v. 3, n. 18, 2023

Scientific Journal of Applied Social and Clinical Science

THE SERVICE AREA OF URBAN PARKS TWO METHODOLOGICAL PROPOSALS FOR MEASURING ACCESS

Francine Gramacho Sakata
FAUUSP; professor; Researcher: Labquapá

Pedro Rezende Mendonça
FAUUSP; graduation student; researcher: Labcidade

Gabriela Oliveira
FAUUSP; graduated

Abstract: This article presents two methodological proposals for measuring the accessibility of urban parks: one based on travel times to parks on foot and by individual transport, simulating travel to parks in predominantly residential neighborhoods in the western zone of São Paulo by public transport; and another based on travel times to parks by public transport, having simulated routes to parks in São Paulo with a high frequency of public. The purpose of these studies is to seek to support the creation and design of new parks and even other public facilities based on an understanding of the population that public facilities can serve.
Keywords: urban park; coverage; service area; mobility.

INTRODUCTION

Urban parks are public facilities for the leisure of the urban masses that can simultaneously fulfill other functions such as urban beautification, conservation of natural resources and regulation of rainwater drainage. In the first two decades of the 21st century, in Brazil, almost all new urban parks were created as environmental actions and their role as spaces for rest, children's recreation and sports was, in many cases, relegated to the background (SAKATA, 2018). However, still, the best-known urban parks in cities and which synthesize the idea of the park in people's imagination are those most appropriate for leisure uses, those that attract crowds on weekends, with open spaces, generous dimensions and in which lawns and woodlands enhance and support recreational uses.

The categorization of the types of public parks in municipalities that have a large number of them is desirable as a management tool. However, there are not always clear criteria and the most common is the division by government instance and by region of the city. In studies on the subject, a frequent approach is one that classifies them by the range of public that the equipment accommodates: the most local is the neighborhood park, followed by those that serve several neighborhoods in one part of the city, and there are those that serve the entire city and those who play a metropolitan/regional role. This categorization has its origins in classic urbanism and makes sense for the planning and management of the open space system because it is related to the needs of the population.

Between 1853 and 1870, the urban renewal plan that Baron de Haussmann directed in Paris had as its trademark the creation of "a hierarchical network of green spaces, typologically defined by dimensions and functionalities in relation to the radius of influence: two large parks intended for to the entire metropolis and situated in opposite quadrants; smaller parks in developing neighborhoods; small green spaces in the traditional historic center; and, finally, trees in the streets". The public garden was taken as the building unit of the city. (PANZINI, 2013).

From the remodeling of Paris, Jean-Claude Forestier launched, in 1906, Grandes Villes et Systèmes de Parcs setting with a complete proposal for a system of green areas, integrated and expanded for the metropolitan space. The system would be composed of large reserves and landscapes, left in their natural state, in places that are almost always distant; suburban parks, distributed regularly according to the needs of the cities, with trees and lawns and as few streets and useless ornaments as possible; large urban parks, places for walks and games, for the beautification of cities; small parks as areas for games and exercises or purely ornamental, distributed no more than 2000m away from each family; recreation areas, small plots of 2,000 to 3,000 m^2, widely distributed; garden-educators; and avenues-promenade, so that the walk is never interrupted. These

ideas were present, as a backdrop, in Joseph-Antoine Bouvard's urban proposal for São Paulo. (BARTALINI, 1999)

In São Paulo, Rosa Kliass and Miranda Magnoli conceived, in the 1960s, an integrated system of parks for São Paulo, the Plan of "Green Recreation Areas" (KLIASS and MAGNOLI, 2006), composed of 29 sectoral parks distributed throughout the network. urban. The ideas of Boston Frederick Olmsted's systems and linear parks were brought by the architects to São Paulo. The plan was not carried out and the system of green areas was violently reduced in the following years. But, in the theoretical field, the repercussions were great and, over the years, the ideas contained therein became a consensus among academics and technicians.

In practice, the design and management of free space systems in large and medium-sized Brazilian cities have been carried out in a fragmented way, the balance of effective interventions leaning towards the road network and the qualification of free spaces occasionally. Renewed efforts are needed to support the planning and integrated management of open spaces. The production of data is one of the tools for this and this article seeks to contribute in this sense, addressing the issue of accessibility to urban parks and their area of coverage or influence.

In consolidated parks, BARTALINI (1999) carried out interviews with users to find out their scope and was able to establish that the users of Parque da Luz, in the central region, for example, came from several other regions of the city and that it plays a role of metropolitan park. In 2008, WHATELY et al (2008) conducted another survey with interviews, commissioned by the city hall to find out about the origin, frequency and demands of users of municipal parks. But, the questionnaires reveal established uses. Project parks, how would it be possible to determine its service area (or influence) and the public that the park, if implemented, would serve?

Two undergraduate students from FAUUSP, Gabriela Oliveira and Pedro Rezende Mendonça, developed separately in 2019, two methodologies for measuring the area of influence of parks in São Paulo motivated by questions posed, respectively, by professors Francine Sakata and João Meyer. Gabriela Oliveira's study aimed to get to know the area of influence and the public of a park that the student designed as her final graduation project for a predominantly residential area in the west zone of the capital of São Paulo and, for this, she proposes the delineation of patches from of travel time on foot or by car to the park in question and to the neighbors and runs some simulations. Pedro Rezende Mendonça, to identify the possible public of Parque Minhocão in the central region, object of study of the subject AUP 0659 Urban Park Project, proposes a methodology that measures travel times to parks by public transport and he makes the simulation for parks in São Paulo high public attendance.

SERVICE AREA AND MEASUREMENT OF ACCESSIBILITY ON FOOT AND BY CAR

One of the Real Estate Market Analysis tools to determine the user profile for an enterprise is to establish the area of influence (or service) of a project, that is, the geographic space susceptible to the consequences of its implantation or operation. Professor João Meyer, Gabriela Oliveira's advisor, has carried out research with the real estate market and understands that techniques for prospecting the potential public that real estate companies use for the design of developments or products can be experimented with in planning the network of parks. real estate agents or that shopping center chains use to define the

"mix" of stores, or even that retail stores use to establish their points. These agents, in addition to being concerned with the profile of the population (in this case, consumers), are also attentive to other businesses already established in the region, which may be complementary or competing.

The most used technique for establishing this area is the simple definition of a coverage radius. Circles can be drawn, with a radius of 500 meters in the projected developments, for example, for journeys on foot, and 2 km or more for journeys by car. This radius may be larger for larger equipment.

CALLIARI (2019) studied how much residents of the city of São Paulo are willing to walk. He concludes that journeys in the city tend to last up to 20 minutes, with 50% of journeys on foot lasting up to 10 minutes.

Circles are a limited method because the existence of barriers or enclaves in urban fabrics, which may hinder or prevent access to the center of the circle, is neglected. Railway lines, expressways and airports are examples of barriers or enclaves. When traveling on foot or by bicycle, the relief can also be a barrier. In São Paulo, the Tietê Ecological Park is a large public facility, but it is located next to the Presidente Dutra Highway and the Marginal Tietê and few people in São Paulo are able to point out where its entrance is.

Another methodology used to determine the coverage areas of educational institutions, supermarket chains and retail stores are the Voronoi diagrams. The principle of the Voronoi Diagram is that, in a plane, there are points (or houses) that are closer to a generating source (for example, a school or a supermarket) than to another source and the result is polygons whose distances between source and point are as small as possible. In Figure 1, OLIVEIRA (2019) applies the ``Polígonos de Voronoi`` to a park under study, Parque da Fonte, in Butantã, west of São Paulo, to obtain its area of influence. The author indicates, as generating sources, the other parks in the region. The main entrance to each park is marked with some points.

The map was produced with the Q-GIS software using the geographic information system (GIS). This software has the "Polígonos de Voronoi" tool and the algorithm generates a layer of polygons containing the `` Polígonos de Voronoi``. (AURENHAMMER, 1991)

This technique is particularly interesting for walking routes or for equipment that is relatively similar, such as health centers or stores belonging to the same network. In the case of parks or shopping malls, it may happen that one offers more options than the other and polarizes the public.

Influence radii and `` Polígonos de Voronoi`` consider distances in meters that do not correspond to displacement times. Travel times are related to the existence or not of barriers, with the design of the road system, being a more accurate measure. The user takes the time to travel into account more often than the distance when deciding.

Thus, OLIVEIRA produced, with the aid of the tool Google Maps paths, maps of the areas isochronous to such displacement times (Figure 2). The map shows that Vila Pirajussara, Intituto de Previdência, Conjunto Residencial Butantã, Vila Indiana, Jardim Rizzo and part of Vila Gomes are within walking distance of Parque da Fonte. The purpose of this approach was also to verify whether the area identified by the paddock isochron is disputed by another competing park.

Isochronous five-minute car lines were also drawn from the entrance of each competing park, considering the typical traffic condition on a Sunday morning (Figure 3). The maps were produced using the Isoscope application, which uses Nokia Here databases.

The maps allowed the author to observe that ``Parque da Previdência`` disputes

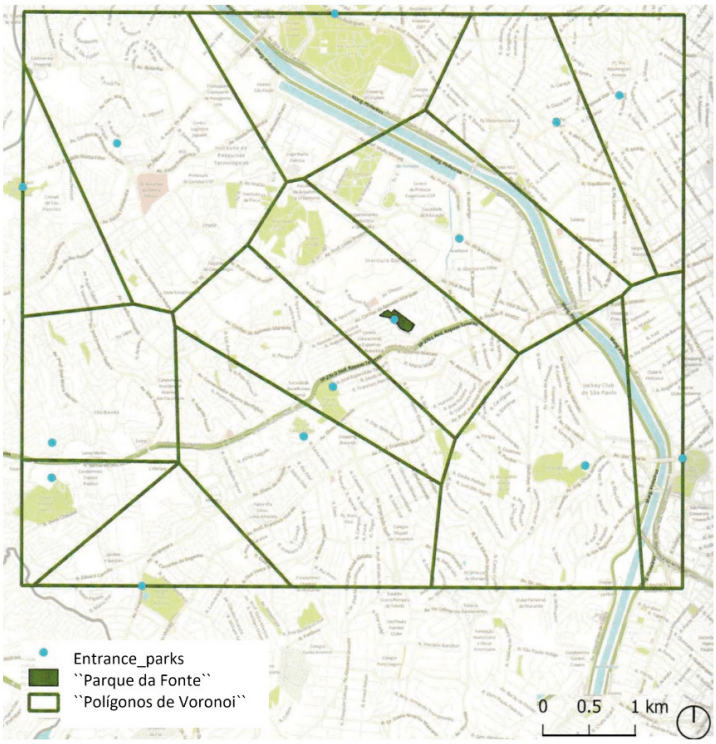


Figure 1: Area of influence for parks around Parque da Fonte, using Voronoi diagrams.
Elaborated by OLIVEIRA, 2019.

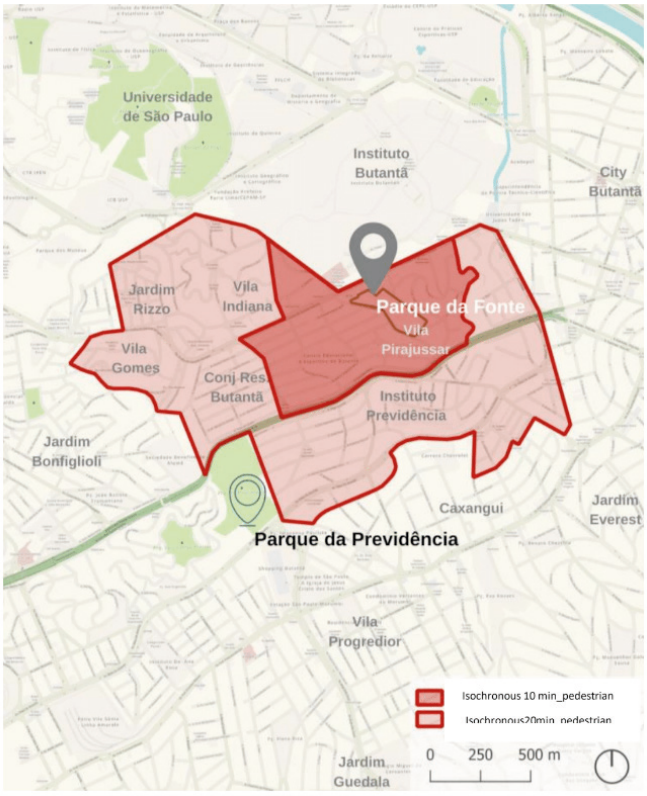


Figure 2: Isochrones of 10 and 20 minutes on foot, from: Parque da Fonte.
Elaborated by OLIVEIRA, 2019.

potential users at a walkable distance with ``Parque da Fonte``. The methodology used initially considered the time of the itinerary from the park towards the neighborhood, but the author considered it necessary to delineate the isochron of the inverse route, to understand the shortest route for residents of the surrounding neighborhoods.

But it must be noted that the time a person is willing to move depends on many factors, including the possibilities offered by the park. Villa Lobos park, due to its generous dimensions and the diversity and quality of the equipment it offers, has a greater power to attract users than other parks in the region. In addition, for residents of less central districts of the capital, trips of up to 15 minutes for a leisure activity, sport or shopping could be considered reasonable.

MEASUREMENT OF ACCESSIBILITY BY PUBLIC TRANSPORT

Pedro Rezende Mendonça, seeking to understand the position of the ``Parque Minhocão``, in project, in the network of municipal parks in São Paulo, decided to carry out a structured analysis on the accessibility of municipal parks with a wide range of public from the public transport system.

Accessibility, broadly defined, can be understood as the "potential for opportunities for interaction" (Hansen, 1959; our translation), or as "the extent to which land use and the transport system enable (groups of) people to reach activities or destinations through (a combination of) transport modes" (Te Brömmelstroet et al., 2016; our translation). It is a qualifier of possibility, associated with a series of friction components – whose existence reduces the possibility of access. The following friction components can be understood: travel time, fare, comfort, free space design (sidewalks, trees, bus stop), feeling of security, income, readability of the transport network, psychological level factors, among others.

The recurrence of formulas to calculate an accessibility indicator, reduced using friction coefficients and exponents, is common in the literature. The measurement of these coefficients moves large research projects, and is not the scope of the exercise proposal. We are looking for a simple and readable indicator, not very complex, which allows a direct understanding of the results and its use as an indicator for comparisons.

The analysis clipping is the coverage area of the public transport network within the Municipality of São Paulo. This is because the subsidies for the analysis are made available exclusively by the Department of Transport of that municipality, through the company SPTrans. It was decided to restrict the analysis to the public transport network of SPTrans, Metrô (Subway company) and CPTM, without including individual modes. The authors propose to understand accessibility as a broad public service, made up of public equipment served by a public transport system and by planning the use and occupation of land.

METHODOLOGY

This analysis does not deal with demand – a very common topic in transportation planning. Having accessibility as a public service, it is about guaranteeing the possibility of access to public facilities – in this case, the park system – and not scaling the service offered by bus and subway lines. This is because the reorganization of access also includes changing the supply of equipment, the density of urban activities and the design of free spaces; elements not contemplated in a model based on demand.

To conduct the analysis, it was necessary to establish points of origin and destination in order to create the travel itineraries. With

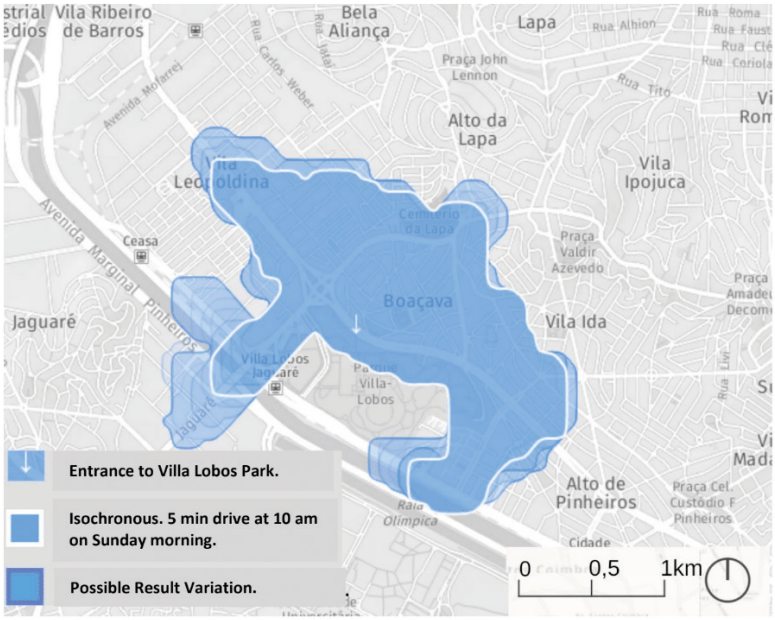


Figure 3: Isochronous Villa Lobos Park, 5 minutes by car at 10 am.

Elaborated by OLIVEIRA, 2019, from Isoscope.

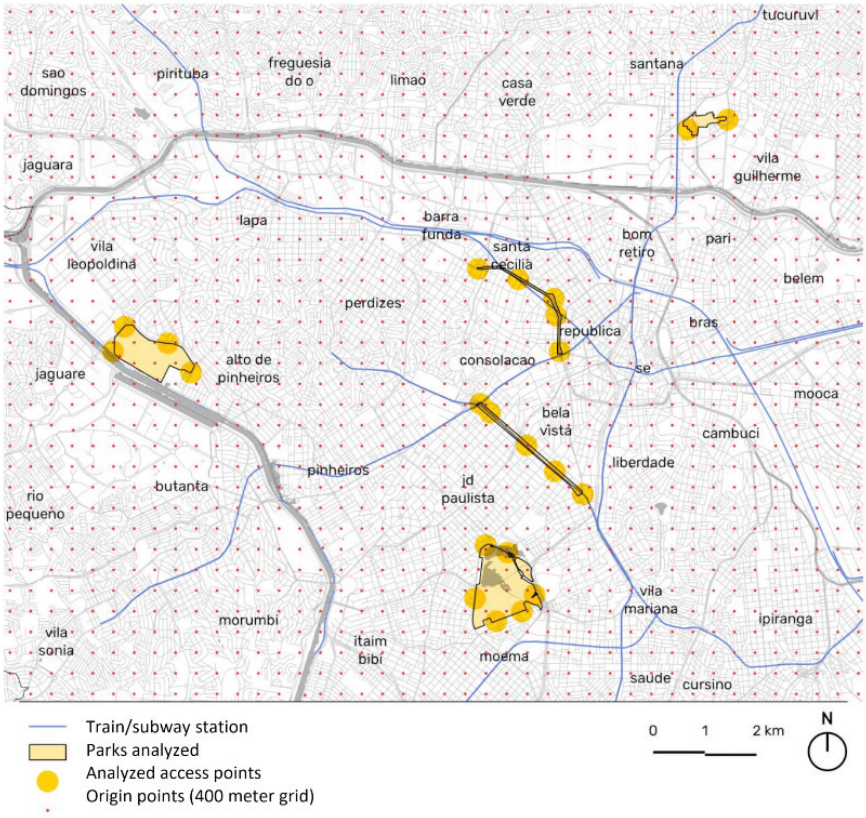


Figure 4: Cutting the matrix of origin points (red) and destination points (yellow).

Elaborated by Pedro Rezende Mendonça on the base: Geosampa.

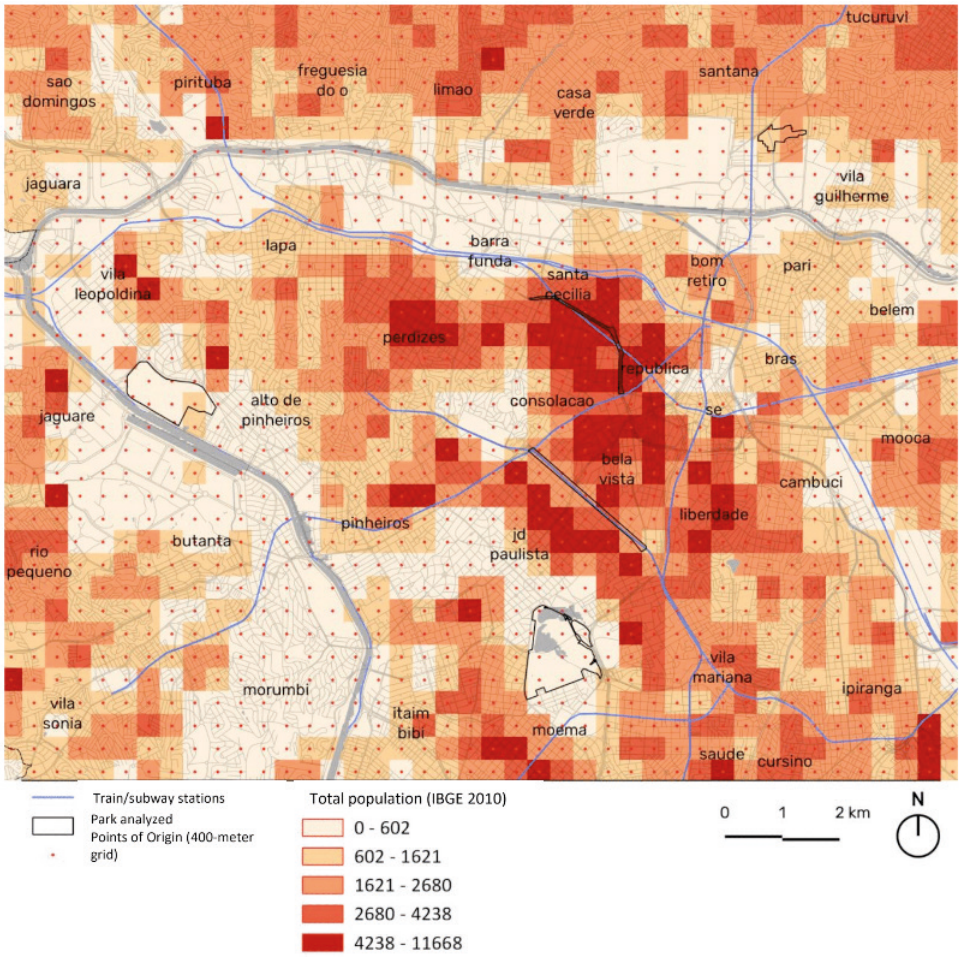


Figure 5: Clipping of the demographic grid associated with the matrix of points of origin, colored by population density.

Elaborated by Pedro Rezende Mendonça based on the Geosampa and IBGE.

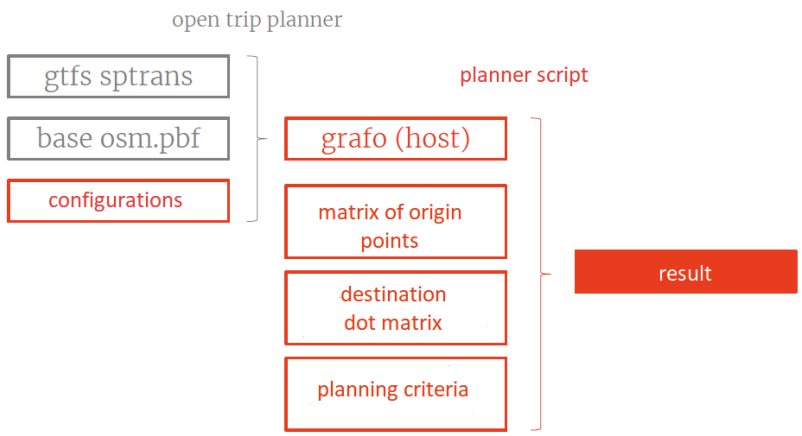


Figure 6: Scheme of the trip planning process. In red, elements created or specified locally.

Elaborated by Pedro Rezende Mendonça.

the QGIS software, two matrices of points were created in shapefile format: an origin matrix, with a grid of points spaced at 400 meters covering the entire municipality, and a destination matrix, composed of access points to some municipal parks selected. these parks are: do Carmo, CERET, da Barragem, da Juventude, Villa-Lobos and Ibirapuera. Two free intermittent leisure areas were also included: Parque Minhocão and Paulista Aberta. Opening hours and availability of free time informed the access conditions used as a parameter for trip generation. The trips were planned on a Saturday, departing at 10:00 am, considering that people have more leisure time on that day of the week and prefer to do it in the morning. In the case of Avenida Paulista Aberta, the trips were planned for Sunday, since it is the only day that Avenida Paulista is open for pedestrians.

A grid with demographic information was associated with each point in the source matrix. This information was obtained from the proportional distribution, by area of census sectors, of the census population in the 2010 Census. The total population of each square was used to calculate an accessibility indicator presented below.

Trips would be generated from each point in the origin matrix to each point in the destination matrix, and for each park the fastest route would be chosen – thus discarding the most distant access gates. To plan trips, a routing application is needed. OpenTripPlanner (OTP) software, open source, available at opentripplanner.org, was used. This application allows you to create a local routing server, replacing non-free online services such as the Google Maps API and time-consuming solutions, such as manually planning trips using Google Maps.

To use OTP, it is necessary to install the Java Development Toolkit. Next, it is necessary to obtain information about the road network and public transport services in the analysis region. The road network serves to plan the sections on foot, and therefore depends on a map with well-documented pedestrian paths. An osm.pbf file from the São Paulo Metropolitan Region was used, generated from OpenStreetMap (OSM), an open mapping platform. The OTP requires information about the road that is already in the OSM base, such as the type of vehicle with allowed traffic and the maximum speed. For public transport information, a GTFS (General Transit Feed Specification) file was used, made available free of charge by SPTrans through a developer registration on the website www.sptrans.com.br/desenvolvedores/. GTFS files are a standardized way of organizing information about the transport network, such as opening times, fares, agencies, stops, lines and routes.

The planning process then proceeds in two steps. First, the GTFS file, the OSM base and some variables, such as file location and internal memory usage, are used to run the OTP. The result is a graph (a network of lines and points) that reproduces the specified transport network, hosted on the local computer and that can be used for planning trips. In the second stage, trips are allocated in the network based on the origin and destination matrices, the graph and planning criterion variables. In order to carry out the allocation on a large scale, with thousands of points, a planner script was written in Python language, for automatic calculation of all routes. The planning criteria were: start of trip at 10:00 am, on August 31, 2019 (September 1 in the case of Paulista Aberta, also at 10:00 am), using only public transport and walking stretches of a maximum of 1.2 km in total. This walking value was obtained through tests, where it was demonstrated that smaller distances tend to generate very complex travel routes to avoid short stretches on foot. Upon execution of the planner script, result files are

generated for each source point.

RESULTS

The result files allow the elaboration of maps of isochronous, iso-modal areas (whose means of transport used are the same), iso-tariff, by the same number of integrations and by total distance covered on foot. For a brief and exploratory accessibility analysis, we chose to use only travel time data. An attempt was made to answer a simple question: how would access difficulties be distributed if all inhabitants of São Paulo decided to go to the same park at the same time?

The analysis started with aggregated results. For each park, the percentage of squares and population reached by time interval was calculated. It is noted that the transport network provides faster access to some squares with low population density, and therefore takes longer to reach most of the population in denser areas of the city. The opposite is also possible, as seen in the example of CERET, in the East Zone of São Paulo: with 120 minutes of travel, 65% of squares and 75% of the population are reached (graphs 1 and 2).

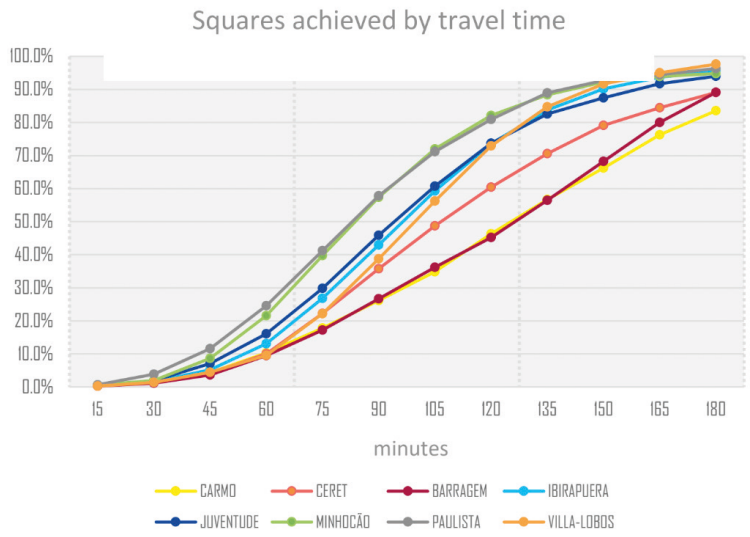
An indicator of universal accessibility was then calculated, given by the sum of the travel time of all people to each park (graph 3). Based on this indicator and the graphs above, it is possible to group the parks analyzed into three groups. The ones with the worst accessibility (Parque do Carmo and the Barragem) depend on the bus and are located in areas far from the center. Despite the high density of the nearby surroundings, travel times are long for the majority of the population, and as a result these parks end up having a more local character. A second group is made up of parks on the edges of the expanded center, with dependent access both by bus, subway and train. (Ibirapuera, Parque da Juventude, CERET and Villa-Lobos). Finally, with the best access times, we have the intermittent leisure areas, which were not designed as a park. (Parque Minhocão and Paulista Aberta), but with a wide availability of transport infrastructure in the immediate surroundings and a privileged location in the city.

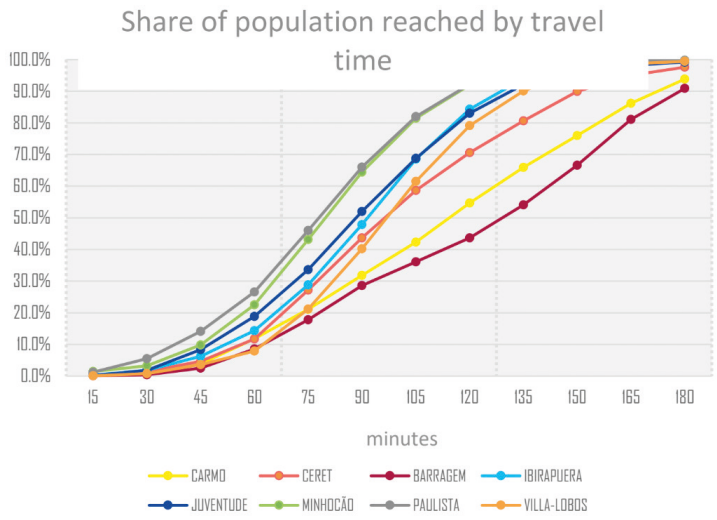
The planned routes allow identifying the main access lines, and consequently which are the entrances with greater and less possibility of use. In case of: Parque Minhocão, for example, the main access line is subway station 3-Red, through Santa Cecília station. The subway exits at this location can be included as structuring elements in the park's design.

Identifying these main lines can also provide guidelines for the design of signage for both parks and the public transport network. Still in the example of: Parque Minhocão, the main bus line for access is 6913-10 (Terminal Varginha – Terminal Bandeira). The line does not serve the Park directly, as it ends at Vale do Anhangabaú, but it is possible to offer good access conditions with good pedestrian signs or with integration to a line that connects the terminal point to one of the accesses to ``Parque Minhocão``.

FINAL CONSIDERATIONS

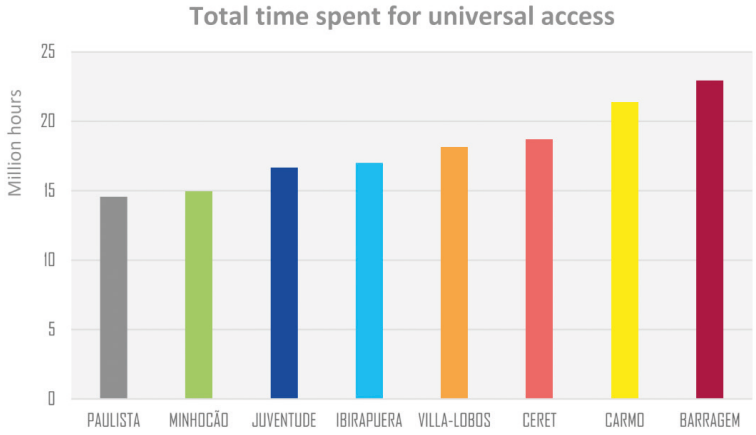
The results obtained from the methods presented allow us to visualize some possible actions, both by public authorities and by landscape architects who propose interventions in open spaces. At the municipal scale, these methods can be applied in planning the transport network, the open space system and land use. As shown by the accessibility results for Parque Minhocão, the creation of parks in an area with consolidated transport infrastructure corresponds to a broader public. The densification of these areas, with appropriate urban parameters and housing policies, can further reduce access times to these parks and increase the number of potential users of these facilities. As the





Graphics 1 and 2: Grids reached by travel time and share of population reached by travel time.

Elaborated by Pedro Rezende Mendonça.



Graph 3: Total time spent for universal access.

Elaborated by Pedro Rezende Mendonça.

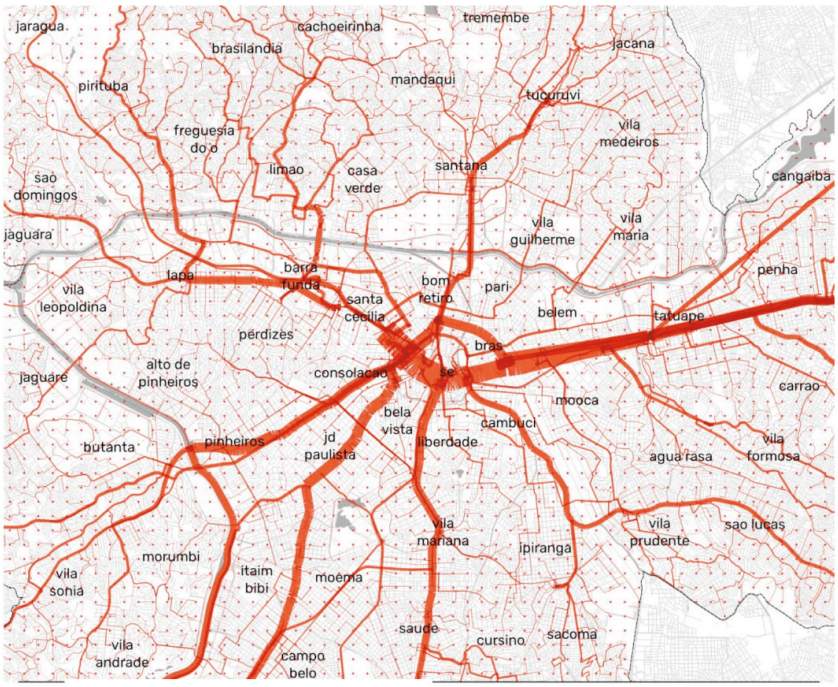


Figure 7: Main lines of access to: Parque Minhocão. The thicker it is, the more important it is for accessibility. Prepared by Pedro Rezende Mendonça based on Geosampa/State Department of the Environment/Center for Metropolis Studies.

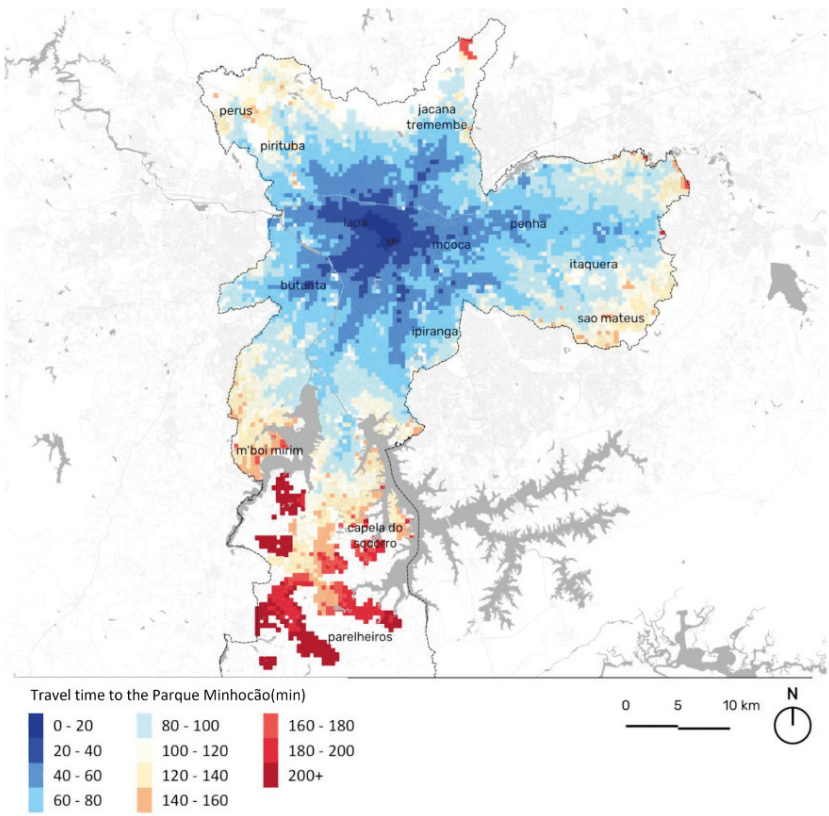


Figure 8: Isochronous access areas to the: Parque Minhocão. Elaborated by Pedro Rezende Mendonça based on the Geosampa.

statistical grid relies on census data, data such as income and family composition could be included to define target groups for these policies.

On the other hand, visitors to parks with a more local character – where universal access takes longer – may benefit from a restructuring of the local transport network, such as the creation of express bus lines to subway stations or the relocation of lines to service the gates of these parks.

As for open space planning and design, the time to universal access indicator can help define park categories based on accessibility rather than location. It is possible that some parks geographically outside urban centers, such as Parque da Juventude, have high accessibility and a potential metropolitan reach. Consequently, this value can help define which activities must be included in the parks program, and what type of infrastructure must be designed. In addition, the combination of results for pedestrians, cars and public transport provides subsidies for interventions in open spaces around the parks. It is possible to visualize which roads are priority for access, and thus design elements for traffic calming, signaling or parking strategies, for example.

More broadly, both methods of analysis presented together bring the planning of the free space system closer to mobility policies and everyday transport choices. The view behind these methods is that a city's transport infrastructure has an impact on people's travel decisions, and consequently, contributes to defining who uses which park in the city, when and how. For large-scale decision-making, these tools also provide information beyond traditional methods such as interviews or field counts.

Finally, the methods presented in the article contribute to operationalize the association between urban and landscape planning. The results bring information that can contribute to better conditions of mobility and use of public equipment in cities, if associated with design decisions and actions in public policies.

REFERENCES

Franz Aurenhammer (1991). Voronoi Diagrams - A Survey of a Fundamental Geometric Data Structure. ACM Computing Surveys, 23(3):345-405, 1991

BARTALINI, Vladimir. *Parques públicos municipais de São Paulo*: a ação da municipalidade no provimento de áreas verdes de recreação. 354 f. Tese de Doutorado. São Paulo: Faculdade de Arquitetura e Urbanismo, Universidade de São Paulo. 1999. P. 86 e p. 87.

CALLIARI, Mauro Sérgio Procópio. *O pedestre e a cidade:* mobilidade e fruiçãojuçg em São Paulo. 2019. Tese (Doutorado em História e Fundamentos da Arquitetura e do Urbanismo) - Faculdade de Arquitetura e Urbanismo, Universidade de São Paulo, São Paulo, 2019.

KLIASS, Rosa Grena; MAGNOLI, Miranda Maria Esmeralda Martinelli. Áreas verdes de recreação. Paisagem e Ambiente, São Paulo, FAU/USP, n. 21, p. 245-256, 2006.

OLIVEIRA, Gabriela. *Programa de Necessidades:* uma discussão metodológica. Trabalho final de graduação - Faculdade de Arquitetura e Urbanismo, Universidade de São Paulo, São Paulo, 2019.

MEYER, João Fernando Pires. *Demanda residencial* - adequação da análise de mercado imobiliário - o caso de São Paulo. 2008. Tese (Doutorado em Tecnologia da Arquitetura) - Faculdade de Arquitetura e Urbanismo, Universidade de São Paulo, São Paulo, 2008.

PANZINI, Franco. *Projetar a natureza.* Arquitetura da paisagem e dos jardins desde as origens até a época contemporânea. São Paulo, Senac São Paulo, 2013.

SAKATA, Francine Gramacho. *Parques urbanos no Brasil* - 2000 a 2017. 2018. Tese (Doutorado em Paisagem e Ambiente) - Faculdade de Arquitetura e Urbanismo, Universidade de São Paulo, São Paulo, 2018.

Te Brömmelstroet, M., Curtis, C., Larsson, A., Milakis, D., 2016. Strengths and Weaknesses of Accessibility Instruments in Planning Practice: Technological Rules Based on Experiential Workshops. European Planning Studies 24(6), 1175-1196.

WHATELY, Marussia; SANTORO, Paula Freire; GONÇALVES, Bárbara Carvalho; GONZATTO, Ana Maria. *Parques urbanos municipais de São Paulo:* subsídios para a gestão. São Paulo, Instituto Socioambiental, 2008.

Wulfhorst, G., Büttner, B., Ji, C., 2017. The TUM Accessibility Atlas as a tool for supporting policies of sustainable mobility in metropolitan regions. Transportation Research Part A: Policy and Practice 104, 121-136.