LANDSCAPE AND ENVIRONMENT IN ARCHITECTURE AND URBAN DESIGN.

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ABSTRACT: This paper discusses the importance of respecting landscape and environment values in architecture and urban design. These values involve the conservation of nature (its vital system, environment and appearance), habitat (biodiversity) and the construction and maintenance of the human artefacts, seen as work of art (beauty, utility and stability). This research is part of a doctoral thesis carried out at Faculdade de Arquitetura e Urbanismo of Universidade de São Paulo, SP, Brazil [1]. The research concluded that landscape and environment aspects are neither considered nor appreciated in architecture and urban projects. The actions of saving lives and the costs of conservation are frequently in shock in urban planning. It is essential to recognize that without protection of natural elements the costs of urbanization will be high and the natural resources scarce.
Architecture and urban projects must be committed to the landform of the site, i.e. hills (privileged places to built on) and valleys (privileged places to create water conservation parks). The urban microclimate can be qualified through the creation of parks, corridors alongside rivers and drainage, leading to an efficient use of energy by the existing buildings in the vicinity of these parks.
Conference Topic: 2.2 Environmental Planning Criteria and Strategies

1. LANDSCAPE AND ENVIRONMENT NEGLECTED IN URBAN PLANNING

The main goal of this paper is to present suitable alternatives for the occupation of slopes, taking into account landscape and environmental values. Many aggressions to the environment and to the landscape result from inadequate treatment given to hill slopes and valleys, which have often been totally neglected (Fig. 1).

MORRO DA CRUZ (CROSSHILL)

Figure 1: In Florianopolis - SC we can observe the inadequate treatment given to hills and seaside.

During many centuries human beings understood the concept of urban development as the opposite of a rural environment and tried to tame nature and the physical surroundings by building cities. In the middle of the XX century researchers began to understand that there is a close relationship between urban natural disasters (rock slides, landslides and floods) and inadequate occupation of areas such as hills, mountains and slopes, river valleys, streams and natural drainage lines (Fig. 2).

AMPARO IMPRISONED STREAM

Figure 2: The City of Amparo - SP is susceptible to flooding because the borders of the rivers are confined.

2. METHODOLOGY

The alternatives for the occupation of slopes proposed in this paper have been devised after comparing actual examples, in line with environmental criteria expressed by various authors. Therefore, this paper can be said to be of a qualitative nature. For these comparisons were used the topographic (Fig. 3) and cadastral (Fig. 4) plans of various cities and neighbourhoods presenting interventions of interest such as squares, parks or dwelling units. In the case of the grid with empty spaces we chose to verify how the road was situated relative to the terrain, to assess adequacy of the alignment to the existing environment, with special consideration to the drainage lines. In the case of dwelling units we tried to establish a relationship between total plot area and occupation rate, as well as rate of utilization and percentage of the area with vegetation. We can say that landscape quality in the examples mentioned is closely linked to the existence of green areas in lots, as well as in squares and parks. Environmental quality can be expressed in terms of pleasant climate and in efficient water drainage.

VILA MARIA DISTRICT LANDFORM

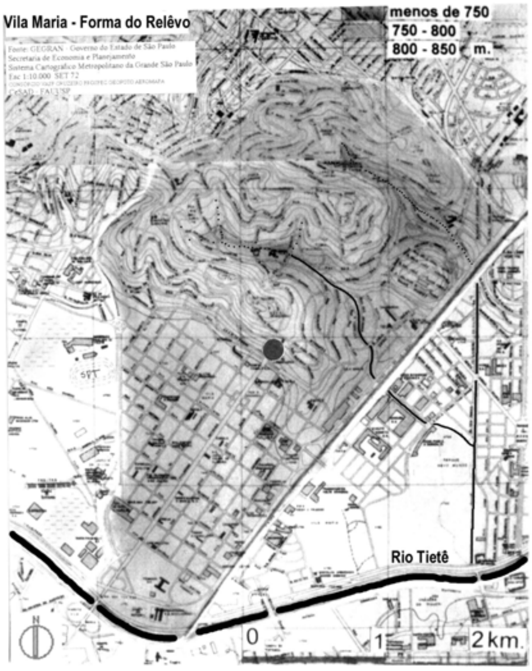

Figure 3: Lower Vila Maria (São Paulo-SP) is located along the flood plains of the Tiete River, in an area which used to be highly susceptible to flooding in the past. Upper Vila Maria occupies 3 hills interlinked by watersheds.

3. CONSIDERATIONS ABOUT ENERGY

This research [1] has its theoretical fundamentals in some statements established by many authors, concerning about urban landscape design, but for this paper we had emphasized Lyle [2] and Akbari et al. [3] for their considerations about energy flows and energy consumption, landscape and environment.

We can observe in Lyle [2] that flows of energy and material are taken for granted in many urban planning decisions around the world. We tend to forget that life is dependent on a continuing supply of energy, water, and chemical elements necessary to its dynamics. The most essential function of all ecosystems is to make the needed energy and materials available to their inhabitants.

The urban environment is different in character from the natural environment, but they are the same in at least one fundamental respect: both depend on the same basic process. In cities, we tend to forget about these vital links because natural sources of energy, food, and water have often become almost totally obscure, having been replaced by artificial single-purpose systems that transport these necessities from distant landscapes. Most of energy, food, and water consumed by people come from hundred of miles away. The cost is high, and the sources are increasingly problematic as growing populations compete for limited supplies of the essential supplies of life.

VILA MARIA PUBLIC AND GREEN SPACES

Figure 4: Lower Vila Maria has an orthogonal road grid. Upper Vila Maria has an interwoven road grid in a zig zaging pattern that adapts itself to the terrain, as if it had been designed by someone on a donkeys back that decided to conquer the slopes smoothly. The two valleys separating the 3 hills were designated for green areas. It is such a good example that could be adopted as an urbanistic pattern.

We can hope that ecosystematic design might contribute to the energy conservation. It may be too much to hope that every design will result in some type of evolution, but with thoughtful organization of the flows we can create islands of order in the urban environment. Flows in the human environment are generally faster and less complete than those in nature, since people tend to be impatient with nature's pace, demanding quick results.

3.1Energy and Landform [2]

Usually, we think of form as a visual concern. Landscape forms have symbolic meanings that are part of our culture, our relationships with nature. The specific form of the landscape has a strong influence on the working of ecosystems. For the short term, form is not shaped by natural process but by human control. By shaping the landscape, human beings determine the ecosystem function, structure, and location relationships.

In landscape design, we might say that since form influences ecosystems function, structure, and location patterns, along with human activity and symbolic meaning, it should be shaped accordingly.

Specifics forms play a special large role in controlling the flows of water and energy. Otherwise, landscapes designed only to serve natural processes will fail as human ecosystems.

As an example of the influence of specific forms is the purpose of project basins along streams and channels, to avoid floods, holding surface water until it's able to settle into underground storage.

The spreading grounds would support wildlife community. The planting parks of riparian vegetation along these banks would increase the habitat value in the cities.

In the same way, the deciduous trees used to control solar radiation on the north facades of the houses are common to create a stratum of cool air near ground level that is drawn into the homes and exhausted, once its warmed, through clerestory windows above ceiling level, avoiding the use of powered air conditioning. Devices like these require close integration of building and landscape, which is rare in the design professions.

3.2 Optimum population density for energy [2]

Observing the ecosystem structure we can state that valley bottom are suitable to be maintained open for the flow of water to provide common recreational space, vegetation, flooding, ground water recharge, minimum building and wildlife corridors. The peaks of hills might be left in their natural state for views and wildlife habitats. Construction is restricted to the hillsides of low and medium grading, with good solar exposure, preserving the vegetation. The roads in the upper valleys might to be in grid pattern besides; in the slopes they might follow the contour lines seeking suitable declivities.

We can design the landscape using industrial models or soft energy path models. The soft energy path, as with water, pre-empts more land. Solar, wind and biomass energy are by nature less concentrated and therefore require larger areas for collection. At this moment we come to relationship between energy flow and population density. Some studies have attempted to determine an ideal urban density based on a specific set of concerns.

The New York Regional Plan Association, for example, studied the relationship between density and energy consumption decreased with increasing density up to average about 25.000 people per square mile, which is roughly 39 people or 13 dwelling units per acre (32 units/hectare). Above that level, consumption increased with increasing density. This information is useful because it give us a general indication that some sort of optimum density seems to exist for a given patter of urban development and energy flow (i.e. that of the New York City). It says nothing about other patterns of settlement and energy flow, but a number of researches have concluded that higher levels of urban concentration that now exist will probably be brought about by energy shortfalls in the future.

3.3 Shade trees, cool pavements and energy [3]

Elevated temperatures in urban areas increase cooling-energy use and accelerate the formation of urban smog. Modern urban areas have darker surfaces and less vegetation than their surroundings. These differences affect climate, energy use, and habitability of cities. Dark surfaces and reduced vegetation warm the air over urban areas, leading to the creation of urban 'heat islands'. Akbari et al. [3] found that peak urban electric demand rises 2-4% for each 1oC increase in temperature. Thus, the additional air-conditioning use caused by this urban air temperature increase is responsible for 5-10% of urban peak electric demand, at a cost of several billion dollars annually. Mitigation of urban heat islands can potentially reduce national use in air conditioning by 20% and improve urban air quality.

The benefits of trees can be divided into direct and indirect effects: shading of buildings and ambient cooling (urban forest). Shade trees intercept sunlight before it warms a building. The urban forest cools the air by evapotranspiration. Trees also decrease the wind speed under their canopy and shield buildings from cold winter breezes. Urban shade trees offer significant benefits by both reducing air-conditioning, lowering air temperature, and thus improving urban air quality by reducing smog.

Data on measured energy savings for urban trees are rare. Measuring and monitoring the cooling-energy consumption of buildings before and after adding trees, researchers [3] found cooling-electricity savings of up to 50% in Florida, 30% in California, and 10-15% in Canadian cities, what prove the shading and microclimate effects of the trees.

There are other benefits associated with urban trees. Some of these include improvement in the quality of life, increased value of properties, decreased run-off water and a protection against floods. Otherwise, there are some potential problems associated with trees. Some trees emit organic compounds that exacerbate the smog problem. Some trees need significant maintenance. Tree roots can damage underground pipes, pavements and foundations. Proper design and selection of appropriate species might minimize these effects. The wide range of costs associated with trees might be justified by other amenities they provide. The programs might provide data on energy and smog saving of trees to the communities and homeowners that have decided to plant trees for other reasons.

Other strategy mentioned by Akbari et al. [3] is cool surface. The practice of paving the streets with asphalt improved the movement of automobiles, but there are associated problems to be considered: cover streets with dark asphalt surfaces increase the heating of the city by sunlight. If urban surfaces were lighter in colour, more of the incoming light would be reflected back into space and the surfaces and the air would be cooler. This tends to reduce the need for air conditioning in the buildings. The alternative of cement concrete might be economic and cooler, and might increase the visibility at night and in wet weather. They conclude that cool surfaces and urban trees can have a substantial effect on urban air temperature and, hence, can reduce cooling energy use and smog. They estimated that about 20% of the cooling demand in the USA could be avoided through a large-scale implementation of these heat-island mitigation measures.

4. ARCHITECTURAL AND URBAN STANDARDS ACCORDING TO LANDSCAPE AND ENVIROMENTAL CRITERIA.

Brazil does not have a tradition of setting aside riverbanks, streams, lagoons or beaches for environmental preservation or public use. There are actually no established criteria in so far as the occupation of hill slopes. River and stream valleys are typically covered and transformed into avenues. For the purpose of this paper, we have defined architectural and urban occupation standards based on free areas configuration criteria as well on the appropriate typologies for the occupation of slopes, in all their segments, and on the banks of water bodies. As a result, empty plots of land not put into use gain importance from the environmental and landscape perspective. They are then designed as self regenerating and self sustainable systems where the flood plain with trees would safeguard at the same time: the drainage of rainwater, a system of interlinked parks and a micro climate favorable to economy in terms of energy consumption

5. CONSTRUCTION OF LANDSCAPE UNITS ACCORDING BUILDING TYPOLOGIES

We think that the possiblities of division for slope lands previously defined can generate satisfactory landscape units, especially if they are occupied according to the following construction typologies:

I – Landscape unit with six story buildings on pilotis plus two stores for semi-underground garages predominantly horizontal on pilotis as the ones observed in the Bristol, Nova Cintra and Caledônia buildings, designed by Lucio Costa inside the Guinle's Park, Rio de Janeiro, RJ. To each building correspond roughly one-hectare (2,47 acre) of green area (Fig. 5).

II - Landscape dwelling units with two to three story buildings in lots of 220 square meters (allowing for larger lots), in lands with slopes inferior to 45 per cent. Even in the small sized lots, front and lateral backups with at least 50 per cent of gardens ought to be included. These must be implemented in zigzagging streets in at least one of the walkways. In doing so along a sequence of hectares the landscape unit will be characterized as a set of hills with even afforestation and buildings (Fig. 6).

III - Landscape dwelling units with two to three stepped story buildings, implanted in lots with 30 and 45 per cent slope, as in the slopes of San Francisco, California; especially in Lombard Street (Fig. 7).

GUINLE'S PARK

Fonte: Lúcio Costa - Registro de uma Vivência

Figure 5: With low density of urbanization, from the buildings of Guinle's Park, Rio de Janeiro, RJ it is possible to appreciate the landscape of trees and lakes.

PACAEMBU ZIG ZAGING STREET PATTERN

Figure 6: Little gardens were implemented in zigzagging streets in Pacaembu District, São Paulo, SP.

LOMBARD STREET HOUSES

Figure 7: The singular example of Lombard Street, San Francisco, CA, could be adopted as an urbanistic pattern to restore deforested settled urban slopes.

IV - Landscape dwelling unit with two to three story buildings, implanted in the middle of 4.000 square meter lots, in lands with slopes greater than 45 percent. These should follow the pattern of the house built by architect Lina Bo Bardi in 1951. (Fig.8).

LINA BO BARDI'S GLASS HOUSE

Figure 8: The singular example of the Glass House, Morumbi District, Sao Paulo, SP could be adopted as an urbanistic pattern in remaining forested urban sites.

V - Taking into account the characteristics of land slopes is necessary in order to complement and link the landscape units with traffic and pedestrian components: constructing orthogonal grids complemented by stairways and ramps in strategic high places in the hills; construction of transversal ways and elements such as lifts, steep plans and cable-cars to integrate the upper and lower area of the slopes. (Fig. 9).

VI - Identifying and enhancing landscape units through the implementation of emblematic buildings with different shapes and serving different uses localized in strategic spots of the slopes, preferably at the tops and sides. These areas can also be used for belvederes and the backs and bottom of valleys are adequate for parks. (Fig.10).

LOMBARD STREET STEPS

Figure 9: An example of connection between landscape units is the Lombard Street Steps, San Francisco, CA.

VINICIUS DE MORAIS SQUARE

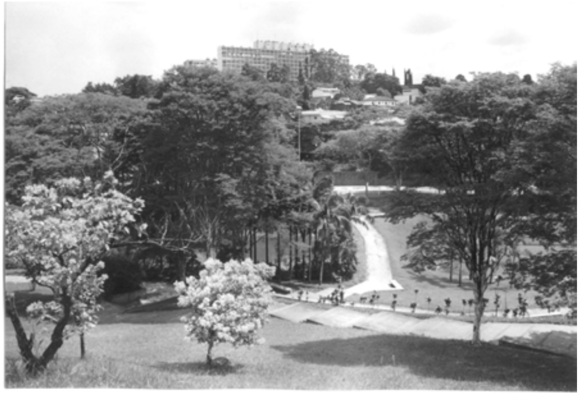

Figure 10: The Vinicius de Morais Square, Morumbi District, Sao Paulo, SP is a fine example of suitability of the valleys to implement parks inside urban areas.

6. FINAL SUMMARY

If the above mentioned elements were to be used in urban planning, future master plans shoud take into account at least 4 main criteria: afforestation of areas alongside drainage lines, paving streets and sidewalks with cool surfaces, establishing densities of about 30 houses per hectare (roughly 13 dwelling units per acre) in deforested urban sites; and 2 houses per hectare (roughly 1 dwelling unit per acre) in remaining forested urban sites.

This research identified some typologies which are more appropriate for the occupation of hilly land slopes and river valleys as well as the need of linking free and green areas to the occupation rates and to the index of the development project suggested. The follow up of this case study is directed to the use of quantitative methods based on the hypothesis raised.

REFERENCES

[1] S. Afonso, Urbanização de Encostas: Crises e Possibilidades: o Morro da Cruz como um Referencial de Projeto de Arquitetura da Paisagem, São Paulo, FAUUSP, Tese de Doutorado, 1999.

[2] J. T. Lyle, Design for Human Ecosystems: Landscape, land use and natural resources, Washington / Covelo, Island Press, 1999, pp. 4, 110-123, 228-230, 239-240.

[3] H. Akbari, M. Pomerantz and H. Taha, Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas, Solar Energy, Volume 70, Issue 3 (2001), Elsevier Science Ltd, 295-310.