

# Assessing the influence of public transport in public green space evolution in Porto and Matosinhos region since the 19th century

Laura Costa; Frederico Meireles and Luís Loures

**Abstract** - Public transportation and mobility typologies are conditioners of the urban space design and consequently of the general urban green structure. Since the 19<sup>th</sup> century green structure and urban space in Porto and Matosinhos have been undergoing profound changes, largely as a result of the mobility typologies implemented in these regions. It is largely acknowledged that public rail transport contributed to promote the emergence and preservation of gardens, parks, squares and *allées* enabling the development of green corridors/greenways along the rail infrastructure. The study of the evolution of green public spaces in two municipalities - Porto and Matosinhos - allowed to relate the implementation of the railroad transport with the appearance and preservation of different green spaces. Three different periods are identified in this study: 19th century – the arrival of public rail transport; 20th century – rethinking public rail transport; and 21st century – back to public rail transport. The study area focuses on municipalities of north of Portugal where the harbor, the airport, and other significant infrastructures and industries is located, and area densely populated 237.591 (Porto) and 175.478 (Matosinhos), respectively [1].

**Keywords**— Green public spaces; Public transport; Tree planting; Urban growth

## I. INTRODUCTION

In Portugal the implementation of rails structure and the public transport systems associated with them have had a strong reflection in the expansion of green spaces and buildings and, consequently, in landscape transformations since the nineteenth century. The boundaries between municipalities are diluted, as the boundaries between urban and rural areas. Rail structure implementation, if understood as an urban requalification opportunity, can promote public space - in quantity and quality - enhancing urban afforestation, which by its linear expression can be a strategic element of connectivity and multifunctionality along the urban space. The rail structure can thus be considered as a promoter of public green spaces that can and should be an integral part of the green structure playing a significant role in urban areas.

Laura Roldão e Costa is with the University of Trás-os-Montes and Alto Douro, UTAD, Vila Real, Portugal (e-mail: lauracosta@utad.pt).

Luís Loures is with the Instituto Politécnico de Portalegre, IPP, Portalegre, with the CIFAP - UTAD, and with the CIEO – Centro de Investigação sobre o Espaço e as Organizações - UAIG (e-mail: lloures@esaivas.pt).

Frederico Meireles Rodrigues is with the CITAB and with CIFAP - UTAD, (e-mail: fmeireles@utad.pt).

### A. 19th century: the arrival of public rail transport

In Porto region, till the first half of the 19th century, mobility was difficult and people usually use vehicles carry by men and animals to travel. At the end of the 19th century train, steam traction and the "*americano*" (transport with animal-traction that circulates on rails) are introduced as public transport. These new types of public transport became very popular because they were more comfortable, regular and capable of carrying a large number of passengers (Fig. 1) [2].



Figure 1. Square Infante D. Henrique with garden. 1888 - 1894. Post Card. "Americano" pulled by six mules. Source: AHMP

Though, the steam traction and the "*americano*" were both types of public transport which promoted urban development, while the steam traction and the "*americano*" promoted linear urban development, the impact of the train spanned further promoting urban development around stations which acted as nodes where activities tended to be concentrated. Railway stations were located far from each other fostering up higher speeds and components associated with public space and leisure are limited to adjacent areas to stations and crossings. In this regard, it can be said that trains had a crucial contribution to the processes of urbanization and to the construction of public green spaces mainly around the stations and crossings. Still their impact was not so influential along the corridor initially created as was the impact of the "*americanos*", the steam tract and later the tram installed in 1895 [2], [3], [4].

The implementation of the public transport in Porto and Matosinhos was designed primarily to ensure the links between consolidated urban areas and potential sites for the

development of activities. The “*americano*” lines were initially established in urban settlements, industrial areas, train connection, sea port connection and areas of recreation and leisure [2], [5], [6], [7], [8].

To construct these rail transport there were some indispensable planning and design actions aiming the delimitation of the adequate space for rails, vehicles and pedestrians, and the definition of specific paving [3]. These public transport infrastructures were implemented in Porto region in the last decades of the 19th century, a period that began to have concerns in improving health and in offering recreational and leisure spaces for those who left rural activities and started working in the industry and he went to live in urban spaces [2], [5], [6].

As a result of the combination of all these factors the construction of the public transport infrastructure became an opportunity for the emergence of arborized streets, squares and gardens in urban spaces.

### B. 20th century: rethink public rail transport

In the early 20th century urban growth observed since the 19th century continued, which was greatly due to the continued industrialization of Porto and Matosinhos. The construction of public transport on rails proceeded in these municipalities, with an emphasis on tram lines with the main objective to connect not only the consolidated urban areas, but also places with potential for the development of urban settlements or areas with ability for specific activities, as is the case of industrial areas, train connections, harbour connections and spaces for leisure and recreation gardens [2], [5], [6], [7], [8], [10]. During this period continued the implementation of public green spaces, as squares, gardens and parks, accompanied by the plantation of trees lines along exiting streets and roads (Fig.2).



Figure 2. Douro waterfront. Tram lines, trees lines, pedestrian and road traffic. 1910. Post Card. Source: AHMP

By the 40s the public transport strategy changed and decision makers started to consider that the public road transportation is more versatile, because it is easier to penetrate and surround the urban space, reason why the tram lines were abandoned. Still, during the 40s and 50s buses and trams remained simultaneously in circulation [2], [3].

As a consequence of the economic development in late 60s and 70s and of the population growth in the outskirts of Porto, roads and bus routes were increasing working as a preferential way of mobility both within the city and between adjacent municipalities, in the metropolitan area of Porto. Still, there is a loss of passengers in public transport due to the increasing competition with the private car.

After this, trams basically disappeared and were replaced by buses. The number of private cars had a significant boom and the 60s marked the construction of roads for fast transit. The urban development ceases to be linear and becomes more polarized. From then the requalification of public space is no longer so directly associated with public transport planning [2], [5], [10] (Fig.3). In these decades public construction of roads and highways followed *hand in hand* with the promotion of road transportation. During this period urban growth took place essentially along streets, roads and intersections. Public green spaces did not undergo significant changes and requalification/redevelopment processes becoming identified with roads for fast transit.



Figure 3. Leixões Harbour. Construction of docks, bridges, buildings and access along 50s, 60s and 70s. Matosinhos (s/d.) Source: APDL

In the 80s and 90s, urban planning calls for the integration of ecological principles, [5], [10] and at the same time we assisted the emerge of new ways of thinking public transportation systems took into consideration the reduction of pollution levels. Stations became highly charged nodal points that accommodate a broad range of complementary uses and act as new centralities. Public space received significant investments for requalification [11]. This phase initiated the redefinition of public transport strategies in Porto region and the enhancement of public transport on rails became the new policy. In this scenario the Metro emerged, connecting a complex network of public transport: trains, tram, trolleybuses, buses, and funicular railways. In the end of the century tram lines were practically designed to tours because tram was replaced by road transportation (bus). Urban development was no longer linear and became more disperse, reason why the requalification of public space was no longer so directly related to transportation [2], [4], [10].

### C. 21th century: back to public transport on rails

The Metro structure settled in the Porto region since 2003 in a mixed system of surface light-rail and underground Metro required specific construction conditions for its circulation, which has involved planning actions that promoted the requalification of public spaces along the corridor in several municipalities.

This requalification resulted both in the construction of several public spaces and green areas and the maintenance of existing green spaces. The design of public green spaces along the Metro was incorporated in the definition of transport infrastructure [5], [10], [11]. In Matosinhos light rail was implemented in part of the Porto-Varzim and Sr<sup>a</sup> da Hora-Leixões railway lines. The project requalification of public spaces along the corridor was a great opportunity to settle public green spaces in different types (streets, car parking, squares, "rail channel", gardens, pocket gardens, etc. (Fig. 4).



Figure 4. Light rail – Avenida Fabril do Norte -Matosinhos. 2013. Used by permission of Laura Costa – all rights reserved.

In the Porto region metro runs in mixed system - light rail and underground. When runs in underground, and whenever possible, the stations were located in landscaped public spaces.

Some of the spaces now used as metro stations had already been “*americano*” or the tram location lines or stations. It is interesting to notice that the new transport infrastructure by rails kept the same locations, allowing the daily enjoyment of several centenarian green spaces of the city. It is evident that not all of the operations performed in these spaces maintained the original landscape design or principles of composition of squares or gardens of the 19th century/beginning of the 20th century, which is considered to be a loss of memory and identity of public spaces [4], [10] (Fig. 5).

Regarding the influence of the light rail on the urban growth in Porto and Matosinhos regions it is not yet possible to make an assessment given its recent installation (first line started to operate in 2003).

However, one can note that the implementation of the Metro has enabled the maintenance of existing green spaces (Porto) and the plantation of a large number of trees and the implementation of new green spaces (Matosinhos). In the 21st century streets in Porto and Matosinhos were redesigned favoring the implementation of public transport in various typologies and in addition to mobility it was expected to promote environmental quality.

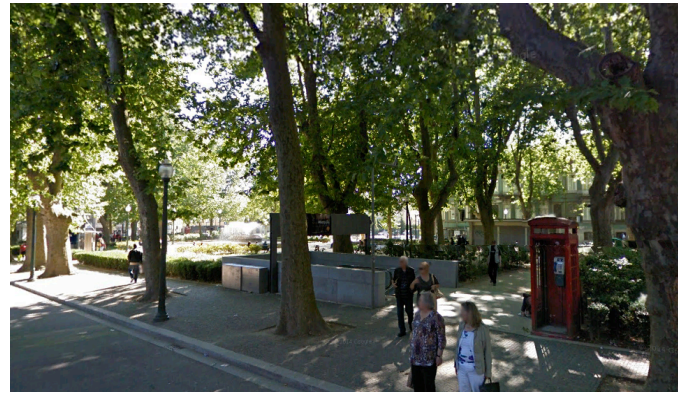


Figure 5. Underground - Metro Station – Marquês de Pombal Square with garden -Porto. 2013. Source: Google Earth image

In this regard, the green public space system/network is understood as a network which should be continued and interconnected with the network of public transport.

## II. PROBLEM FORMULATION

Considering the aforementioned information it is possible both to explore the relationship between public transport on rails and the promotion of green spaces in two municipalities: Porto and Matosinhos (North Portugal) and to answer specific questions related to transportation and urban green space design, considering also the influence that public transport on rails had on the promotion/construction and/or requalification/preservation of public green spaces.

The used methodology is based on the comparative analysis between the construction dates of public transport on rails, the construction or requalification dates of public green spaces as is the case of tree planting in streets, squares, gardens and parks and the expansion of urban area since the end of 19<sup>th</sup> century (first line of public rail transport) until the beginning of the 21<sup>th</sup> century (last rail infrastructure installed – light rail).

## III. DISCUSSION AND CONCLUSIONS

Three analytical maps were developed considering at the same level urban growth and urban structure, public transport on rails and public green space development in Porto and Matosinhos in 1911 (Fig. 6), in order to reflect the relevance of the emergence of the different rail transportation typologies (“*americano*” steam traction, tram and train) to urban development and green space design. The 1930’s corresponding to the decade where the tram lines had greater expansion represented also an important mark in terms of urban development and green space design (Fig. 7); The 2013 map (Fig. 8) reflects another significant change in terms of transportation and in the way it influences urban design considering the arrival of the light rail.

Below we present a table 1 and figures 6, 7, and 8 which relates the construction dates of public transport on rails with the dates of construction/rehabilitation of specific public green spaces which played a significant role in the development of the city.

Table 1 – Installation of public transport rail lines and greening in urban areas - Porto and Matosinhos

| "americano", tram lines and train  | Date line opening | street(s), trees planting, garden and square landscaping along "americano" and tram lines   | date of intervention   |
|--|-------------------|---|--|
| <b>"Americano" and Tram lines – open dates between 1870 - 1907</b>                             |                   |   |  |
| Miragaia (Porta da Alfândega) - Foz  | 1872              | Urban requalification and street trees planting in Douro river waterfront   | 1865   |
|  |                   | Jardim do Passeio Alegre landscaping  | 1890   |
| Foz - Matosinhos   | 1872              | Urban requalification and Carreiros street trees planting Carreiros street  | 1869   |
|  |                   | Av. Brasil and Av. Montevideu landscaping   | Decades of 20 and 30 of the 20 <sup>th</sup> century                               |
| Matosinhos - Leça da Palmeira (Marginal)   | 1872              | Alameda de Passos Manuel  | 1896 (VM plants)   |
|  |                   | Parque Basílio Teles  | 1907 (APDL projects)   |
| Carlos Alberto – Rua da Boavista - Fonte da Moura  | 1874              | Urban requalification and street trees planting in Rotunda da Boavista and Av. da Boavista: east and west section to the intersection of Fonte da Moura | 1892 (Ferreira Telles Plant)   |
|  |                   | Rotunda da Boavista landscaping   | 1906   |
| Fonte da Moura - Cadouços - Foz  | 1878              | R. de Gondarém street trees planting  | Last decades of 19 <sup>th</sup> century and beginning of 20 <sup>th</sup> century |
|  | 1883              |   |  |
| Foz – Matosinhos (Rua Roberto Ivens)   | 1872              | Jardim da Cordoaria landscaping   | 1860-1870  |
|  |                   | R. 1º de Dezembro street trees planting   | 1892 (Ferreira Telles Plant)   |
| Carmo - Massarelos   | 1872              | Jardim da Cordoaria landscaping   | 1860-1870  |
| Campo Mártires da Pátria – Palácio de Cristal  | 1874              | Palácio de Cristal construction and landscaping   | 1865   |
| Praça do Infante – Praça da Liberdade  | 1882              | Praça do Infante D. Henrique landscaping  | 1888 / 1900  |
|  |                   | Urban requalification and Praça da Liberdade street trees planting  | 1893   |
| Praça da Liberdade - Batalha - São Lázaro - Campanhã   | 1874              | Jardim de S. Lázaro landscaping   | 1839 (inauguration)<br>1869 (remodeling)   |
| Praça da Liberdade – Praça da República - Rua da Boavista – Carmo                              | 1875 (?)          | Praça da República landscaping  | 1909   |
| Marquês de Pombal – Praça da República – Lapa - Constituição, Vale Formoso – Campo Lindo       | 1885              | Praça Marquês de Pombal landscaping   | 1898   |
| <b>1895 start tram; 1904 ends on "americano (animal traction); 1914 ends on steam traction</b> |                   |   |  |
| <b>Train lines - open dates between 1870 - 1907</b>  |                   |   |  |
| Train line Póvoa de Varzim and Famalicão. Station - Boavista                                   | 1875              | Street trees planting: in Rotunda da Boavista   | 1892 (Ferreira Telles Plant)   |
|  |                   | Rotunda da Boavista landscaping   | 1906   |
| Campanhã station   | 1875              | Street trees planting around the station  | 1892 (Ferreira Telles Plant)   |
| Train line Ramal de Leixões ou linha de Leça   | 1893              | Alameda de Passos Manuel  | 1896 (VM plants)   |
|  |                   | Urban requalification and street trees planting av. Menéres e República Alameda de Leça ou Sala de visita Jardim Domingues de Oliveira                  | Last decade of 19 <sup>th</sup> century and beginning of 20 <sup>th</sup> century  |
| <b>Tram Lines between 1907 and 1913</b>  |                   |   |  |
| Extension Boavista - Castelo do Queijo   | 1907 - 1913       | remaining western end of Avenida da Boavista street trees planting  | 1917 (?)   |
| Extension Paranhos Ponte da Pedra  | 1907 - 1913       | Jardim da Arca d'Água landscaping   | 1928 (?)   |
| Extension Praça da República - Monte dos Burgos  | 1907 - 1913       | Praça da República landscaping  | 1913 (remodeling)  |
| Extension Marques de Pombal – Águas Santas   | 1907 - 1913       |   |  |
| Extension S. Roque - Venda Nova  | 1907 - 1913       | Jardim do Campo 24 de Agosto landscaping  | 1904   |
| <b>Tram Lines between 1914 and 1935</b>  |                   |   |  |
| Extension Fonte da Moura – Castelo do Queijo   | 1914-1935         | Street trees planting in new urban areas  | Decades of 20 to 50 of the 20 <sup>th</sup> century                                |
| Extension S. Pedro da Cova   | 1914-1935         | Praça Velasquez Francisco Sá Carneiro   | Decade of 40 of the 20 <sup>th</sup> century                                       |
| Extension Ermesinde  | 1935-1950         |   |  |
| Extension Matosinhos – Leça da Palmeira (around doca nº 1)                                     | 1935-1950         | Quinta da Conceição as a public park (APDL rent Quinta at CMM)  | 1956 - 1958  |
| <b>Light rail (metro) and Underground (metro) lines - open dates 2003</b>                      |                   |   |  |
| Metro –Trindade – Sr. de Matosinhos  | 2003              | Urban requalification and street trees planting – Porto e Matosinhos Connection with Parque Basílio Teles.  | 2003   |

|  |      |   |                             |
|--|------|---|-----------------------------|
|  |      | Parque do Real, Parque urbano do Carrical and Rotunda da Boavista Connection with Jardim do Sr. do Sr, do Padrão anda v. Atlântica  |                             |
| Metro – Estádio do Dragão – Trindade           | 2004 | Urban requalification and street trees planting - Porto Campo 24 de Agosto Garden (remodeling and station) Connection with Parque de S. Roque   | 2004                        |
| Metro – Câmara de Gaia – Pólo Universitário    | 2005 | Urban requalification and street trees planting - Porto Av. dos Aliados (remodeling and station) Praça do Marquês (remodeling and station) Connection with Quinta do Covelo and Jardim da Cordoaria | 2005                        |
| Metro –Senhora da Hora – Pedras Rubras         | 2005 | Urban requalification and street trees planting - Matosinhos Connection with Parque do Carrical   | 2005                        |
| Metro –Fonte do Cuco – Forum da Maia           | 2005 | Urban requalification and street trees planting - Matosinhos  | 2005                        |
| Metro –Pólo Universitário– Hospital de S. João | 2006 | Urban requalification and street trees planting – Matosinhos Parque da Quinta de Lamas  | 2006<br>2015 (inauguration) |

Sources: Ferreira Telles plant 1892; "Vila de Matosinhos com a canalização para o abastecimento de água" plant 1896; film from Serviços Cinematográficos do Exército – Companhia Produtora 1927; Marques, 2009; Costa, 2015.

### A. 19th century – transport rails arrival and the emergence of public gardens and squares

From the analysis of figure 6 one may observe that both in Porto or in Matosinhos there was a linear growth of urban areas is coinciding with the lines of the "americano" and tram. As observed in Table 1 that the construction and/or requalification of streets, squares and gardens inserted along public transport corridors had very close construction/opening dates to the construction dates of the public transport rail lines. There are several examples of this correspondence, as is the case of the opening of the "americano" line Miragaia-Foz in 1872 and Passeio Alegre garden inaugurated in 1890; the opening of "americano" line Marques de Pombal - Campo Lindo in 1885 and requalification of Praça Marques de Pombal in 1898; the opening of "americano" line Matosinhos – Leça da Palmeira in 1872 and Alameda de Passos Manuel was already mapped in Vila de Matosinhos with water supply infrastructure - 1896.

Regarding train lines, they were also important as urban corridors, however since the stations were located far from each other, considering that train fostered higher speeds, public spaces and leisure areas were limited to areas adjacent to stations and crossings. Still, Matosinhos had several train lines and stations responsible for the growth of some of their urban centers (Line Porto - Póvoa de Varzim - Famalicão - 1875) promoting industrial and urban development; (Ramal de Leixões ou Leça Line - 1893), creating connections that promoted urban growth, harbor development (Leixões) and other important connections as is the case of the connection to Senhora da Hora (Fig. 6; Table 1), which had a great relevance in city development.

In Porto, the Campanhã station (1875) allowed the creation of connections both to the north and south of the country enabling also the industrialization of this area and its urban growth. Links between tram, "americano" and railway lines promoted the requalification of public space associated to stations and corridors as is the case of Boavista roundabout, S. Lázaro garden; e Campo 24 de Agosto) (Table 1).

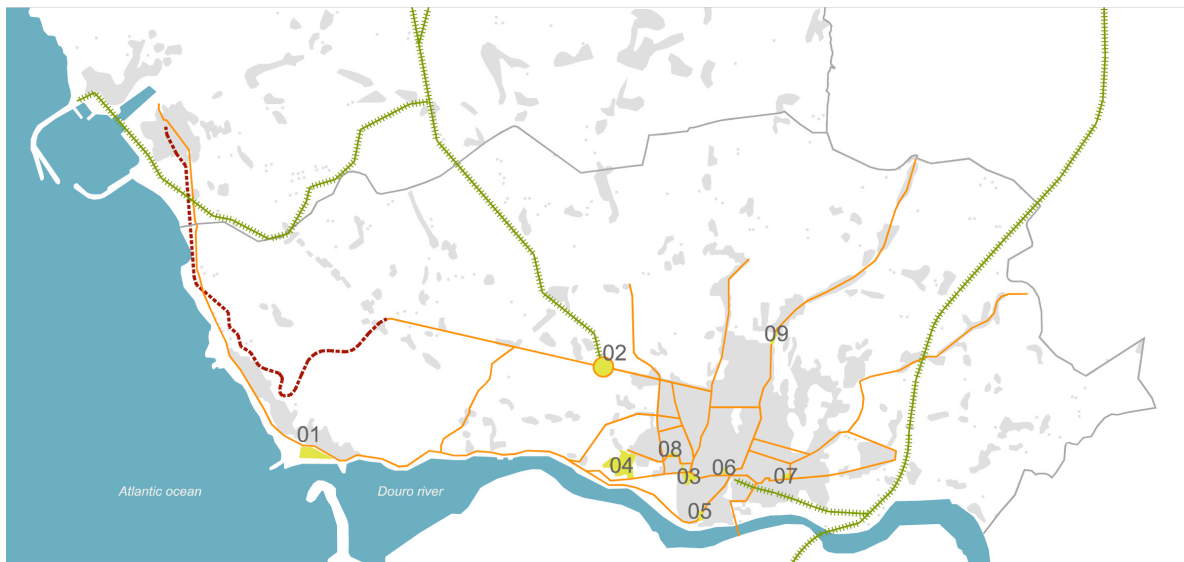


Figure 6 - 1911 urban evolution, public transport and green spaces in Porto and Matosinhos.

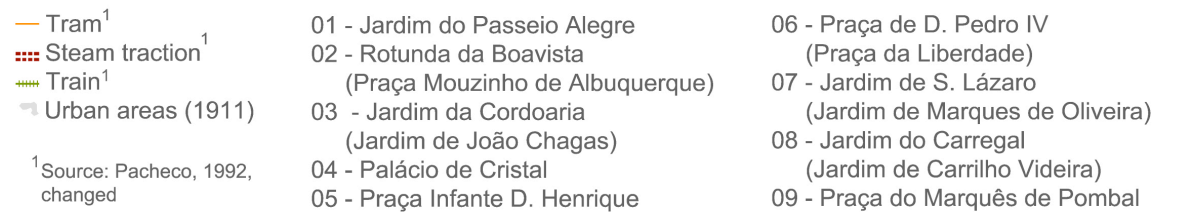


Figure 7 - 1930 urban evolution, public transport and green spaces in Porto and Matosinhos.

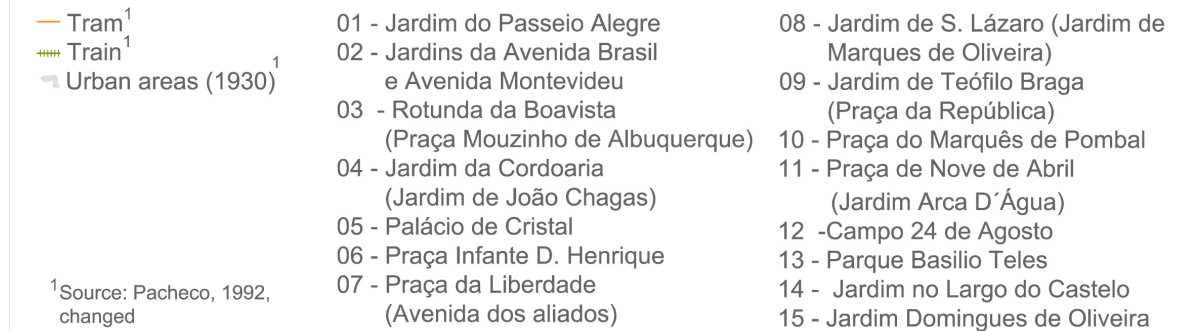




Figure 8 - 2013 urban evolution, public transport and green spaces in Porto and Matosinhos.

|                         |   |  |
|-------------------------|---|--|
| — Bus                   | 1 - Jardim do Passeio Alegre                            | 13 - Parque Basilio Teles                                |
| ... Tram                | 2 - Jardins da Avenida Brasil e Avenida Montevideu      | 14 - Praça de Francisco Sá Carneiro (Praça de Velasquez) |
| — Light rail (Metro)    | 3 - Rotunda da Boavista (Praça Mouzinho de Albuquerque) | 15 - Parque de S. Roque                                  |
| - - Underground (Metro) | 4 - Jardim de João Chagas (Jardim da Cordoaria)         | 16 - Praça da Corujeira                                  |
| --- Train               | 5 - Palácio de Cristal                                  | 17 - Parque de Serralves                                 |
| Urban areas (2013)      | 6 - Praça Infante D. Henrique                           | 18 - Quinta do Covelo                                    |
|                         | 7 - Praça da Liberdade (Avenida dos Aliados)            | 19 - Parque da Cidade                                    |
|                         | 8 - Jardim de Marques de Oliveira (Jardim de S. Lázaro) | 20 - Parque da Pasteleira                                |
|                         | 9 - Jardim de Teófilo Braga (Praça da República)        | 21 - Parque Oriental                                     |
|                         | 10 - Praça do Marquês de Pombal                         | 22 - Quinta da Conceição                                 |
|                         | 11 - Praça de Nove de Abril (Jardim Arca d'Água)        | 23 - Quinta de Santiago                                  |
|                         | 12 - Campo 24 de Agosto                                 | 24 - Parque de Real                                      |
|                         |   | 25 - Parque do Carriçal                                  |
|                         |   | 26 - Jardim do Sr. do Padrão e Av. Atlântica             |
|                         |   | 27 - Jardim no Largo do Castelo                          |
|                         |   | 28 - Jardim Domingues de Oliveira                        |
|                         |   | 29 - Parque da Quinta de Lamas                           |

### B. 20th Century: rethink public rail transport and green public spaces

In the early 20th century, the construction of tram lines continued as well as urban growth and as the construction of gardens and squares, mainly due to the ongoing industrialization of the municipalities of Porto and Matosinhos. The urban growth continued along the tram lines and densified in the areas where the tram lines are concentrated (Fig. 7 and Table 1).

Still, from the middle of the century road transportation became the most used infrastructure, which promoted a change in public green spaces structure, leaving a positive relationship between the implementation of public transport and public green spaces.

At the end of the century green spaces are understood according to principles of *continuum naturale* (greenways and green corridors) considering both in their planning and design principles the preservation of natural resources and ecological systems and the protection of cultural and heritage values. These principles were reflected not only in planning options but also in the design/landscape architecture projects that took place in Porto and Matosinhos as one may notice for examples in Porto City Park – *Parque da Cidade* the most ambitious project promoted by the city of Porto, near the ocean and covering an area of approximately 80 ha, in the *Pasteleira* park and in the acquisition of ancient '*quintas*' (*villas*) turned into public parks and gardens, such as S. Roque da Lameira, Covelo or Virtudes in Porto and in Matosinhos the *villas* of N. Sr<sup>a</sup> da Conceição, or new parks as *Parque do Real* and *Parque do Carriçal*.

### C. 21th century: back to public transport on rails and to the green public spaces

From the analysis of Fig. 8 it possible to observe that Metro has been a public transport system distributed through Porto and Matosinhos in a mixed system: light rail and underground. In order to implement it, it was necessary to carry out some specific actions in urban spaces. When the metro run underground the objective was to locate the stations in public green spaces. In Porto municipality some of the spaces used as metro stations were formerly used by the “americano” or the tram. It is interesting to notice that the Metro kept the same locations of these centenarian green spaces of the city as *Rotunda da Boavista, Praça Marques de Pombal, Campo 24 de Agosto and Avenida dos Aliados/Praça da Liberdade* (fig. 8 and Table 1). Both in Porto and Matosinhos a great extension of the line run on the surface allowing the integration of the line with existing green spaces – gardens and parks (Fig. 8 and Table 1) while promoting their requalification and increasing their use. Moreover, it is possible to observe the influence of the light rail in the urban requalification considering not only the construction of new green spaces, the creation of new tree *allées* in streets, and the connection to parks and gardens as happened in Porto and Matosinhos. These urban developments associated to the Metro which led/enabled the construction of more green spaces, ensured connections with existing gardens and parks and *allées*, as is the case of the Asprela area in Porto, and Sr<sup>a</sup> da Hora area in Matosinhos.

As a final remark considering the influence of public transport to the municipalities of Porto and Matosinhos it is possible to say that:

- i) Urban growth occurred along the main public transport corridors. Trains and trams created new urban centers associated with the location of the stations promoting new corridor development along the lines. Public green spaces are closely related to stations and linear transportation corridors;
- ii) The processes of urban growth and expansion of public spaces and of public transportation typologies reflects relations of cause/effect in time and space;
- iii) Public transport on rail allowed the construction, requalification and preservation of green spaces;
- iv) When public transport on rail runs on surface and is inserted into the urban space the circulation corridor is able to requalify public space creating trees lines along streets (*allées*), squares, parks and gardens;
- v) Public railway transport enables the construction and/or preservation of public green spaces associated with their stations and connections;
- vi) The light rail system and metro (underground) allowed the preservation, requalification and construction of green spaces along the lines defining green corridors closely related to the transportation infrastructure; and
- vii) Metro both in light rail system and underground no longer depends exclusively in the road system but in the promotion of links with other modes of public transport, as well as on the relationship with the existing/historic public spaces and the new parks and gardens.

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**Laura Costa** is a landscape architect with a PhD in Landscape Architecture from the Faculty of Science of University of Porto under the theme: “The vegetation in the implementation of projects of landscape architecture”. She is an assistant professor in the Forestry and Landscape Architecture Department at University of Trás-os-Montes e Alto Douro, and currently develops teaching and research in landscape architecture field: landscape design and planting in urban and rural environments.

**Luis Loures** is a Landscape Architect and Agronomic Engineer, Professor both at the Polytechnic Institute of Portalegre and at the University of Trás-os-Montes e Alto Douro, who holds a Ph.D. in Urban Planning, focusing the relevance of Landscape Architecture design projects not only to urban planning procedures but also to the maintenance of industrial heritage. Since he graduated he published several per reviewed papers at the national and international levels and he has been a guest researcher and lecturer both at Michigan State University (USA), and at University of Toronto (Canada) where he has developed part of his Ph.D. research with the Financial support from the Portuguese Foundation for Science and Technology (Ph.D. grant). On recent years he had teach in several courses in different Universities, regarding the fields of landscape architecture, urban and environmental planning and the reconversion of depressed areas in shrinking cities.

**Frederico Meireles Rodrigues** was born in Vila Real, in the north of Portugal. He holds a five-year diploma in landscape architecture by the University of Trás-os-Montes and Alto Douro (UTAD). In 2015 he has concluded his PhD in Landscape Architecture at the Faculty of Sciences of the University of Porto, focusing the post-occupancy evaluation of the contemporary urban parks in Portugal. He has been teaching at UTAD since 2001, where he is now a Professor in Landscape Architecture and also been involved in professional practice, cooperating with offices and in the University studio. His publications have been focusing the evaluation of green spaces and the alternative recreation and restoration in the urban setting. He is a researcher of the CITAB Research Centre and his main fields of research are urban green park evaluation and critique; urban allotment gardens design and evaluation; open space, health and inclusion. Doctor Meireles Rodrigues has been a member of the Executive Committee of European Council of Landscape Architecture Schools (ECLAS) since 2009, and was awarded in 2015 for his Outstanding Service in the organization and running of ECLAS.