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URBAN ACCESSIBILITY AND SPATIAL SEGREGATION IN BRAZILIAN CITIES: A CONFIGURATIONAL PERSPECTIVE

Ana Paula Borba Gonçalves Barros
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DISCUSSION **PAPER**

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URBAN ACCESSIBILITY AND SPATIAL SEGREGATION IN BRAZILIAN CITIES: A CONFIGURATIONAL PERSPECTIVE[1]

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CONTENTS

ABSTRACT

This article investigates the use of the configurational variable, which deals with the city form-space relations regarding transportation issues, to study spatial segregation and urban accessibility in four Brazilian cities (Belém, Manaus, Recife and São Paulo), with a focus in precarious settlements and in the location of social classes in the urban space and their relative degree of accessibility/integration to the city as a whole.

The study searches to verify to what extent such settlements are more segregated/isolated in the urban fabric as compared to the other areas of the city. For this purpose, we have used the classification of census tracts prepared by the Centro de Estudos da Metrópole (CEM) of the Ministry of Cities of Brazil (Marques *et al.* 2007), based upon data from the 2000 demographic census of the Brazilian Census Bureau (IBGE, 2003), as well as axial maps of these cities, according to the methodological tools of the Theory of the Social Logic of Space, also known as Space Styntax, which allows quantifying the configurational variable by means of the so-called "integration value". The confrontation of the information, organized on a Geographical Informational System (GIS), has underpinned a series of interpretations over the existing process of "voluntary" and "involuntary" segregation in such cities, highlighting the importance of the configurational variable for urban studies of such nature.

Keywords: urban mobility; space syntax; spatial segregation; urban accessibility; integration.

SINOPSE

Este trabalho investiga o uso da variável configuracional, que trata das relações entre forma urbana-espaço no que se refere ao transporte, para estudar a segregação espacial e a acessibilidade urbana em quatro cidades brasileiras (Belém, Manaus, Recife e São Paulo), com foco nos assentamentos precários e na localização das classes sociais no espaço urbano e seu grau relativo de acessibilidade/integração à cidade como um todo.

O estudo busca verificar até que ponto tais assentamentos são mais segregados/isolados no tecido urbano em comparação com outras áreas da cidade. Para tanto, utilizamos a classificação de setores censitários elaborada pelo Centro de Estudos da Metrópole (CEM) para o Ministério das Cidades do Brasil (Marques *et al.* 2007), com base em dados do censo demográfico do Instituto Brasileiro de Geografia e Estatística-IBGE para o ano 2000

(IBGE, 2003) para o ano 2000, bem como em mapas axiais dessas cidades, de acordo com as ferramentas metodológicas da Teoria da Lógica Social do Espaço, também conhecida como Sintaxe Espacial, o que permite quantificar a variável configuracional por meio do chamado "valor de integração". O confronto das informações, organizado em um Sistema de Informações Geográficas (SIG), possibilita uma série de interpretações sobre o processo de segregação "voluntária" e "involuntária" existente nessas cidades, destacando a importância da variável configuracional para estudos urbanos desta natureza.

Palavras-chave: mobilidade urbana; sintaxe espacial; segregação espacial; acessibilidade urbana; integração.

1 INTRODUCTION

The research presents a preliminary approach on the insertion of the configurational variable in studies on the locational pattern, the residential segregation and the integration value (road accessibility) of the precarious settlements in four Brazilian cities (Belém, Manaus, Recife and São Paulo) and their level of segregation/integration with the entire city.

In this study, precarious settlements are assumed to be the census tracts classified by IBGE (2000) as special sectors of substandard agglomerations,[1] such as an "agglomeration constituted by a minimum of 51 dwelling units (shacks, houses) occupying until recently, land belonging to others (either public or private), generally disposed in a dense and wayward manner and lacking essential infrastructure services. They are also designated as informal settlements, slums ("favelas"), "mocambos", "alagados", etc., together with those sectors classified by the CEM as precarious ("those sectors identified by IBGE as regular but very similar to substandard sectors, according to socioeconomic, demographic and housing characteristics" – Marques, et al. 2007).[2]

The results related to the different types of census tracts and income levels of the household head in the four cities are then compared with the indicators of road accessibility (integration value). In the case of São Paulo we make a comparison of these indexes with the results of the integration indexes for the different neighborhoods of the city.

Our objective is to understand how the investigation of the different degrees of road accessibility distributed over the urban system, originated in the ways of articulation between the component elements of the city (spatial configuration), are able to reveal significant findings over the process of spatial segregation, what can contribute to the formulation, monitoring and evaluation of actions, projects and urban policies. In this sense we intend to insert the discussion of how the structure of the road network

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1 For the 2000 census, IBGE divided Brazil in 215.811 census tracts (smaller spatial disaggregation for statistical information, that corresponds roughly to 300 households), classifying them as regular sectors and special sectors of substandard agglomerations, boats, camping, prisons, asylum, indigenous camps etc. In Brazil there were 7.9891 census tracts classified as special sectors of substandard agglomerations by IBGE, 98% considered by CEM, that realized the study considering the 56 municipalities with population over 150 thousand inhabitants in 2000 (Marques et al. 2007).
2 For more details over the methodology and the variables used in the CEM study see Ferreira et al. (2007).

(design/layout of the roads), understood in its relational aspects, *i.e.*, the interdependence between the diverse component parts, is able to interfere in the circulation aspects (action of circulate), accessibility (capacity to reach a certain place) and spatial segregation (distribution of individuals by income, social class, race or any other factor related to the physical separation of the distinct social groups in space, according to their local of residence/housing conditions).

It is well known that the rapid urbanization process in Brazil, especially in the last decades of 20th century, is due to a series of factors: *i*) great industrialization; *ii*) rural-urban migration; *iii*) substantial demographic growth; and *iv*) public policies, that, associated, favored the great transformation of the urban spaces in the country. The investigation of the Brazilian case reveals that this urbanization or growth had occurred in a very fast way, mainly between 1960 and 1980 (Rolnik, 1998; Villaça, 2001; Santos, 2005), producing a contemporaneous scenery that presents several challenges to the improvement of the quality of life in the Brazilian cities.

Of its consequences, maybe the most visible, one corresponds to the process of spatial segregation in the urban space: the less favored strata tends to localize in the city suburbs or in slums in risky prone areas or not suitable for edification thanks to the high value of the urban soil, what progressively provokes the apartheid between the periphery, the slums and the active centers – understood as that part of the city to where converge, in quantity and quality, diverse uses and different flows (Hillier and Hanson, 1984; Hillier, 1996; Trigueiro et al., 2001). In this Brazilian "sprawl", the great distances, besides provoking an increase in average commuting distances, progressively produce an urban space that, fragmented, puts the different social groups apart (Barros et al., 2009, 2010 a, 2010 b e 2016; Holanda et al., 2008; Medeiros, 2006). Besides, it ends up to cause serious externalities to the urban agglomerations, taking into account that they provoke: *i*) an increase in the economic, social and environmental costs of urban transportation (infrastructure, maintenance, prices, urban sprawl, pollution and carbon emissions etc.), connected to *ii*) the process of reduction in the citizens capacity to move/circulate. Due to promotion of gradually greater distances, the movements to and from the central areas (but also to the diverse component parts of the city) are reduced, causing, then, serious implications to the urban mobility.

The definition of urban mobility is comprehensive and includes meanings related to the dynamics and permanence of the cities. Etymologically speaking, mobility relates to the movement or capacity to move what, in the end, includes the notions of circulation and accessibility in the urban space. So, above all, in the urban context, mobility is a mean, not an end. It incorporates a series of implications to mobility that enables the performance and the realization of social relations that exist in the city space. The analysis of the literature brings more specific meanings to urban mobility, that can be summarized by that one adopted by the Ministry Of Cities (Brasil, 2006), defining urban mobility as "an attribute of the cities that refers to the facility of movements of people and goods in the urban space. Such movements are made through vehicles, routes and all related infrastructure such as pavements, etc."

By this vision of the Ministry of Cities (Brasil, 2006), the facility of movement seems to be exclusively a product of the elements of infrastructure that serve as support to circulation, what reveals a strong content of space geometry, such as, the urban mobility as a dependent variable of the organization, function and performance of routes and pavements, etc. As noticed, this concept is restricted to the transport field, and does not incorporate other features or variables that seem important to the evaluation of the capacity to move. According to Vasconcellos (2001), the interpretation of urban mobility needs to go beyond the questions that deal only with spatial geometry and space project and should incorporate variables such as land use, income, employment, age, gender, schooling, household size, etc., expanding the items that influence the performance of such movements.

This paper presents precisely an effort in such sense, by incorporating in the study of urban mobility and accessibility, questions related to spatial segregation by census tract, neighborhood, and household income strata. To this set of variables that are important either by: *i*) questions of traffic engineering; or *ii*) insertion of the socio-economic aspects of the people involved, still lacks a view that incorporates the spatial structure of the city, in its complex network of interactions, as a variable of significant importance to urban mobility – what implies, then, the insertion of the configurational variable in the analysis (figure 1).

FIGURE 1
Distinct spatial structures generate distinct patterns of movements
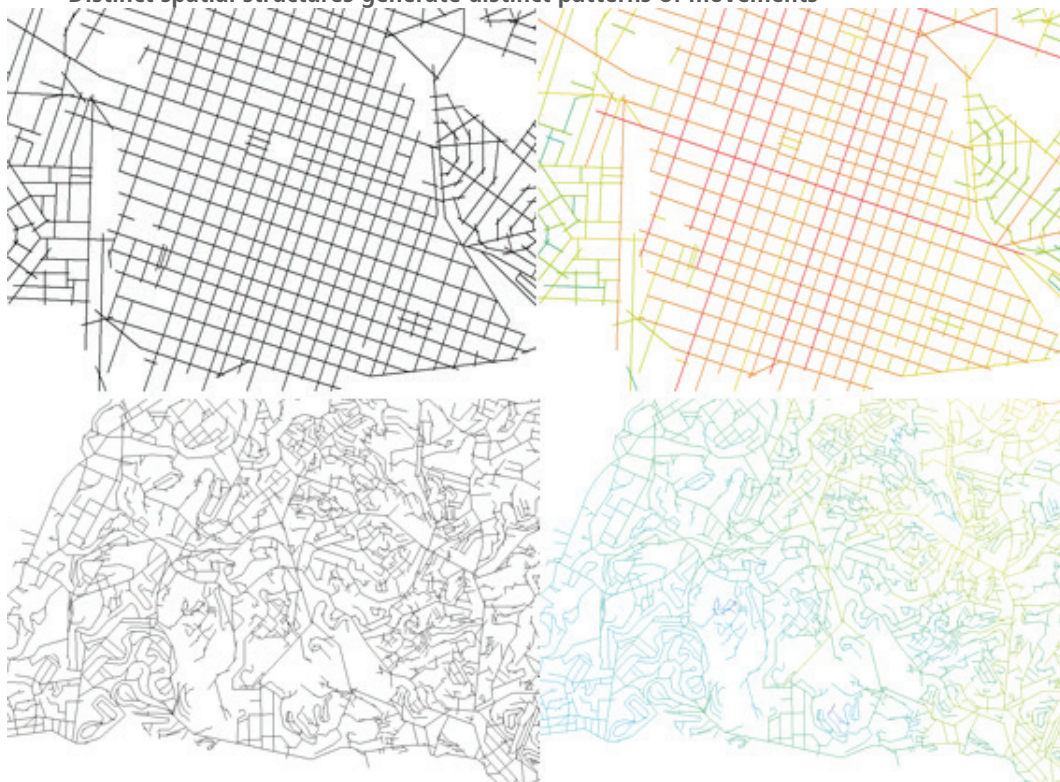
Elaborated by the authors.

Obs: above Pelotas-RS and its regular grid in a chess table format; below, Salvador-BA and the significant irregularity of its street network map – the colors represent the

potential movements: red colours means higher integration while blue colours means lower integration.

This first section presented a general introduction about the themes of precarious settlements, spatial structure of cities and urban mobility, in the light of the urbanization process in Brazil. The methodological considerations relative to the space syntax and the procedures adopted in the study are described in section 2. Section 3 presents the preliminary results of the research for the four cities selected in the study, besides showing in more detail the case of São Paulo municipality, considering the results of a previous study by one of the authors about the integration values among the neighbourhoods of São Paulo municipality. Last, section 4 presents the main conclusions of the article.

2 METHODOLOGICAL PROCEDURES

2.1 About the theory of the social logic of space

As a theoretical and methodological tool to discuss spatial segregation and road map configuration/form, we have adopted the Theory of the Social Logic of Space, more well-known as space syntax, that investigates the space from the social logic incorporated in it. For this research, it means to say that in the conception of urban space there are implicit (or explicit) social attributes that belong to the society that builds it, according to a series of expectations, including the ones of circulation.

The objective of the space syntax is to study the relations between the architectonic space – also understood as the urban space – and society – seen as a system of the possibilities of meetings (Holanda, 2002). The creation of this theory, supported by systemic and structural thoughts (Hillier, et al., 1993; Lefebre, 1999), derives from the worry that according to Hillier and Hanson (1997), "the (space) theories had been extremely normative and less analytic".

We propose that, instead of postulating a formulation and try to fit it in the urban space at any cost, it will be necessary to study the subject till exhaustion, and try to find general properties of its related schemes (Medeiros, 2006). To the authors of this theory, the gradual development of the techniques had convinced them that there is, in the investigation of space, a very important relational property called "configuration" (Hillier and Hanson, 1997). Configuration, therefore, is a basic property found in the relations among city parts (blocks, streets, open spaces, etc.), revealing how different urban layout patterns produce distinguished relational performances. Configuration, based on this point of view, is a complex of interdependency relations in space with two fundamental properties – the configuration is different when seem from: *i*) different points within the same system; and *ii*) only from a part of the system. Due to changes in one of the elements of system or in one relation, the entire system can be altered in various degrees. The interpretation of the variations in the configuration can reveal attributes derived from the interaction of the space form and different processes associated to circulation, accessibility and urban mobility.

The investigation of these associations can reveal new interpretations about the urban phenomena, bringing information about the movement related questions that occur in the city. About this subject, engineers, architects and urban planners, when looking over the space, several times do not understand that their focus of action surge and is a product of a series of complex relations associating different components. Either the physical objects (buildings, neighborhoods, roads and circulation systems) or these relations are a product of the concept of space and represent properties closely related to their functioning.

In terms of tools, the space syntax, offers instruments to understand and represent the urban space. Of the recommended strategies, the linear representation is useful to investigate the movement and its related urban aspects and is the one that better applies to big systems and structures such as the city. The linear representation is obtained designing over the road network, from the available cartographic base, the smaller number of possible lines that represent the direct accesses through the urban space. After the processing of such lines, we can generate a matrix of intersections, from where are calculated, by especially programmed applications, values that correspond to their axial inter-relations (Hillier and Hanson, 1984; Hillier, 1996; Holanda 2002; Medeiros, 2006), representing the potential of attraction of the flows and movements of a certain axis within the urban system, called the value or potential of integration, accessibility or permeability. Such values can be represented numerically or by a chromatic scale with graduation going from red, passing through orange, green until reaching blue – where the more integrated axis tend to red and the less integrated to blue – what produces the so called axial map (figure 2).

FIGURE 2

Axial map of the municipality of Belém – Pará
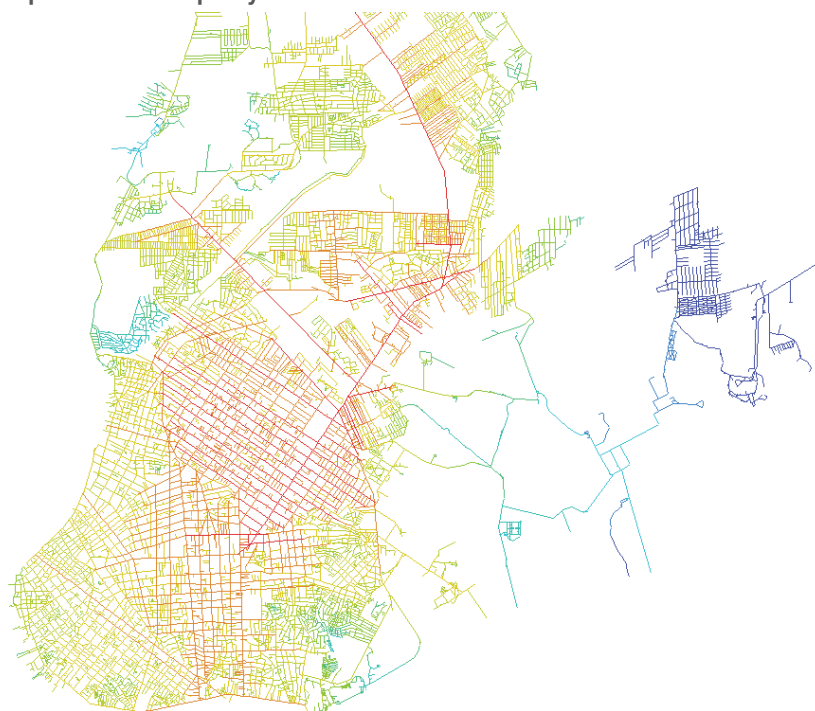
Elaborated by the authors.

The more integrated axis are those more permeable and accessible to the urban space, from where it is easier to reach the others. They imply, on average, the shorter topological ways to be reached from any other axis of the system. More integrated axis tend to assume a position of control, once they can connected themselves to a higher number of axis and hierarchically present a higher potential of integration. To the set of the more integrated axis is given the name of integration core.

From this information, can be inferred that from the procedures that investigate the configuration of the road network of a city, the simulations done by the spatial syntax consist of an instrument able to measure, quantify and distinguish different levels of connections between each road and the system where it is inserted, establishing in such way correlations, connections and hierarchy between the roads and the urban complex (Medeiros, 2006). This permits, consequently, the visualization of the road network in several gradations of the potentials of flows and movements, that is, of integration. It becomes perceptive the definition of areas with a predominance of axis with high potential of movement in opposition to those peripheral areas with less flows. We have, in such way, a valuable tool to study urban mobility by facilitating that factors related to urban configuration can be quantified mathematically and easily visualized and therefore can be correlated with several information that involves movement and circulation.

2.2 Social Data Procedures

After the survey of the information on accessibility of the axial maps (derived from the study by Medeiros, 2006) for *i*) the urban systems as a whole; *ii*) the census tracts classified as substandard by IBGE; *iii*) the census tracts classified as precarious by CEM; and *iv*) the other urban sectors, the data was compared with information on head of household income in minimum wages, collected at CEM data base. Our objective was, then, to verify what are the most common patterns of spatial segregation, according to GIST and FAVA classification (*apud* Villaça, 2001) in voluntary segregation (when the individual or the family opts for isolation) and involuntary segregation (when the individual or the family is forced to live in certain areas of the city). All the information was displayed in a GIS software, in order to help the visual and statistical correlation of the variables.

3 ANALYSIS AND MAIN RESULTS

This section presents the preliminary results of Ipea study on space syntax and residential segregation for the municipalities of Belém, Manaus, Recife and São Paulo. Table 1 shows the population living in precarious settlements, that corresponds to the sum of people living in IBGE substandard census tracts (A) and the sectors classified as precarious by CEM, whose socioeconomic characteristics are similar to substandard sectors (B). As we can see, the highest level of precarious housing in relative terms is found in the cities of the North region, mainly in Belém municipality, where more than half of the population lives in precarious settlements. São Paulo presents the highest absolute numbers of the problem, with almost 1.5 million people living in precarious settlements. Manaus and Recife also present percentage of precarious housing above the national average (14.1%).

By analyzing the variables of head of household income level and type of sector versus the road accessibility originated from the axial maps, we can notice that there is a positive correlation for all the studied cities, as there is a clear tendency of high income people or the residents of regular/ non-special census tracts (proxy for medium and high class neighborhoods) to locate near the more central areas or in areas of higher degree of accessibility. Such parts of the city, as revealed by the maps, coincide with the so called active centers or integration core, that is, areas with a higher number of roads potentially more accessible to the circulation system as a whole (red axis).

TABLE 1

Population living in precarious settlements in urban areas (including rural areas of urban extension), by sector and municipality- 2000

Municipality	People in substandard sectors (A)	People in precarious sectors (B)	People in precarious settlements (A + B)	Total population	% people living in precarious settlements
Belém	447,915	205,039	652,954	1,268,230	51.49
Manaus	166,870	193,006	359,876	1,389,892	25.89
Recife	134,317	121,990	256,307	1,413,119	18.14
São Paulo	902,490	557,158	1,459,648	10,215,800	14.29

Source: CEM (2007), based on IBGE 2000 Census microdata.
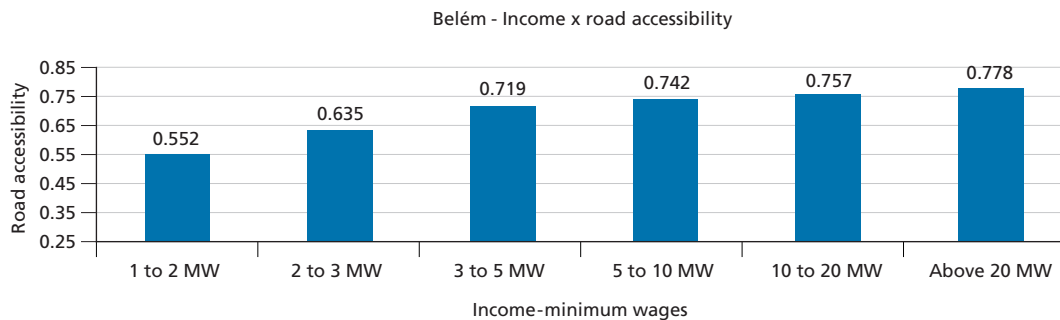Elaborated by the authors.

For the four studied cities, we have observed that as the income level increases there is a tendency for a progressive increase in the average integration value, what means higher accessibility/proximity to the urban active center and therefore higher facility of movement (graph 1). On the other hand, the smaller the income level the higher the distance to the urban center, expressing how much accessibility is a good indicator of social status in Brazil, except for the cases of voluntary segregation. Finally, accessibility

is a good that is positively incorporated, especially by the real estate market and that is reflected in the price of housing.

When we observe the average degree of integration for CEM precarious tracts (proxy for peripheral allotments) and IBGE substandard sectors (proxy for slums) in relation to the averages for the regular/non-special sectors (proxy for medium and high income neighborhoods) and for the city as a whole (figure 4), except for Recife, where the location pattern of precarious settlements is relatively more central, it is perceptive how much these spaces related to precarious settlement belonging to A and B groups are less accessible and present lower integration averages, except when located near the city center, in marginal areas with high level of inclination/slope and river and lakesides, mainly. On average, in general, the IBGE substandard sectors present more central locations when compared to CEM precarious sectors, reaffirming the results of other studies on the subject, that argue that the population living in slums search for locations near employment centers (Morais et al., 2003).

In Belém, for instance, the study confirms that medium and high income classes (head of household income above twenty minimum wages) are located in the noble areas of the city (Nazaré and Batista Campos neighborhoods), located near the integration core (figures 5 and 6). Even in smaller scale, there are also sectors of closed condominiums, with high household income level, located in peripheral areas such as Parque Verde neighborhood, what represents the scenery of voluntary segregation in the so called fortified enclaves or gated communities, as Caldeira (2000) defines.
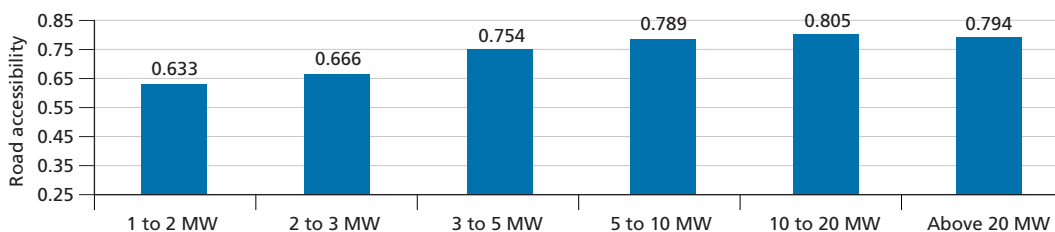
GRAPH 1
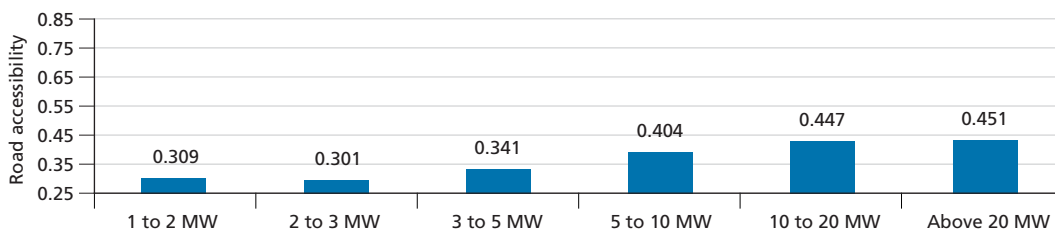**Average head of household income and road accessibility**
(In minimum wages)

Belém - Income x road accessibility

Manaus - Income x road accessibility
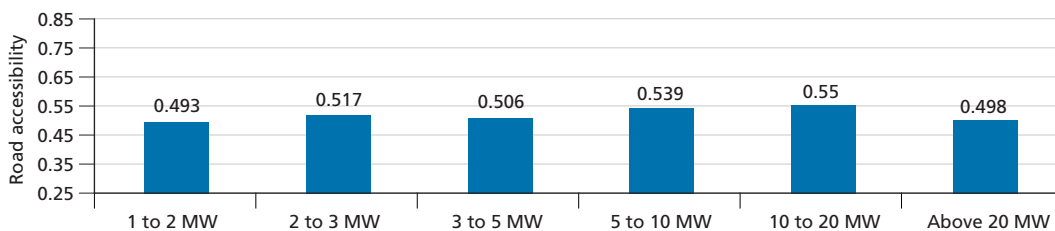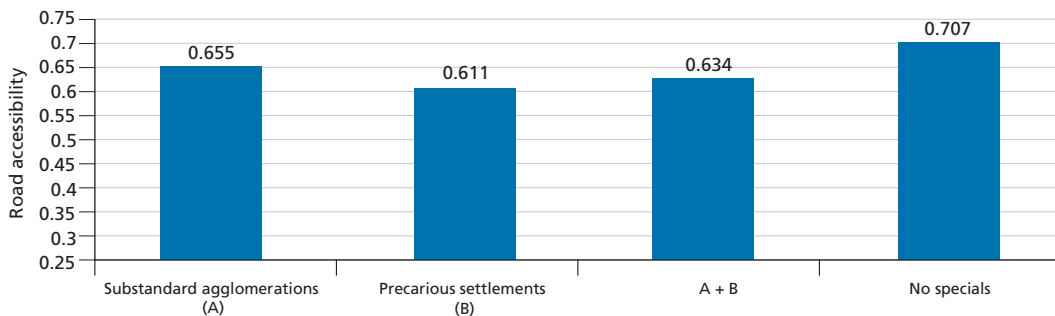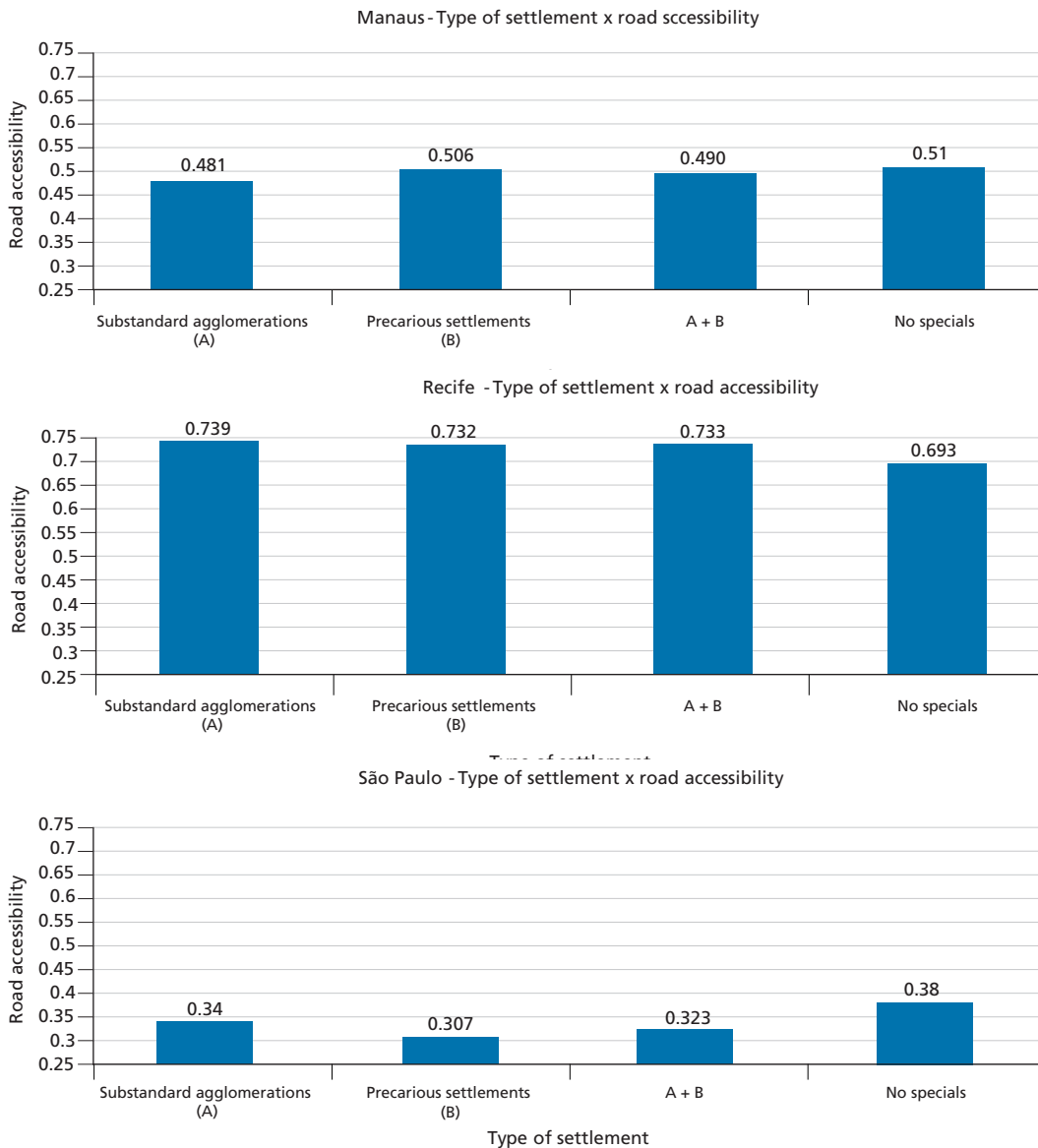

Recife - Income x road accessibility

São Paulo - Income x road accessibility

GRAPH 2
Type of settlement and road accessibility

**Belém - Type of settlement x road accessibilty**

Manaus - Type of settlement x road sccessibility

Recife - Type of settlement x road accessibility

São Paulo - Type of settlement x road accessibility

Elaborated by the authors.

It is important to clarify, however, that such scenery of voluntary segregation is relative, because despite the higher distance, such areas tend to be accessible from express roads that reduce distance, like the BR 316, that acts as the continuation of Almirante Barroso Avenue and penetrates Belém, in the format of one of the higher accessible road of the system. On the opposite side, cases of involuntary segregation are located in the neighborhoods of Terra Firme and Guamá, with low accessibility in relation to the entire urban system, that present average household income around one to three minimum wages, conforming patterns of precarious settlements (figure 5).

FIGURE 3
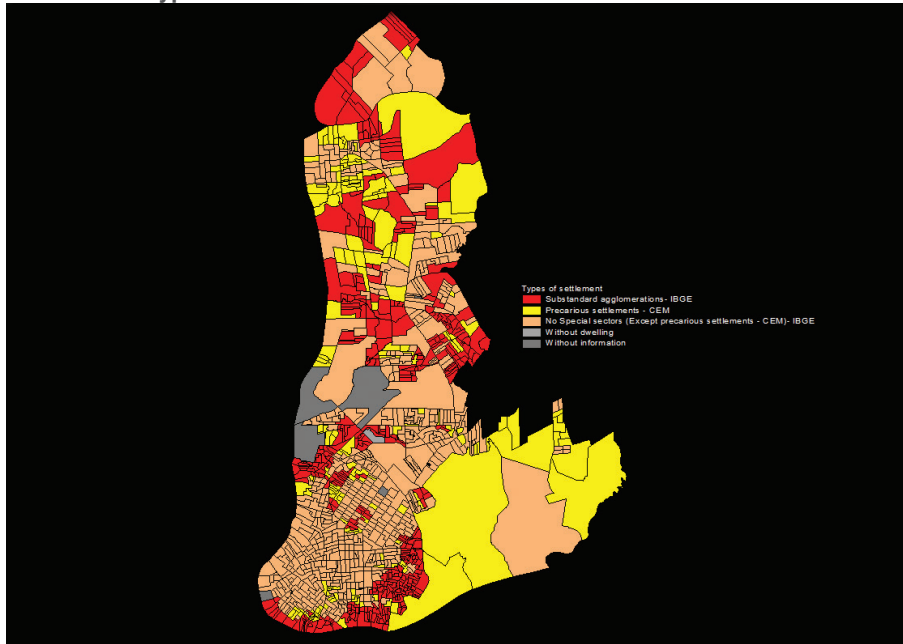**Belém: average income of the head of household**
(In minimum wages)
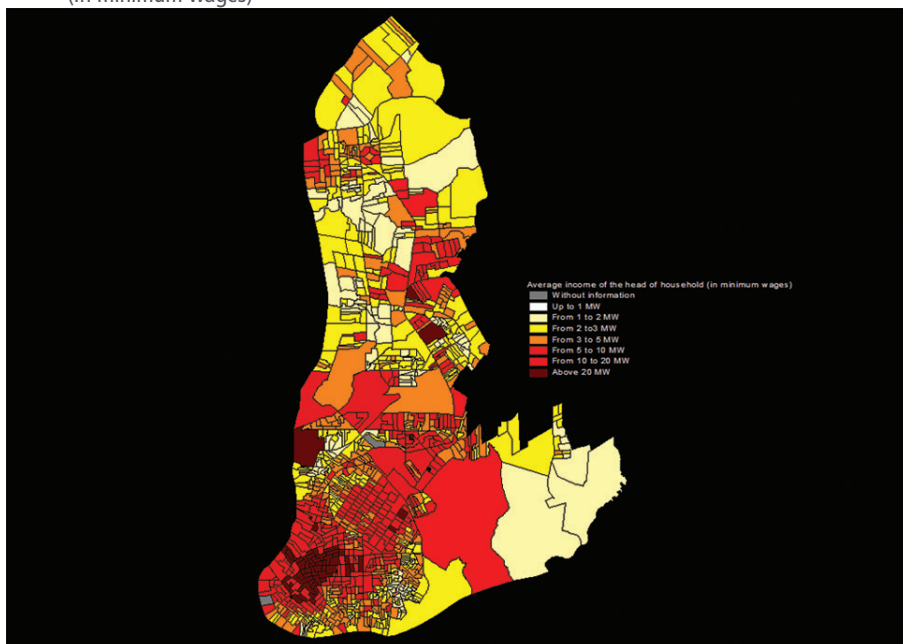
Elaborated by the authors.

FIGURE 4
Belém: axial map
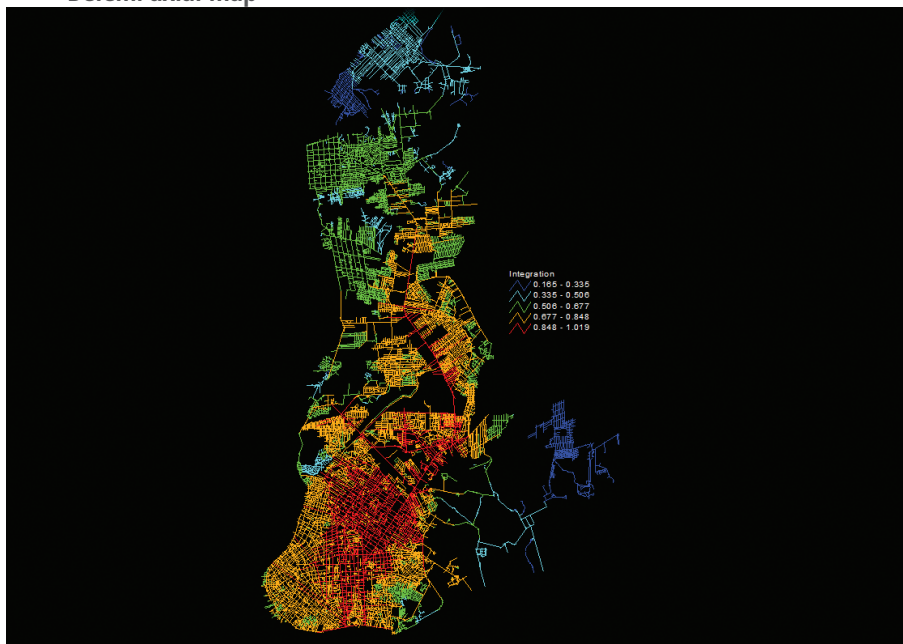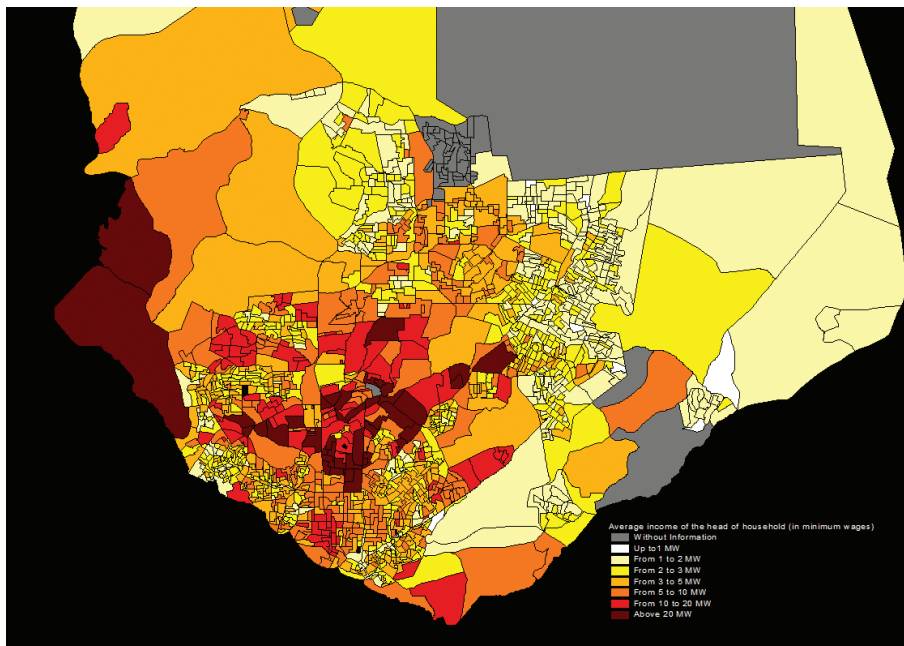

Elaborated by the authors.

FIGURE 5
Belém: type of settlement
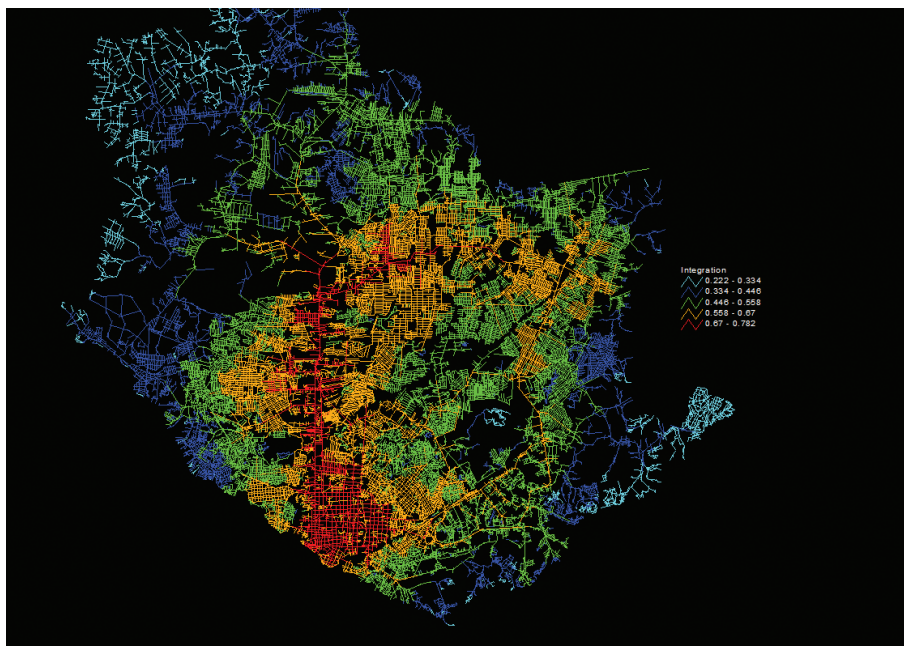

Elaborated by the authors.

In Manaus, the medium income and medium-high income classes are located near the urban center, accompanying its active center or integration core (figures 6 and 7), and its distribution can be considered in dispersed when comparing to Belém. In Manaus volunteer segregation also occurs, especially in the Ponta Negra – neighborhood in the west part of the city, that concentrates a good parcel of the population whose the head of household average income level is above twenty minimum wages. The lower income classes are located near the center to the south, occupying marginal areas derived from land filled water streams, or more distant areas to the north and the east, what can be noticed by the strong presence of precarious and substandard sectors in those areas (figure 8).

FIGURE 6
Manaus: average income of the head of household
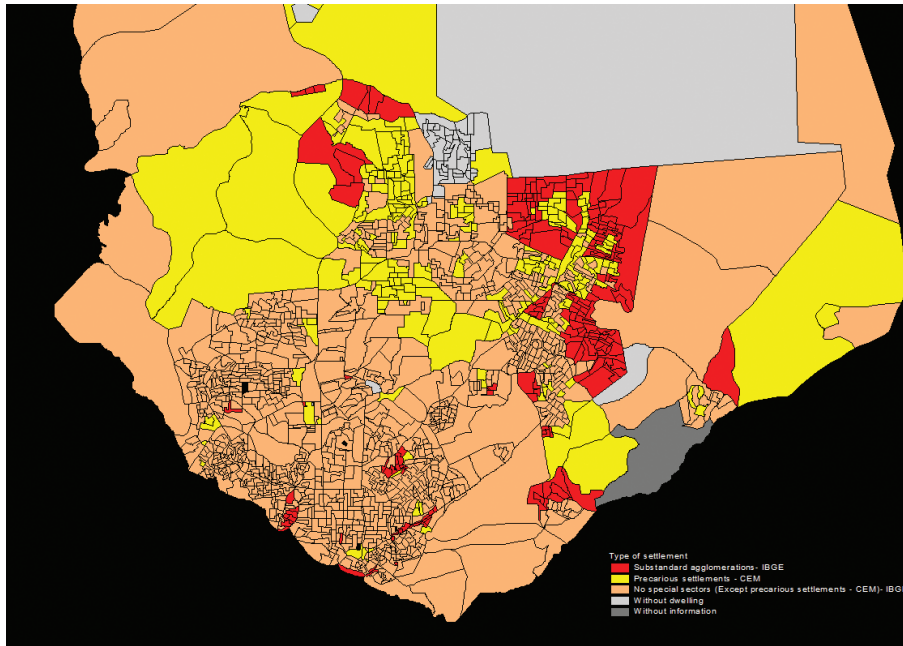(In minimum wages)

Elaborated by the authors.

FIGURE 7
Manaus: axial map
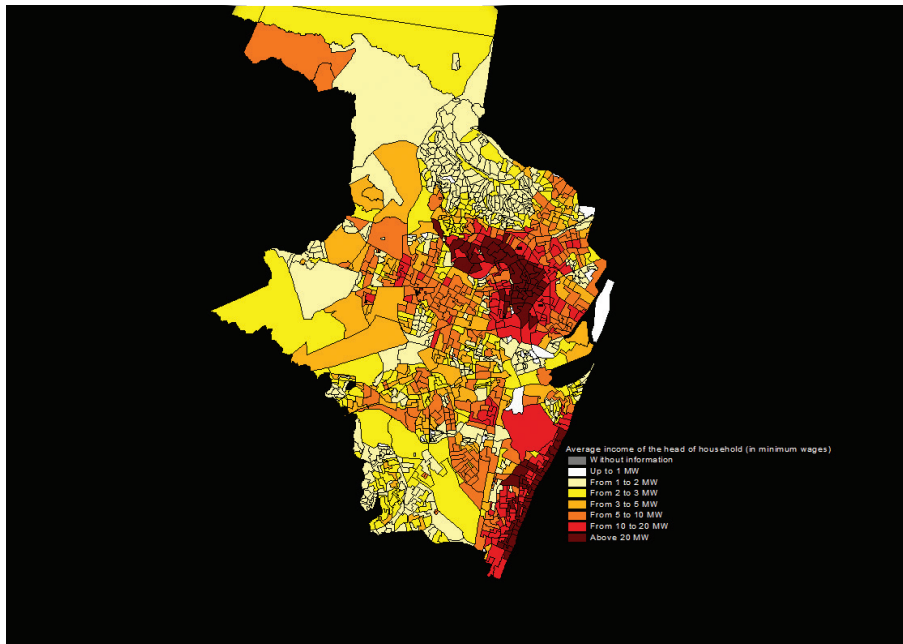

Elaborated by the authors.

FIGURE 8
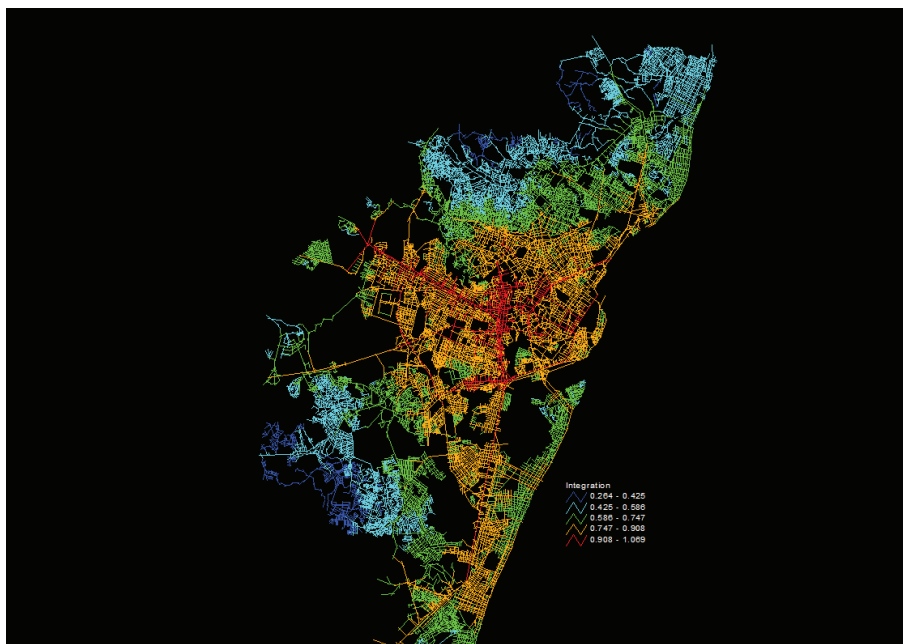**Manaus: type of settlement**

Elaborated by the authors.

In Recife, the active urban center (figure 10) is located in the center north part of the city, coinciding with Graça neighborhood, that concentrates the high income households (above twenty minimum wages – see figure 11). The Boa Viagem neighborhood corresponds to a hotspot of voluntary spatial segregation, as the income levels are similar to the ones in Graça, the same happening in the south expansion, still going through the municipality of Jaboatão dos Guararapes (figure 11).

FIGURE 9
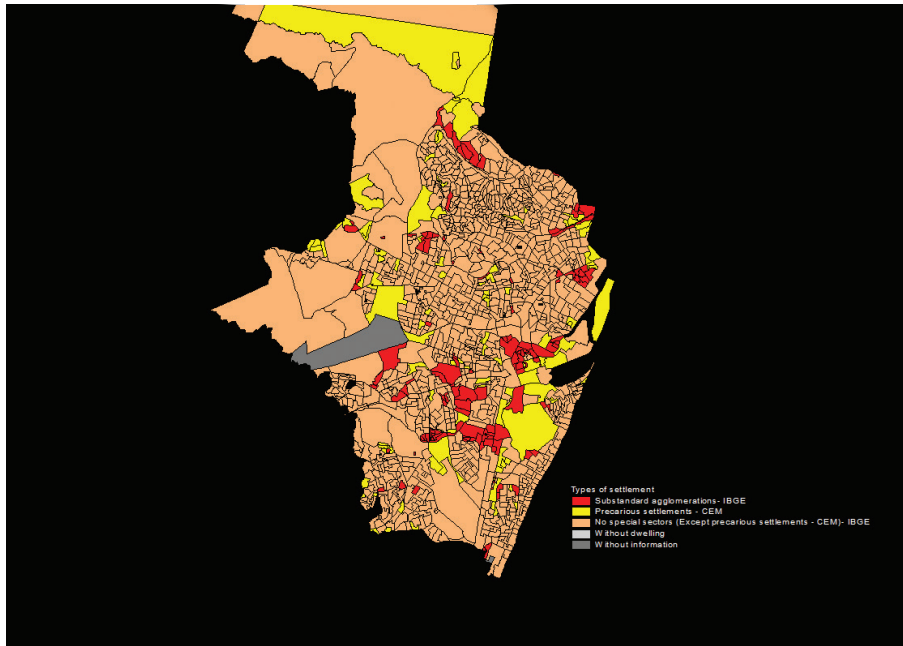**Recife: average income of the head of household**
(In minimum wages)

Elaborated by the authors.

FIGURE 10
Recife: axial map
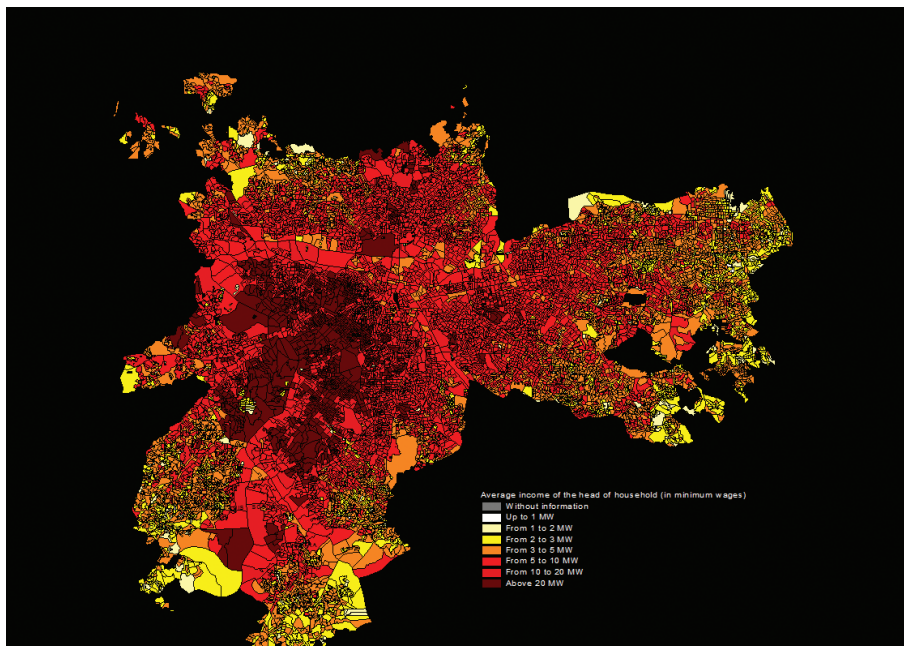

Elaborated by the authors.

FIGURE 11
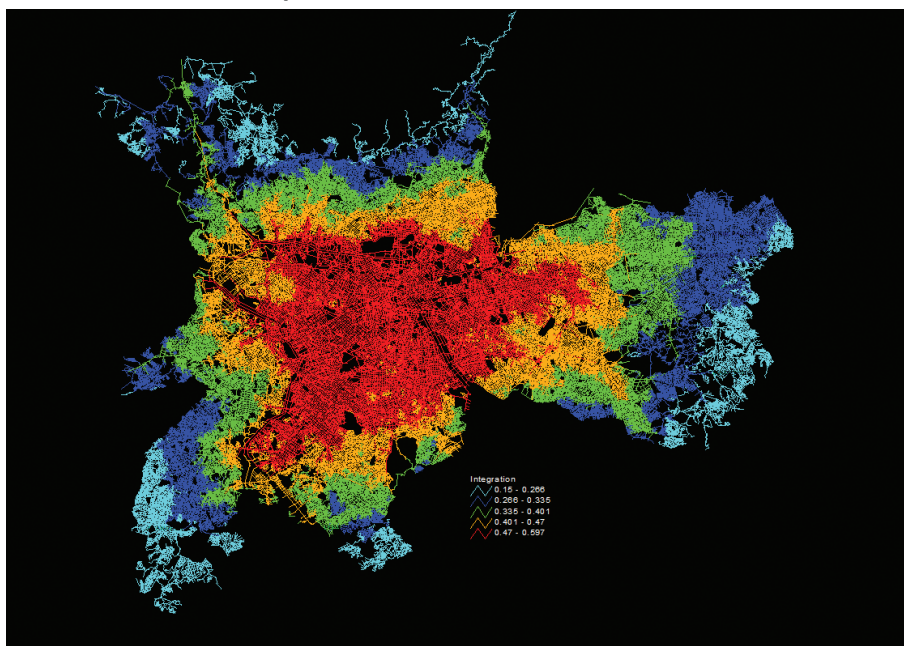**Recife: type of settlement**

Elaborated by the authors.

Finally, in the case of São Paulo, the higher income bracket (above twenty minimum wages – figure 12) is localized in the middle east of the city, in the neighborhoods of Morumbi, Jardim Paulista, Alto de Pinheiros, Pinheiros, Santo Amaro, Vila Andrade, Moema, all with high road accessibility (figure 13). In these neighborhoods there are almost no census tracts classified as substandard or precarious, that are common in peripheral areas such as the neighborhoods of Capão Redondo, Pedreira, Jardim Angela, Grajau, São Rafael, Jardim Helena, Itaim Paulista, Lajeado, Cidade Tirandentes, Jaragua, Brasilandia, among others, characterizing a situation of involuntary segregation (figure 14).

FIGURE 12
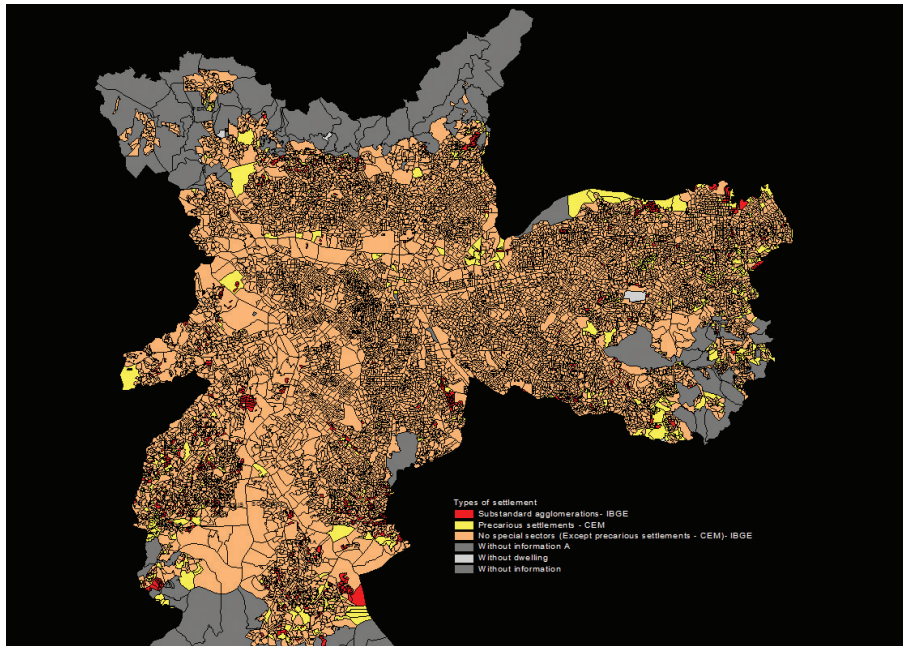**São Paulo: average income of the head of household**
(In minimum wages)

Elaborated by the authors.

FIGURE 13
São Paulo: axial map

Elaborated by the authors.
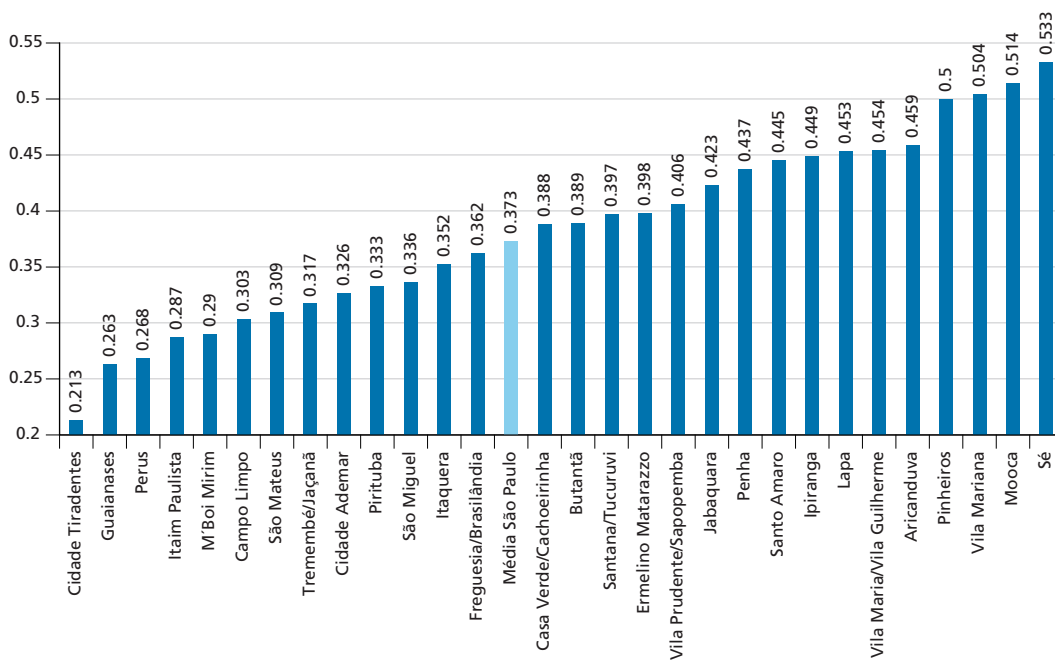
FIGURE 14
São Paulo: type of settlements

Elaborated by the authors.

In São Paulo, if we analyze the values of integration by districts, we find that those with higher purchasing power correspond to the more accessible areas, like what happens in Pinheiros (0.500) and Vila Mariana (0.504). The opposite situation is also true: Cidade Tiradentes presents the lowest integration value in the city, with only 0.213 (graph 3).

An experiment to compare the performance of some neighborhoods located at the same distance from the Se/República region (8.5 km) reveals the continuity of such trend (figures 18 and 19): the highest the purchasing power, the higher the integration value (Mandaqui: 0.338; Tucuruvi: 0.404; Freguesia do O: 0.410; Butantá: 0.432; Morumbi: 0.438; Alto de Pinheiros: 0.466; Itaimbibi; 0.509). From what we can see, the accessibility to the urban space, resulting from its configuration, tends to be a good indicator of income concentration, once accessibility is also converted in an economic good: more permeable areas, in thesis, are those with greater mobility, and, usually, with the highest market value.

GRAPH 3

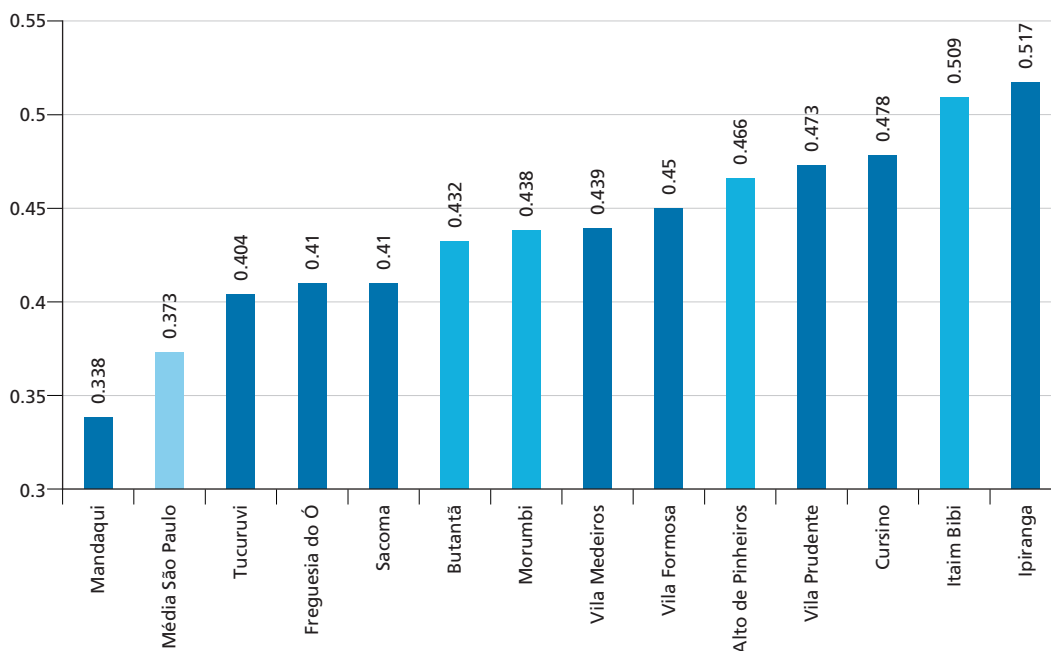**São Paulo: road accessibility value of integration by district**

Elaborated by the authors.

FIGURE 15
São Paulo: selected neighborhoods for analysis
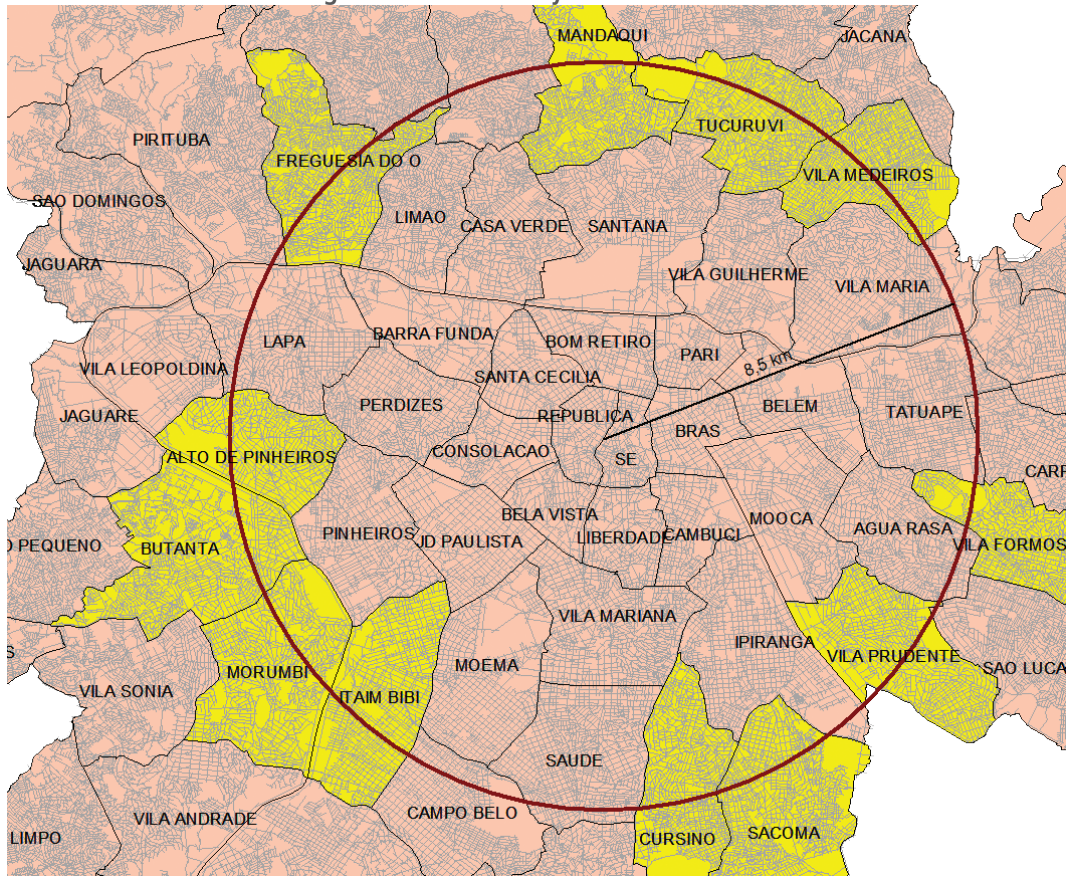

Elaborated by the authors.

GRAPH 4
São Paulo: average integration by selected neighbourhoods

Elaborated by the authors.

Finally, for the last variable – average road accessibility or integration – we have verified that, among the studied cities, São Paulo is the one that possesses an urban grid with less road accessibility (0.373 – graph 5). According to Medeiros (2006), this value results from a labyrinthine urban form, with strong irregularity and discontinuity of its road axis (figure 13). Belém, on the other hand, presents the highest road accessibility index (0.651), resulting from an urban grid where roads are more straight and there is a strong continuity among the axis, producing a less labyrinthine pattern and therefore, more permeable system (figure 4). Recife has an accessibility index very close to Belém (0.650), showing a good integration of the system with the entire city, what is the result of a more continuous and regular road network (figure 10). Manaus, on its turn, presents a medium integration value, among the four cities, indicating the existence of a road network sometimes continuous sometimes fragmented, a product of a physical space with high incidence of small watercourses called "igarapés" (figure 7).

GRAPH 5
Average integration values of the studied cities, comparing to other Brazilian state capitals
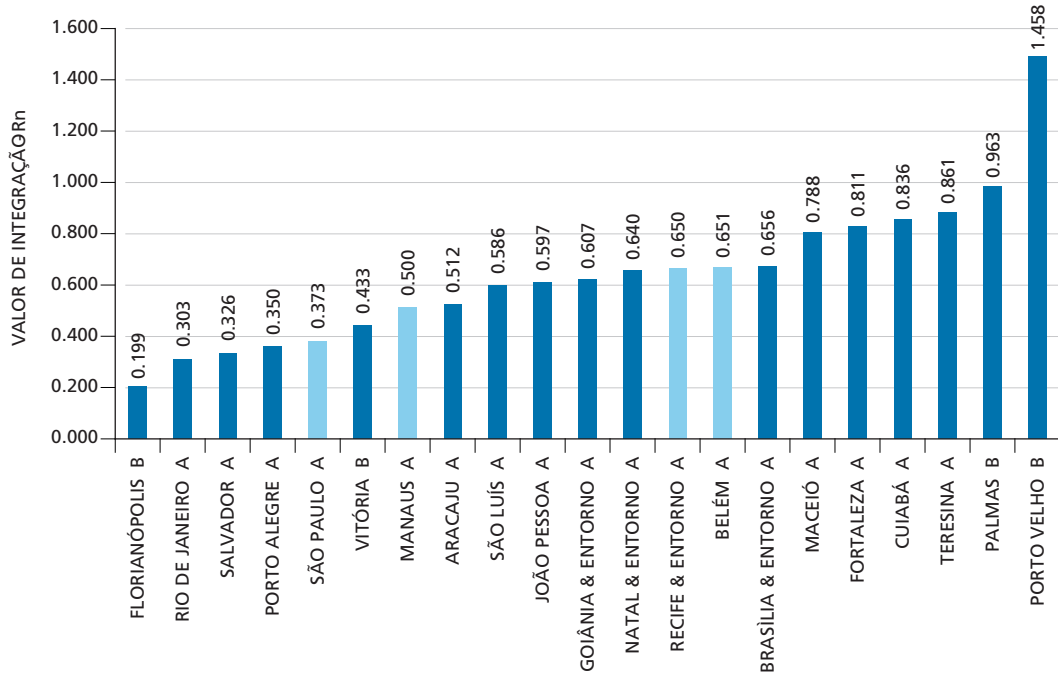
Source: Medeiros (2006).

4 CONCLUSIONS

From our results, specifically obtained from the Brazilian sample, we can observe that the spatial urban structure, revealed in its configurational aspects, seems to contribute for a clearer understanding of the phenomena of spatial segregation in the cities of Brazil.

Historically the cities have been treated in the literature according to the distinct degrees of geometry in its road network (Kostof, 1992; 2001; Teixeira, 2000; Morris, 2001; Reis Filho, 2001), usually classified between the extremes of irregularity (organic patterns, with design of complex geometry) or regularity (planned patterns, whose resulting structure is based mainly in grids, linear models or radial schemes).

Apart from the discussion of the layout of the cities and of the social expectations that have promoted the consolidation of one of the two patterns of road network, it is interesting to understand in what way such patterns – taking from a relational

point of view, that is, in the relation of interdependence between all the component parts of the system – affect the urban accessibility in cities, according to the distinct composition of its spatial structure. It means to observe how the layout of the components of the circulation system (patterns of the circulation structures related to road design, forms of connections, existence of nodes, the size of the links, the high or low density of the roads, etc.) interferes in mobility, resulting in restrictions or enabling conditions for road accessibility. It has a direct impact on the aspects of the spatial segregation of social classes in space, as confirmed by our results, where the low income populations or the residents of precarious settlements have lower levels of urban mobility and, therefore, less access to the entire urban system, what represents a deny in their human right to the city.

We conclude, then, that the configurational approach verified by the use of axial maps, contributed to the study of spatial segregation and urban mobility in the four studied cities, showing that the configuration of the road network is a relevant aspect to explain some of the urban problems related to social apartheid/inclusion and physical segregation /accessibility in the Brazilian cities. It happens that the spatial hierarchy depends directly on the modes of relationship among the different components of the circulation system, in their various degrees of regularity or irregularity in what regards to its spatial structure, what tends to be one of the most robust expressions of the distribution of social classes in the city.

REFERENCES

BARROS, A. P. B. G.; MEDEIROS, V. A. S.; MORAIS, M. P. A. Configuração espacial para o diagnóstico dos assentamentos precários no Brasil. *In*: ENCONTRO ANUAL DA ANPOCS, 33., 2009, Caxambu, Minas Gerais. **Anais**... São Paulo: Anpocs, 2009. v. 1.

_____. Spatial segregation and urban accessibility in Brazilian cities. *In*: ANNUAL CONFERENCE ON PLANNING RESEARCH, 3., 2010, Porto, Portugal: Universidade do Porto, 2010a.

_____. A new issue for transport mobility and spatial segregation agenda: the configurational focus. *In*: WORLD CONFERENCE ON TRANSPORT RESEARCH SOCIETY, 12., 2010, Lisboa. Portugal: Instituto Superior Técnico, 2010b.

_____. A configuração espacial para o diagnóstico dos assentamentos precários no Brasil. *In*: MORAIS, M.P.; KRAUSE, C.; LIMA NETO, V. C. **Caracterização e tipologia de assentamentos precários**: estudos de caso brasileiros. Brasília: Ipea, 2016.

BRASIL. Ministério das Cidades. **Brasil acessível** – Caderno 2. Brasília: Secretaria Nacional de Transporte e da Mobilidade Urbana. 2006.

_____. Ministério das Cidades/ Secretaria Nacional de Habitação. **Política Habitacional e a Integração Urbana de Assentamentos Precários**: Parâmetros conceituais, técnicos e metodológicos. (2ª reimpressão) Brasília: Ministério das Cidades. 2008.

CALDEIRA, T. **Cidade de muros** – crime, segregação e cidadania em São Paulo. Editora 34/ EdUsp: São Paulo, 2000.

FERREIRA, M. P. et al. Uma metodologia para a estimação de assentamentos precários em nível nacioanal *In*: BRASIL. Ministério das Cidades/Secretaria Nacional de Habitação. **Política Habitacional e a Integração Urbana de Assentamentos Precários**: parâmetros conceituais, técnicos e metodológicos. (2ª reimpressão) Brasília: Ministério das Cidades, 2008.

HILLIER, B. et al. **Natural movement**: or, configuration and attraction in urban pedestrian movement. Environment and Planning B, Londres: Pion Publication, 1993.

_____. **Space is the machine**. Londres: CUP, 1996.

HILLIER, B.; HANSON, J. The reasoning art. *In*: 1st International Space Syntax Symposium 1997. **Proceedings**… Londres: SSL/UCL, 1997.

_____. **The social logic of space**. Cambridge Press: Cambridge, 1984.

HOLANDA, F. **O espaço de exceção**. Brasília: Editora UnB, 2002.

HOLANDA, F. et al. Brasilia, Brazil: economic and social costs of dispersion. *In*: 44th. ISOCARP Congress, 2008. **Proceedings**… Dalian: ISCRP/UPSC. 2008.

IBGE – INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. **Censo Demográfico 2000**: agregado por setores censitários dos resultados do universo. 2. ed. Rio de Janeiro: IBGE, 2003.

KOSTOF, S. **The city assembled**. Londres: Thames and Hudson, 1992.

_____. **The city shaped**. Londres: Thames and Hudson, 2001.

LEFEBVRE, H. **Writings on cities.** Oxford: Blackwell, 1999.

MARQUES, E. et al. **Assentamentos precários no Brasil urbano**. Centro de Estudos da Metrópole/ CEBRAP; Secretaria Nacional de Habitação; Ministério das Cidades, 2007. Disponível em: <http:// www.centrodametropole.org.br/mc/assets/pdfs/assentamentos_web.pdf>. Acesso em: 20 Sep. 2009.

MEDEIROS, V. **Urbis brasiliae ou sobre cidades do Brasil**. 2006. Tese (Doutorado) – Faculdade de Arquitetura e Urbanismo; Universidade de Brasília, Brasília, 2006.

MORAIS, M. P. et al. **Residential segregation and social exclusion in brazilian housing markets**. Brasília: Ipea, 2003. (Texto para Discussão, n. 951).

MORRIS, A. **Historia de la forma urbana**. Barcelona: GG, 2001.

REIS FILHO, N. **Evolução urbana do Brasil 1500/1720**. São Paulo: Pini, 2001.

ROLNIK, R. **O que é cidade**. São Paulo: Brasiliense, 1998.

SANTOS, M. **A urbanização brasileira**. São Paulo: Editora da USP, 2005.

TEIXEIRA, M. **Imagens do arquivo virtual da cartografia urbana portuguesa**. Lisboa: CEUA/ISCT, 2000.

TRIGUEIRO, E. B. F. et al. Disneyfication now?: assessing spatial correlates for heritage preservation in Natal, Brazil. *In*: Space Syntax 3rd International Symposium. 2001, Atlanta, **Proceedings**… Atlanta: Georgia Institute of Technology, 2001.

VASCONCELOS, E. **Transporte urbano, espaço e equidade**. São Paulo: Annablume.

VILLAÇA, F. **Espaço intra-urbano no Brasil**. São Paulo: Nobel, 2001.

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