Sustainability Principles for the Urban Environmental Rehabilitation

The case of the city of Manaus, Amazonas, Brazil.

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ABSTRACT: This article aims to analyze the conditions of the environmental degradation in the city of Manaus – capital of the state of Amazon, Brazil – proposing the environmental rehabilitation and qualifying the urban environment of a fraction of the urban space, particularly a part of the Djalma Batista Avenue subjoined south / north connecting the sectors of suburb to downtown. This environmental rehabilitation is supported on two principles of urban sustainability and emphasizes its concepts: the re-vegetation, using vegetation as one of the possibilities in the recovery of form and function in the environment, generating the Urban Environmental Revitalization and the accessibility and urban mobility to ensure Sustainable Transport, promoting social inclusion, equal opportunities and the exercise of citizenship.
Keywords: sustainability, re-vegetation, urban accessibility, urban mobility.

INTRODUCTION

Manaus, capital of Amazonas, has gone through processes of expansion and renovation of its physical space, as well as the obvious increase of its population since the establishment of the Manaus Free Zone (1967-1980) and the hydroelectric plant of Balbina (1980-1995), attests Loureiro [1]. This process of expansion and transformation of the physical space has also contributed to urban degradation, resulting in loss of life and ecological balance, which leads to the disharmony in relationships that provide a *healthy habitat*[1]. Within this logic, one can assert that the factors of urban degradation are those that can prejudice the relations of the hydrological cycle, the process of photosynthesis, the food chain, urban mobility, accessibility and others.

The absence or inefficiency of an urban planning is the principal element of a list of causes and signs of urban degradation in the city. Despite of representing the largest state of Brazil, in the midst of the Amazon forest, the population in general, seems to deny their relationship with the environment. It is easy to perceive that by observing the construction in progress and the buildings already established in that area. Deforesting up the whole lot and then make the replacement of the plant layer, which is with rare exceptions.

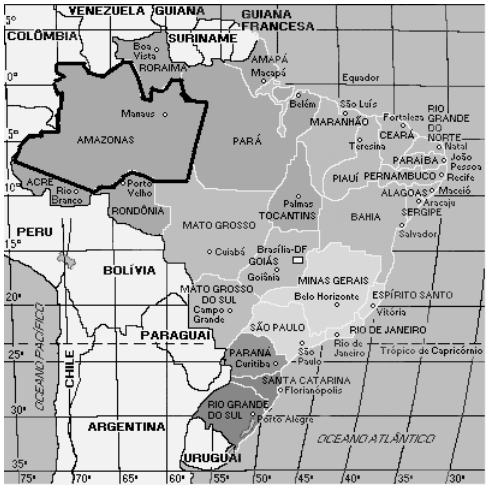


Figure 1: Delimitation of the Amazon State in Brazil.

PRINCIPLES OF SUSTAINABILITY

This research aims to emphasize the concepts of sustainability seeking the quality of urban environment supported by two[2] main themes of urban design: the infrastructure and landscape. Thinking of sustainability as a process requires the presence or application of criteria / principles of sustainability, namely, that a number of values, attitudes, institutions, instruments and actions are sustainable and others not.

Andrade [2] asserts that these criteria, principles of sustainability associated with urban morphology can directly guide the design of human settlements and recovery of urban communities at various levels or scales even if these principles are not relevant to the entire settlement. It creates a systematic and integrated structure that helps us understanding the potential to implement sustainable urban settlements.

A systematic view means that by identifying or solving a problem according to a principle, you're also identifying or solving other problems, according to other principles. They are: Ecological Protection (biodiversity), Urban densification, Urban Revitalization, Implementation of Neighborhood Centers, Development of Local Economy, Implementation of Sustainable Transport, Housing economically viable, with the Sense of Neighborhood (live), and Alternative Treatment of Sewage Drainage Natural, Integrated Management of Water, Energy Alternatives and finally, policies based on the 3R's (reduce, reuse, recycle).

These principles do not change depending on culture, habits or styles, and it's up to the designer to adopt local criteria in accordance with the place for urban interventions that break with the prevailing urban tradition, and implementing sustainable strategies for planning and urban design.

Based on two principles of sustainability it is intended to rehabilitate and qualify the urban environment of Djalma Batista's Avenue, in the city of Manaus, Brazil. Through the 'urban regeneration' it is proposed, in according to the Revegetation support, afforest the urban corridor to alleviate the avenue's microclimate, taking advantage of the aesthetic effect for the landscape beautification. With the Accessibility and Urban Mobility through 'sustainable transport' it is intended to analyze the situation of the sidewalks along the avenue's pathway, the terms of accessibility in these sidewalks, and public transport, proposing the rehabilitation and suitability of these areas in accordance with the Universal Rights.

URBAN ENVIRONMENT REVITALIZATION IN SUPPORT RE-VEGETATION

The revegetation, as well as the terms of urban afforestation and landscaping, covers the practice that uses vegetation as one of the possibilities in the recovery of form and function in the environment, a mechanism of architectural and urban environmental rehabilitation.

The city of Manaus, capital of Amazonas State, has an estimated population of 1,688.524 inhabitants in a land area of 11,401 square kilometers, according to IBGE (Brazilian Institute of Geography and Statistics), [3]. The World Health Organization – WHO [4] - recommends 12 m² of green area per capita in urban areas, which means that, Manaus needs 20,262.288 square meters of green area! This represents approximately 19% of the city's area.

The avenue is in the north-south axis, which means the incidence of solar radiation from east and west over the routes and sidewalks adjacent to them. It is perceived in Figure 2 that the urban pathway of Djalma Batista Avenue compares to the model of 'dispersed city' proclaimed by Rueda (Andrade 2007, p.40 [2]), with a low rate of urban density, which commits the network infrastructure and maintenance, increasing the number of trips and the emission of pollutants, biodiversity loss and formation of "islands" by the natural expansion of mobile networks (roads, public transport), increase in energy consumption and emissions of gases causing the greenhouse effect and atmospheric contamination.

Figure 2: Urban pathway of Djalma Batista Avenue.

Also citing the characteristics of 'dispersed city' and comparing them with the chosen pathway, there is the loss of capacity for water infiltration and increasing the flow velocity of rainwater caused by the diminishing of areas for water infiltration and canalizing streams. The absence of dense vegetation and vegetation as pavements (permeable paving) further exacerbates this environmental scenario. In the images captured from satellite (Google Earth) and imported into AutoCAD, it was possible to measure the total area of the pathway chosen in Djalma Batista Avenue, and comparing with existing green area. Then it is presented the following areas:

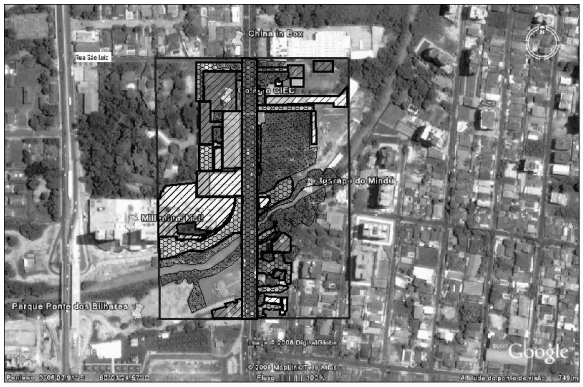


Figure 3: Area delimitation for comparing and gauging.

Legend:

Pathway area;

Paved área

Roof area;

Green area.

In Figure 3, is possible to perceive that the percentage of green area is not well distributed in the region, since much of it is located in front of the CIEC school, within a particular property. On this scale, the poor distribution of green area associated with the paved area (typical materials used in urban areas), the geographical location (latitude of Manaus: 03º08' south) and climatic conditions, contribute to the formation and intensity of heat islands (HI) in the extension of the path of the avenue. Working to reverse this scenario, afforestation and 'permeable paving' become necessary. Promoting revegetation, using landscaping as a tool and revegetation playing an environmental role, such as thermal control of urban areas are two important tools to reach the urban environmental quality as an answer to those aspects.

Corrêa [5] asserts that the presence of trees brings ecological and environmental services with it. May be the home of an amount of other living beings and ecological relationships and they are a complete ecosystem. The urban afforestation has many benefits that can be obtained through the spaces of cities, as urban vegetation plays an important part in maintaining environmental quality, by its ecological and socio-economic. One of these benefits of urban trees is their great importance for maintaining the thermal comfort of cities.

Primack & Rodrigues (Corrêa 2007, p.25 [5]) claim that, plant communities are important in regulating the local, regional and global climate. It is a fact that plant growth is linked to the absorption of atmospheric CO_2 and the control of greenhouse gases in global scale. On a regional level, the water absorption and transpiration of plants are crucial to maintaining the hydrological cycle and, consequently, regional climatic conditions. Already on a local scale, trees intercept, reflect, absorb and transmit radiation differently from urbanized areas. They can reduce the temperature and local thermal range.

The concept of green area is related directly to urban afforestation and involves three sectors: public green areas, private green areas and afforestation of public streets and roads. In this scenario, forestation is presented as an urban landscape restoration, which mitigates the sense of monotony in cities and has a variety of functions such as:

- Improves and stabilizes the microclimate;
- Reduce air pollution, visual and noise;
- Improves landscape;
- control soil erosion;
- Increases the infiltration of rainwater;
- Offers space for living and social values;
- Improving the conditions of physical and mental health of the population.

Based on the arguments presented, forestation of public roads and streets for the stretch of the Djalma Batista Avenue, in the city of Manaus, is indicated. Therefore, landscaping should be applied, once it is currently not limited to concerns about aesthetics and the microclimate, but also mitigates the environmental impact of the cities construction. Must consider the environmental comfort, the economy in maintenance, ergonomics, environmental services, ecological corridors and the ecosystem where the project is inserted. Seeking to reassert the natural ecosystem. This is the *natural landscape*[3] that uses native species aiming to conserve the diversity of native biomes.

Based on the diversity of species found in the ecosystem of the Amazon, it is recommended the use of native plants on public roads: the central site and on sidewalks of Djalma Batista Avenue. Another relevant point is to enlarge the extension of sidewalks in the area. With more generous sidewalks, it is possible to plan the placement of a big tree, with dense canopies to produce shadows. For that, galleries underground should be planned in order to store electric and phone spinning that today visually pollute the urban landscape and hinder the strategic positioning of high vegetation, so necessary in the warm climate regions with high incidence of solar radiation like what happens in the city of Manaus.

The dense vegetation provides good sun protection while contributing to decrease the temperature thru the evapotranspiration. It is a tool to treat the public space in a bioclimatic way: using vegetation, as sun protection for shading (see figure 4 below).

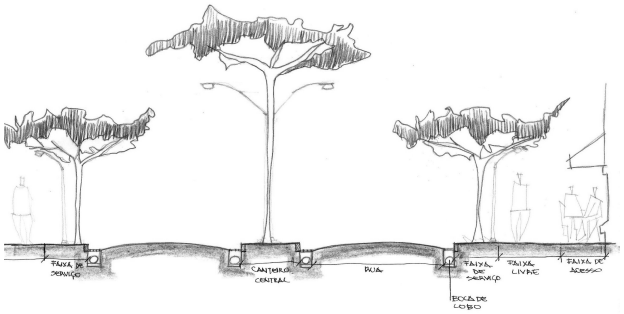


Figure 4: Sketch of the avenue with revegetation established (without scale).

With these instruments applied in environmental rehabilitation of the avenue, it also ensures the stability and control of erosion in the stream of Mindú river, establishing itself as an ecological corridor, increasing the ability to support the fauna of that environment, mitigating the urbanized aspect of that landscape, carbon diminishing, in addition of providing a more pleasant urban landscape.

Correa [5] affirms that the quality of life in cities is highly dependent of the extension of green areas, the amount of trees and how trees and green areas are harmonized in the urban network. The 'green' is capable of exerting positive psychological and physical effects on man. Trees need to be rediscovered by its importance to enjoy a better condition of life in cities.

URBAN MOBILITY AND UNIVERSAL ACCESSIBILITY

First of all urban mobility is the realization of the right to "come and go" for all citizens, guaranteed by the instrument of universal access to public spaces. In this sense, in order to move around the city, people must have access to all equipment, buildings and public spaces in that area (Oliveira and Ferreira, [6]). With that, accessibility becomes essential in the construction of cities.

The inclusion of all people in the daily life of cities is ranked as the biggest challenge to the issues of accessibility and urban mobility. Accessibility is the key component of the process that will ensure the urban mobility by promoting social inclusion, equal opportunities and the exercise of citizenship, when you answer to all inhabitants in their fundamental rights. When talking about accessibility and mobility, it is common to link the issue to the problems of disabled citizens. Although this is a misunderstanding restrict. Access for all citizens should be ensured.

The urban planning and urbanization of a city are the key tools in attendance of universal accessibility.

Urban mobility is reflected in the ability that the individual will be able to walk thru the city, accessible in its route from the origin to its destination. The concept of accessible route is built as the possibility of free, clear of any barrier, capable of guaranteeing the transit with autonomy including the disabled and / or with reduced mobility.

In the scale of the city, Manaus and its urban layout is represented here by the urban corridor from southern segment South/North, considering the physical and organizational form, transport system and traffic. In the scale of the sector, the focus is on the sidewalk (of the Djalma Batista Avenue) showing morphological relations and replies to accessibility, the homogeneity, the functionality. The scale of the place, represented by the 'Bridge of Bilhares Urban Park' (located in the south of Djalma Batista Avenue) confers identity to space, optimizing personal relationships and specifying the functions. Should be evaluated from the perspective of the arrival at the place and the use of it. (This scale is only mentioned in this article). In the scale of the building, its specific dimensions, the perception and its use. Access to the building not only sets the functional and practical issue, but a right of access to citizenship. The scale of the building will be disregarded here as the object of study is the urban environment.

It is, then, characterized more carefully, mobility in four stops in regard to its essential elements, the object of attention to urban renewal, then, make a diagnosis of Djalma Batista Avenue and therefore propose strategies based on the standards, existing laws and good practices already deployed.

The concern of the characteristic scale of the city, with regard to urban mobility, is the way people can walk around the city independently. Emphasis is given to people with disabilities and with limited mobility to ensure the universal rights to minorities, with commitment to the service of diversity. Oliveira and Ferreira [6] emphasize that people with restricted mobility and people with disabilities have special needs to move around the city, and depend on their understanding of reality so that the city offers in fact and law, terms of mobility. In this sense, carried by the great physical shape and organization of the city is the heart of the matter on the scale of the city, and the means used to perform this activity are the public and private transportation. For this, you must provide pathways required by urban plan of a city and ensure the traffic between their sectors. You should also check the factors that contribute to the structure of urban mobility and accessibility, the example of:

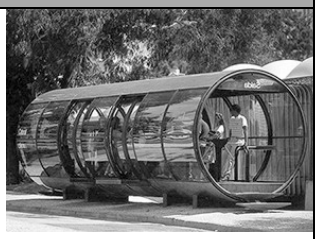
- accessible routes: route that ensures that basic needs of locomotion thru the city and the possibility of

access to the various uses of everyday life. One must consider the capacity of mobility of each user according to age, health, etc. stature.

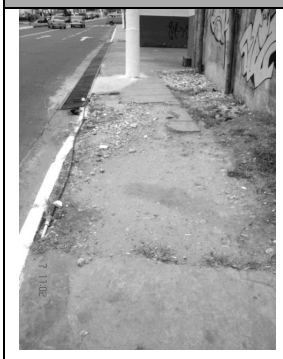
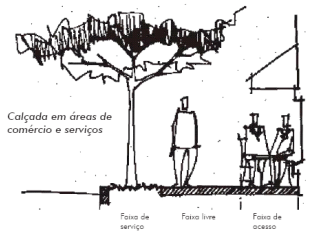
- Means of transport: public or private, which would enhance the traffic and access for all users, apart from any device placed on the route accessible to facilitate the accessibility and urban mobility.
- Signaling: ensuring adequate comprehensive information to all users of the route accessible. All users of urban space must have the security of information concerning the direction and reaching the destination.

Presenting a diagnosis from the mobility and accessibility in the reading of urban space, limiting itself to the path of a survey conducted routinely served as a case study to measure the infrastructure and public transport as a prerequisite for the construction of cities. Based on a travel route that fit the scales - the city and industry - representing the levels of mobility established in a city, can attest, or not, the inclusion of all parts of the population in daily use in the urban space.
Then the diagnosis of the area chosen, divided into scales of urban mobility.

City Scale:

Illustration of the Situation	Proposals / Suggestions
 Figure 5: articulated bus, as the model of Curitiba / PR, with capacity for 170 seats. Available: http://www.cidadesdobrasil.com.br> edição 37, dez/2002. [14 September 2007].	 Figure 6: Bi-articulated of the city of Curitiba / PR. Source: IPPUC - Institute of Research and Planning of Curitiba.
Illustration of the Situation	**Proposals / Suggestions**
 Figure 7: bus stop with coverage horizontal	 Figure 8: Point by bus from the city of Curitiba. Available: http://www.curitiba-parana.net/urbanismo.htm [21 September 2007].
inappropriate for the city of Manaus for not serve as a shelter against heavy rains and high insolation.	

Sector Scale: sidewalks

Illustration of the Situation	Proposals / Suggestions
 Figure 9: lack of maintenance of sidewalks, and barriers to post the power network are factors that hinder the accessibility on sidewalks.	 Figure 10: design and dimensions of the sidewalk ideal: the first track (track service) where you should place trees and lighting poles, traffic signs and street furniture from, the second track should be free to pedestrian forward and the third is range of access to property or to the ground. Available: Primer Walk Free. Mayor of São Paulo, pp. 5.
Illustration of the Situation	**Proposals / Suggestions**
 Figure 11: sidewalk of a college in av. Djalma Batista. Note that the post of the power grid is an obstruction to pedestrian even the left side has 56 cm of way!	 Figure 12: It is the first track (track service) where you should place trees and poles for lighting, traffic signaling and of furniture. Available: Primer Walk Free. Mayor of São Paulo, pp. 7.

CONCLUSION

This survey described critical situations aiming to analyze the physical space, comparing it with the requirements expressed by the law, plans and practices, and then proposing improvements, adaptations, qualifying the urban space to create sustainability in the urban environment.

Manaus had its urban mesh transfigured with the implementation of the Free Zone in 1967, due to the population growth that tripled its number and the city did not correspond to it offering basic infrastructure. With this, the signs of environmental degradation

became increasingly evident compromising the quality of life in urban areas. The results were attributed to the lack of afforestation and commitment of urban mobility.

The lack of vegetation in public sidewalks leads to direct exposure to the sun, increasing the temperature of the microclimate. In addition to making the urban landscape visually impoverished and exert negative psychological and physical effects on humans and, consequently, on the condition of life in cities.

By the end of this research, it is understood that the lack of urban planning or the disorderly growth can cause serious problems. The environment and the landscape is altered by human action, the main actors of change in the public spaces where they passed, leaving a mark on the process of life in the context of its time in place.

The observation of this work should be to point further studies addressing other aspects of the sustainability of urban spaces, aware that the factors presented have direct influence on quality of life of cities. The study provides a more precise diagnosis of the site, providing conditions of visibility for urban planning that have committed to the welfare of the population and to seek the environmental rehabilitation based on sustainability for the urban space.

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[1] The healthy habitat means interaction between the natural environment and built environment, so that both are present in everyday life.

[2] According to Andrade (2007) there are three fundamental pillars of urban design: the housing, infrastructure and landscape.

[3] Natural landscape: that uses native plants and seeks conserves the local flora and fauna.