considered here include the objectives of the assessment process, the criteria and techniques to be employed, and the suitability of the available data, both cartographic and statistical, for a full morphological characterization. This initial step may be slow and sometimes demanding, and may lead to adjustments in the methodology. *Morpho* should be able to assess urban form at different scales – street, neighbourhood and city – allowing the identification of the main strengths and weaknesses of that form and providing guidance on how to mitigate the weaknesses.

The second step corresponds to the measurement of seven assessment criteria: accessibility of street system (similar to the *space syntax* criterion); density of plots;

age of buildings (highlighting the importance of 'time' in the city building process); dimensions of street blocks and plot series (expressing the relation between streets and plots); alignment of buildings (expressing the relation between plots and buildings); ratio of building height to street width; and finally, building use (table 1).

Table 1 Morpho: Criteria, Variables and Sources

Criterion	Variable	Source
C1. Accessibility of streets	Two syntactical measures: • Global integration • Local integration	*Cartography →* *Axial map*
C2. Density of plots	Number of plots per street block	Cartography and statistical information
C3. Age of buildings	Number of buildings built before ... / total number of buildings (per street block)	Cartography and statistical information
C4. Dimensions of street blocks	Dimensions of street blocks	Cartography
C5. Alignment of buildings	Length of the dominant alignment (sum of the lengths of the different facades on the same alignment) / length of the street	Cartography
C6. Ratio of building height to street width	Height of buildings (average between the heights of two sides of the street) / street width	Cartography and statistical information (or *Google Earth*)
C7. Buildings use	Number of buildings with mixed uses / total number of buildings (per street block)	Cartography and statistical information

Table showing the seven criteria of the Morpho methodology, the variables and the sources of information used to measure them. Source: Vítor Oliveira, 2013.

The assessment of each of these criteria involves the production of a number of tables and maps, expressing the different performances and degrees of urbanity in different parts of the city. Graphically, a set of colors ranging from red to dark blue is used. The six criteria, evaluated using Geographic Information Systems/GIS (the first criterion essentially involves analysis of an axial map), usually adopt a type of representation structured into six classes, according to the definition of *natural breaks*. The evaluation of four of these criteria is expressed through an *ordinary kriging*, underlining the most significant territorial differences and diminishing the non-relevant exceptions.

After assessing each criterion, the results are gathered in a matrix, which forms the basis for a kind of *benchmarking* exercise. Each particular result can be then compared with two sets of assessments: a local or context-based set and a general set. The first may provide a citywide background to an assessment at the street level or a regional background to an assessment at the city level. The second set should be a continuing construction, informed by a learning process based on successive applications of the method in a variety of environments and at various scales.

The final step in this procedure is the proposal for the utilization of the results. One important aspect when developing a model or a representation of the city is that no matter how complex or how evidence-based the model is, it will always be just a model of the city and not the city itself. This means that the utilization of *Morpho*, and of the results that it may provide, should always be reflective and critical. Carefully applied, the method can be used by local authority planners, to provide basic information for municipal planning practice and for the guidance of private development.

2 THE CITY OF LISBON

In the second decade of the new millennium, in times of widespread uncertainty (namely economic and financial uncertainty), Lisbon is facing some major challenges. On the one hand, it has to deal with a number of problems already coming from the end of the last century, such as the continuous reduction of the resident population, increasing urban and social imbalances, low levels of mobility and accessibility, the steady and persistent degradation of the built environment, and an inadequate decision-making system. On the other hand, Lisbon has to deal with a number of structural infrastructure projects such as the expansion of the existing airport or the trunk road network at the metropolitan scale. In addition, Lisbon planning authorities are demanded to provide more effective products processes and results both at the municipal and at the local scales.

3 THE APPLICATION OF THE MORPHO METHODOLOGY TO THE CITY OF LISBON

The next paragraphs describe the application of *Morpho* to the city of Lisbon. In addition to the assessment of the city, this section offers an appraisal of the so-called *Plano Diretor Municipal* (PDM) prepared in 2012 and of the *Plano de Urbanização do Alto do Lumiar* (PUAL) completed in 1998, bearing in mind the internal coherence of plan proposals, the role of the plan objectives and the relevance of the plan proposals for the capital of the country.

3.1 TOPOLOGICAL ACCESSIBILITY OF STREETS

The evaluation of the topological accessibility of the streets of Lisbon is based on axial analysis and on the utilization of the *Depthmap* software. After the construction of the axial map of the city, two syntactical measures were analysed: global integration and local integration (tables 2 and 3). In figures 1a and 1b, as in the following figures, the warmer colours, close to red, represent parts of the city with higher values for each of the criteria under analysis. The cooler colors, close to dark blue, represent parts of the city with lower values for each of these criteria.

At the global scale, the syntactical analysis reveals that the most integrated core includes a set of axes ranging from *Rossio* Square to the south (not including the so-called *Baixa Pombalina*), to *Brasil* Avenue to the north (comprising the *Alvalade* neighborhood), and from *Liberdade* and *Almirante Reis* avenues, respectively to the west and east. On the contrary, the most segregated parts of the city (shown in figure 1a in dark blue) are in the west (*Belém, S. Francisco Xavier, Ajuda* and *Alcântara*), in part of the northern area (between *Charneca* and *Lumiar*) and in the east, particularly in the *Chelas* neighborhood.

At the local scale, it appears that in many of the segregated areas that have been previously found in the global analysis, a number of streets emerge with a proximity dynamic that seems to provide a support structure for these territories. *Belém* is an excellent example of this, with its network of radial and circular streets to the south of the *Restelo* Avenue. The most significant exception to this local structuring trend is *Chelas*. In fact, the analysis of this neighborhood, with a municipal zoom or with a local zoom, reveals a strong segregation index and a strong separation in relation to other areas within the city of Lisbon.

Table 2 Topological Accessibility of Streets: Global Integration and Local Integration

	Global Integration [HH]	Local Integration [HH] R3
Average	0,48	1,54
Maximum	0,77	3,87
Minimum	0,25	0,33
Standard deviation	0,10	0,54

Table showing the values (average, maximum and minimum) of global and local integration of Lisbon's street system.
Source: Vítor Oliveira, 2013.

3.2 DENSITY OF PLOTS

This second criterion focuses on the diversity of urban actors that are present in Lisbon, considering this diversity as a 'spatial capital' (MARCUS, 2010) of this territory. In the absence of a plan of the city plots in a digital format, the number

of buildings per block was used as a source of information (information provided by the National Institute of Statistics – 2011). As the number of vacant plots in Lisbon is not too high, it was assumed that this procedure was not far from the existing situation. Yet, we have tried to identify and to correct any incorrect facts using satellite images.

The analysis reveals that it is more difficult, than in the former criterion, to establish a gradual trend (figure 1c). Yet, despite the less expressive pattern, we can find some large 'blue spots', representing blocks with a small number of plots in the western, northern and eastern areas of the city. Interestingly, we can also find a set of 'blue spots' in the historical centre, due to the presence of blocks of a very small size, thus having a maximum limit potential that is not very high.

The areas with higher values (with a larger number of plots) are located in the central area of the city (the area that is 'interior' to the inner ring road, excluding the downtown area) and also in the *Campolide* and *Alcântara* areas. Making a weighting of this data by the area of the blocks, the dominance of relatively low values is maintained.

Table 3 Density of Plots

	Number of plots per street block
Average	15,90
Maximum	136,00
Minimum	1,00
Standard deviation	14,57

Table showing the number (average, maximum and minimum) of plots per block in the city of Lisbon.
Source: Vítor Oliveira, 2013.

3.3 AGE OF BUILDINGS

The third criterion is the age of the buildings. This criterion was assessed using information from the National Institute of Statistics, which is then imported to and worked on (disaggregated at the level of statistical subsection) a GIS environment. As in previous applications of *Morpho*, the year 1945 was established as the border between two time periods.

An analysis of the map corresponding to this criterion, included in figure 2a and table 4, reveals the existence of a dual city. In fact, the figure clearly separates the area of the historical centre, the downtown area and the riverfront, marked by the strong presence of built heritage from the surrounding area, where more recent buildings seem to be dominant.

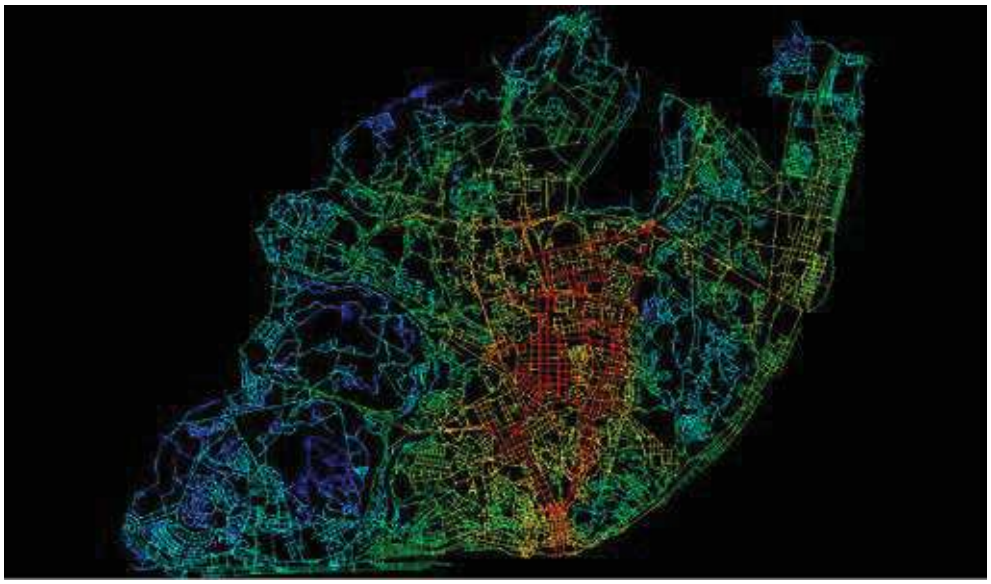

Figure 1a Global integration of streets.
Map showing the global integration of Lisbon's streets system. The warmer colours, closer to red, represent parts of the city with higher values of global integration. The cooler colours, towards dark blue, represent parts of the city with lower values.
Source: João Pinelo Silva e Teresa Heitor, 2013.

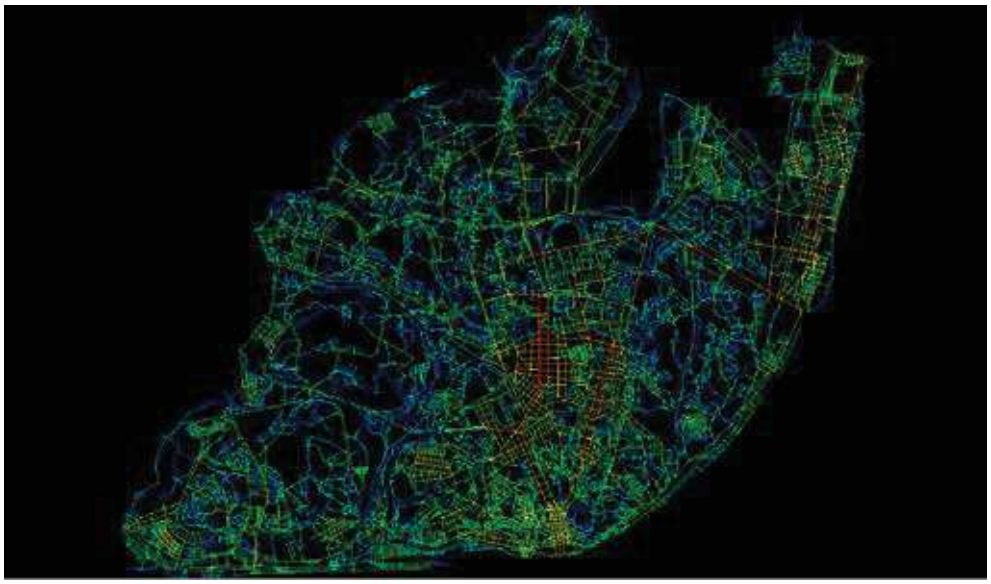

Figure 1b Local integration of the streets.
Map showing the local integration of Lisbon's streets system. The warmer colours, closer to red, represent parts of the city with higher values of local integration. The cooler colours, towards dark blue, represent parts of the city with lower values.
Source: João Pinelo Silva e Teresa Heitor, 2013.

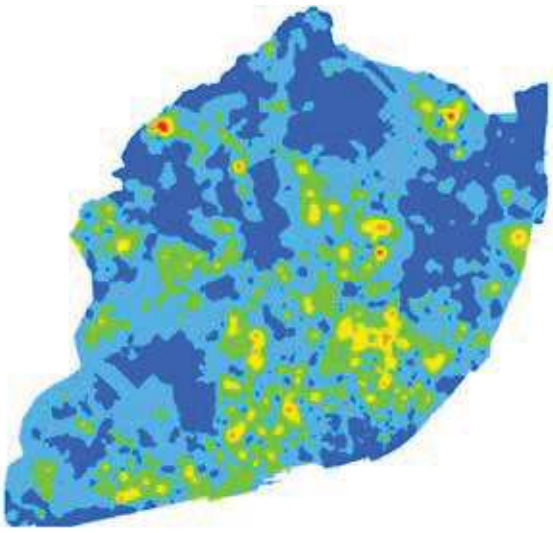

Figure 1c Density of plots.
Map showing the density of plots per block in Lisbon. The warmer colours, closer to red, represent parts of the city with higher values of density of plots. The cooler colours, towards dark blue, represent parts of the city with lower values.
Source: João Pinelo Silva e Teresa Heitor, 2013.

The only relevant exception seems to be the *Encarnação* neighborhood. Although the values considered for *Encarnação* and for the surrounding areas are correct, we feel in the produced map a certain maladjustment to the Lisbon reality, which leads us to consider the need to adjust the measurement of this criterion in future applications of *Morpho*. Despite this consideration, the exclusion of this criterion was not considered.

Table 4 Age of Buildings

	Index of buildings erected before 1945 per street block
Average	0,28
Maximum	1,00
Minimum	0,00
Standard deviation	0,38

Table showing the index of buildings (average, maximum and minimum values) erected before 1945 per block in Lisbon.
Source: National Institute of Statistics, 2013.

3.4 DIMENSIONS OF STREET BLOCKS

The measurement of the blocks size draws on a set of cartographic elements on the blocks plan, defined by the boundary between public space and private space.

In addition to the 'built blocks', gardens, squares, and other outdoor spaces were considered. In this case, the variable under analysis was the area of the blocks, expressed in m^2. Natural breaks with six classes and ordinary kriging were the main options in terms of representation (figure 2b and table 5).

Similarly to the findings in the measurement of criterion 2, this appraisal reveals a relatively heterogeneous situation, where in addition to the progressive increase in the size of the blocks as we move away from the historical centre, it is difficult to identify distinctive trends in higher detail. It should also be noted that the average size of the blocks in Lisbon (relatively low) is very close to the average size of the blocks in the second Portuguese city, Porto.

Table 5 Dimensions of Street Blocks

	Dimensions of street blocks (m^2)
Average	21.851,00
Maximum	3.750.123,00
Minimum	4
Standard deviation	77.964,00

Table showing the dimensions of street blocks (average, maximum and minimum values) in the city of Lisbon.
Source: Vítor Oliveira, 2013.

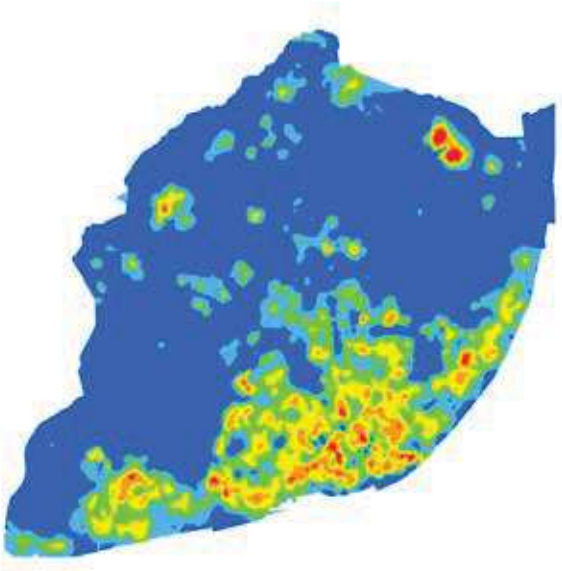

Figure 2a Age of buildings. Map showing the age of the buildings in Lisbon. The warmer colours, closer to red, represent the parts of the city with the higher number of buidings erected before 1945. The cooler colours, towards dark blue, represent the parts of the city with a lower number of buildings erected before 1945.
Source: Vítor Oliveira, 2013.

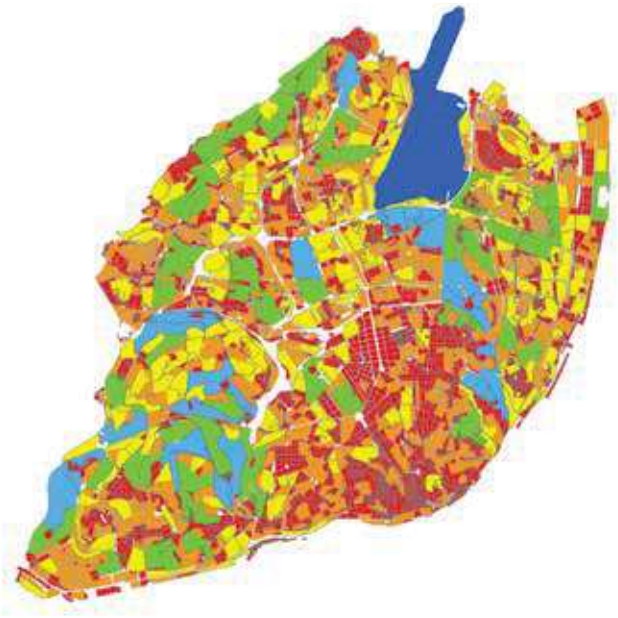

Figure 2b Dimensions of the street blocks. Map showing the dimensions of the street blocks in Lisbon. The warmer colours, closer to red, represent the parts of the city with smaller dimension blocks. The Cooler colours, towards dark blue, represent the parts of the city with bigger dimension blocks.
Source: Vítor Oliveira, 2013.

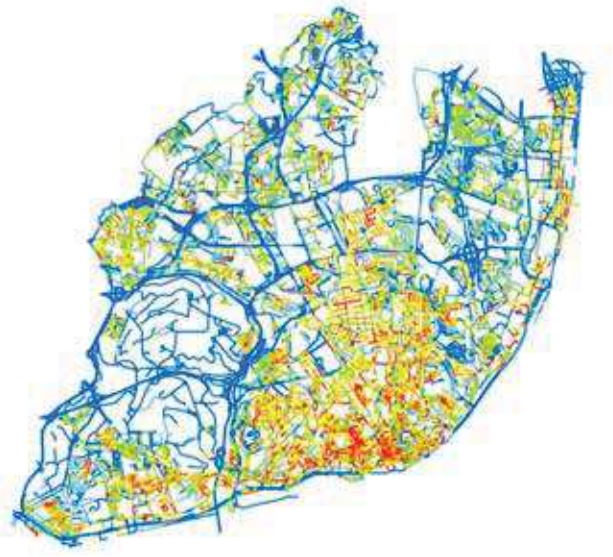

Figure 2c Alignment of buildings. Map showing the continuity of alignment of the building façades along the street in the city of Lisbon. The warmer colours, closer to red, represent the parts of the city with higher continuity of alignment. The cooler colours, towards dark blue, represent the parts of the city with lower continuity of alignment. Source:
Vítor Oliveira, 2013.

3.5 ALIGNMENT OF BUILDINGS

The fifth criterion focuses on the alignment of buildings along the streets. The first stage of this process, supported by GIS, is the calculation of the distance of each building façade to the respective street centre line. Once obtained this collection of distances, their 'mode' is calculated in order to obtain the dominant alignment. Finally, the percentage of repetition of this value with respect to the total of buildings is calculated to understand its significance in relation to the whole. This procedure is carried out for both sides of each street; for each street, the highest value is adopted. A map expressing the percentage of repetition is produced. The form of representation of this criterion (figure 2c and table 6) is associated to the streets, and ranges between six different classes (natural breaks).

The map prepared for the city of Lisbon shows an increasing difficulty in detecting dominant territorial trends. Nevertheless, we can see that the higher values (higher percentage of repetition) occur in the city centre, beginning to decline in the peripheral areas. The lower values are located near the most important street of the city – including the outer ring road, the *Eixo Norte-Sul*, the *Alameda Linhas de Torres*, and the *Av. João XXI*, Calouste Gulbenkian and *Marechal Craveiro Lopes* avenues. In Lisbon the average value for this criterion is not very high, corresponding to a certain dispersion of the building system and to a lesser cohesion in terms of spatial continuity of the territory.

Table 6 Alignment of Buildings

	Alignment of buildings index
Average	0,39
Maximum	1,00
Minimum	0,00
Standard deviation	0,33

Table showing the index (average, maximum and minimum values) of building aligment in the city of Lisbon. Source: Vítor Oliveira, 2013.

3.6 RATIO OF BUILDING HEIGHT TO STREET WIDTH

Criterion 6 evaluates the relationship between the building height and the street width. Its application to Lisbon was supported by the use of GIS, involving the use of vectorial information on the street system, the building system and the statistical subsections. The analysis draws on data on the building height for each subsection of the city.

The generated map shows a relationship between the building height and the street width that assumes higher values in the central area of the city (downtown) and some other areas such as *Lumiar*, *Benfica* and *Belém*. In general, this index is fairly high, the average value being close to 1 (one). The smaller nuclei where this relationship is stronger are the neighborhoods of *Encarnação*, *Santa Catarina* and *Castelo,* and far from the center, the neighborhoods of *Santa Maria dos Olivais* and *São João de Brito*.

In the opposite situation, there are some areas whose values reflect a weaker relationship between the building height and the street width: the surrounding area of *Monsanto*, the surrounding area of the airport and the marginal strip along the river.

Table 7 Ratio of Building Height to Street Width

	Ratio of building height to street width
Average	0,88
Maximum	0,88
Minimum	0,00
Standard deviation	0,81

Table showing the ratio between building height and street width in the city of Lisbon.
Source: National Institute of Statistics, 2013.

3.7 BUILDING USE

As in the case with criteria 2 and 3, the criterion 7 (focusing on the building use) is based on the statistical subsection as the spatial scale (figure 3b e table 8). Based on this information, an index was built to offer an idea of the mixture of uses in this territory. This index is based on the relation between the sum of 'mainly residential buildings' and 'mainly non-residential buildings' and the total number of buildings. The map represents the index of mixture of uses in Lisbon according to six natural breaks.

Lisbon has a considerable percentage of monofunctional areas ('exclusively residential' or 'exclusively non-residential'), as it is shown by the average rate (slightly more than 20%). In areas of a greater diversity of uses there is not a strong continuity but a distribution of monofunctional areas interspersed with mixed use nuclei (except in the most central area). These areas correspond to the subsections 'within' the railway line linking *Entrecampos* and *Sete Rios*, with a greater mix of uses. In the opposite situation are the areas in the southwest quadrant, in the northeast and in the south, with a strong monofunctional character (residential character).

Figure 3a Ratio between building height and street width. Map showing the ratio between building height and street width in the city of Lisbon. The warmer colours, closer to red, represent the parts of the city with a more vertical profile (closed). The cooler colours, towards dark blue, represent the parts of the city with a more horizontal profile (open).
Source: Vítor Oliveira, 2013.

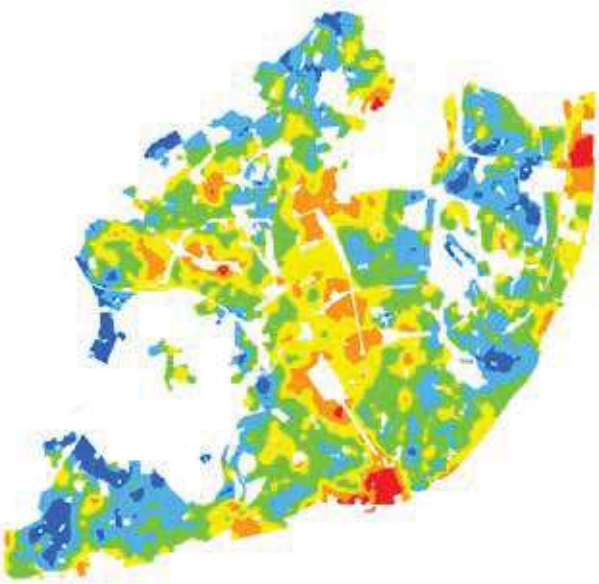

Figure 3b Building use. Map showing the ratio of building uses mix in the city of Lisbon. The warmer colours, closer to red, represent the predominamce on non-residential use. The cooler colours, towards dark blue, represent the predominance of residential use. The intermediate colours represent a higher mix of uses.
Source: Vítor Oliveira, 2013.

Table 8 Building Use

	Number of buildings with residential use / total number of buildings
Average	0,22
Maximum	1,00
Minimum	0,00
Standard deviation	0,31

Table showing the relation between the number of residential buildings and the total number of buildings for each part of the city of Lisbon.
Source: National Institute of Statistics, 2013.

3.8 SYNTHESIS

The application of *Morpho* to Lisbon revealed a number of key aspects of its morphological basis. In general, it can be said that this morphological basis is characterized by a certain balance. The most significant exception against this positive assessment is the city street system. In fact, global and local integration values (especially the first) for the city of Lisbon are below the European city average. (HILLIER, 2002). The other more fragile aspect evidenced by this morphological analysis is the age of buildings. In the case of Lisbon, it determines a dual city.

In terms of the different parts composing the municipality, the main weaknesses can be found in five different territories (figures 4a and 4b): i) *Chelas*, with a clearly segregated street system, with no strong connection to the city street system and with no ability for local structuring given the closed nature of each of the parts that make up this Lisbon neighbourhood; ii) *Lumiar*, with a street system that also cannot participate in the city street system, but, unlike the previous territory, it has a local structuring capacity; iii) *Carnide*, with a very diverse set of street systems, without a unifying element; iv) *S. Domingos de Benfica*, with a high concentration of mono-functional areas, marked by the presence of major highways; and, finally, v) *Olivais*, mainly a residential area, with a very weak relationship between streets and buildings. On the contrary, the parts of the municipality with a more solid morphological basis, and therefore with a higher degree of urbanity, are generally in the historical centre and around *Avenidas Novas* and *Avenida Almirante Reis*.

4 THE APPLICATION TO THE LISBON PDM OF 2012

The application of *Morpho* to the Lisbon plan had assumed (and this was reinforced by a performance-based approach to planning) that goals and objectives must have an increasingly central role within the plan and that the different parts

Figure 4a Chelas, Lumiar, Carnide.
Satellite images showing some parts of the municipal territory that present a higher level of fragility in relation to the urban form.
Source: Google Earth.

Figura 4b São Domingos de Benfica, Campolide, Olivais.
Satellite images showing some parts of the municipal territory that present a higher level of fragility in relation to the urban form.
Source: Google Earth, 2013

composing the plan must contribute to the achievement of these goals. We tried to understand how *Morpho* could contribute to the achievement of one or more goals.

The most obvious contribution of *Morpho* is on the implementation of Objective 2 – to promote urban rehabilitation and regeneration. According to the plan, the pursuit of this goal involves extending the concept of historical area to the whole consolidated city, as a way of defense and enhancement of its historical, cultural and landscape heritage. The performance-based approach to planning also claims that it should be possible to measure, throughout the plan implementation, the degree of achievement of objectives (or of deviation from these objectives, for the consideration of possible changes).

In this sense, it was assumed that the promotion of urban rehabilitation and regeneration in the Portuguese capital would involve the reinforcement of the morphological basis of the city. It was also assumed that the progressive achievement of this objective could be measured by comparing the values obtained in the morphological analysis of the city and the values obtained in the morphological analysis of each planning proposal (plan or project). Taking the five areas with a higher urbanity deficit that were previously identified, the Lumiar area was selected to test this approach, evaluating the impact of the planning proposals for this area on the city taken as a whole (figure 5a).

An analysis of the proposals of the plan for Lumiar revealed that, given the nature and level of detail of these proposals, it was only possible to evaluate two of the seven morphological criteria of *Morpho*: the accessibility of streets and the dimensions of street blocks. The plan proposes five new streets for Lumiar (figure 5b). The evaluation of plan proposals, in relation to the accessibility of streets, involved the redesign of the axial map of the city considering these five streets. The calculation of global and local integration revealed that, in both cases, the implementation of the new plan proposals would result in an increase of the average integration of the city – of 0.20% in the first case and of 0.19% in the case of local integration. Although these values seem relatively low, what we are analyzing is the impact on the city average – in a real situation, what would be important to analyse, by the end of the ten-year plan, would be the impact of all interventions produced over that period of time.

The construction of these five streets introduces changes to eight blocks. The comparison of the existing and the new blocks suggests that the contribution of the action to the city average is a reduction of 0.6% in the dimension of the average Lisbon block.

Figure 5a Lumiar area: current situation.
Satellite image showing the current situation in a part of the municipal territory presenting higher fragility in relation to the urban form, the Lumiar area.
Source: Google Earth, 2013.

It can be said that, in general, the land use proposals included in the plan for this area of the city would increase the quality of the morphological basis of the city and would contribute to the achievement of Objective 2 – the promotion of urban rehabilitation and regeneration.

Figure 5b Lumiar area: PDM proposal.
Map showing the proposals of the Municipal Master Plan for the Lumiar area. Source: PDM Lisboa, 2013.

5 APPLICATION TO THE PLANO DE PORMENOR DA MALHA 14 OF THE PLANO DE URBANIZAÇÃO DO ALTO DO LUMIAR

In the following paragraphs we describe the application of *Morpho* to a case of higher detail, within Lumiar, allowing an analysis of the other five criteria that are included in this technique of morphological analysis. The selected case was a detailed plan, the so-called *Plano de Pormenor da Malha 14* (PP-M14) of the *Plano de Urbanização do Alto do Lumiar* (PUAL), promoted by the *Sociedade Gestora da Alta de Lisboa* and designed by Carlos Guimarães and Luís Soares Carneiro (figure 6).

The assessment of the first criterion of *Morpho* is not changed by the plan proposals as it does not propose the design of new streets, but only the redesign of existing streets. In relation to the density of plots, the plan proposals lead to the definition of five new plots, which has a very small impact on the city average. Yet, it has an impact that is measurable and that is positive. In relation to the age of buildings, the third criterion of *Morpho*, we are facing a new intervention with the construction of five new buildings, which means a residual decrease of the index.

As in the case of criterion 1, criterion 4 does not record any change, because there is no construction of new streets. In relation to the alignment of buildings, the plan provides an alignment in the west side of the street that is higher than the preexisting alignment in the east side: it grows from a dominant alignment of 50% to a dominant alignment of 61%. In the relationship between height of buildings and width of the street: the construction of these five buildings (ranging from 10 to 14 storeys) will be expressed by a sounder definition of a 'canyon' street. In terms of numbers, and looking not to the impact on the city but on a reduced part of the territory, this ratio has a substantial increase, from 0.2 to 0.64. Finally, in terms of building use, the proposal of these five new buildings (three of these offer a functional mixture and the other two offer a residential function) in a street block that previously had no building has a positive impact.

To conclude, we can say that the implementation of the plan in Lumiar contributes to enhancing the quality of the morphological basis of the city (a positive impact on four of the seven criteria) and as such to the achievement of the Lisbon plan.

Figure 6 Detailed plan of Malha 14.
Source: Plano de Pormenor da Malha 14, 2013.

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