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Strategies to Mitigate the Effect of Heat Islands in Urban Centers

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Abstract: The influence of microclimates in urban centers can be observed from ancient civilizations to the present, mainly due to the climatic variations that have occurred over time, since many of them were caused due to the technological advances and population increase without adequate urban planning. The effects of heat islands occur in very densely packed and vegetated centers, and this condition aims at the subject of the research, which seeks to list some alternative means to be adapted in the spaces that suffer from the influence of high temperatures. The research methodology was defined as exploratory, in order to provide a better understanding of strategies to reduce these effects. The main strategies indicated are the insertion of green spaces with the increase of urban afforestation, careful with the choice of floor and wall coverings, with reflective elements and light colors so that there is no absorption of heat and the use of elements such as water for increase air humidity, improving the environmental quality of life of the space for all users.

Key words: temperatures, urban climate, solutions

1. Introduction

Over the years, the urban form was being built and shaped according to its evolution, civilizations and needs of each era, leading to a great demographic and territorial development of these cities. However, has been happening a reduction in areas that can improve the quality of life of the population, such as public recreation areas, urban afforestation, among other factors [1]. As a result of this, the disqualification of the environment and the neglect of the population were generated with the place in which they live. The impulse of verticalization has brought environmental problems, such as climate change, floods and decrease of urban green areas [2].

The new urban planning needs to avoid these problems, and vegetation is essential to unite the natural and built environments, since nature is capable of raising the capacities of the urban environment and the quality of life of the population [3-5]. The green infrastructure connects natural elements, using tree-lined roads and large public areas, to contribute as a solution to specific problems caused by the great development of cities.

The urban centers are affected by heat islands every day, and this concern in providing more pleasant urban environments leads to the search for alternatives to improve urban comfort, especially in the center of cities where air temperature values are higher, the relative humidity of the air and the intensities of the winds are generally smaller [6]. This study aims to address some strategies that help to reduce heat islands in urban centers, such as vegetable coverings or green roof, vertical gardens, the use of materials with a high level of reflectance in buildings, the use of biovalettes, the insertion of more native trees in the urban area and application of cycle paths.

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2. Material and Methods

The level of research was defined as exploratory because it provides a better understanding of the potentially favorable strategies for reducing the effects of heat islands. Therefore, it was the result of a bibliographical research, in which information on the subject was searched in the literature. The synthesis of The Information Was Obtained In Secondary Sources, aiming the analysis of the different strategies, according to Table 1.

3. Results and Discussion

The lack of attention of the public administration in qualifying these spaces and the prioritization of the use of the private car, brought problems to the urban centers. Which are overwhelmed by the demand for real estate and the prioritization of transport routes. Consequently, the population suffers with lack of urban spaces that could be occupied for recreation and mainly because they do not contain enough elements that provide climatic comfort for those who use these green residues.

The concept of sustainable city recognizes that the city must meet the social, environmental, political and cultural objectives, as well as the economic and physical objectives of its citizens [7].

Table 1 Database for analysis of strategies.

Strategies	Authors	Year
Green Roof	Silva	2011
Cool Paint	Sousa Gonçalves et al.	2014 2014
Alternative floors	Matos et al. Abcp Rathke	2010 2010 2012
Biovalettes	Corsini Herzog	2013 2009
Planting of native trees	Lopes Mascaró Romero Serro	2008 1996 2011 2013
Bicycle paths	Furuya De Lourenci Serro Gehl	2016 2013 2015
Community vegetable garden	Costa et al. Herzog	2015 2009
Biodiversity corridors	Franco Ferreira Machado Machado	2010 2010 2004

One of the main solutions to reduce the effects of heat islands is the reduction of the emission of air pollutants in urban areas, and the vegetation cover is one of the alternatives for reducing pollution, as well as reflect and absorb part of the heat emitted. Next, one can analyze alternatives that stand out for the aid of the thermal comfort in the urban centers.

3.1 Green Roof

The green roof, green cover or hanging gardens are constructive systems that can be installed on slabs or on conventional roofs and it consists of vegetation cover. The green roof provides the increase of green areas and the decrease of the temperature, both internal and external of the buildings that enjoy from this benefit, helping to improve the environment, reducing the heat islands and making the energy expenses with the heating or the cooling, consequently decrease [8].

It is suggested the use of plants that are resistant to periods of drought and long periods of rain. It is also recommended to use small, slow-growing species to facilitate maintenance, which should be done once or twice a year [8].

3.2 Cool Paint

Its application is intended for external areas of buildings such as walls and roof, and allows the heating of it, through its opaque effect, preventing the temperature inside the buildings increases, therefore reducing the need for artificial climatization [9].

The most important characteristic of this type of cool paint is its ability to reflect incident solar radiation, thus making the external environment more pleasant, because the heat generated is not concentrated in the buildings but rather, dissipated in the environment [10].

3.3 Alternative Floors

The action in the climatic environment with the use of alternative floors applied in the public walk, is demonstrated firstly on the thermal difference found

between the asphalt and the grass, that is applied in the majority of the spaces. In the research carried out by the authors, three variables were verified: irradiance reflected by asphalt (bituminous concrete), emerald grass (zoysia japonica) and global irradiation. It was possible to perceive the difference between the amount of radiation that these two types of soil covers reflect in relation to the solar radiation [11].

The research reports that areas with more green fences are more pleasant spaces to live with the population. In addition to vegetated areas, one of the alternatives is permeable pavements, which can be used for pedestrian, vehicle and parking traffic, allowing water infiltration and decreasing the waterproofed areas of cities. This type of pavement assists in the decontamination of subsoil soil, filtering rainwater that is usually contaminated with pollution [12].

3.4 Application of Biovallets

Biovalettes, or vegetated bioretention ditches, generally refer to linear depressions filled with vegetation, soil and filter elements and aims to process rainwater cleaning, while increasing their run-time and leading to rain gardens or conventional drainage systems. Biovallets are bound in a series of cells so that water overflows from one to another, they are usually indicated to treat water flows in parking lots and streets [13].

The main functions of the biovalves are the promotion of a pretreatment of the water, through the sedimentation, filtration and biological absorption and the arrest of the rain water, in order to reduce its speed, serving as esthetic element for the city. The infiltrated water is then collected by drilled pipes, located underground, and then directed to downstream water courses [14].

3.5 Retention Basins

Consists of a vegetation depression in the road that during the rains it receives the water, contributing to the reduction of the artificial flow that is the main cause of the floods, being able to delay the entrance of the waters in the drainage system and allowing the infiltration with the recharge of the aquifers. In times of drought, it can be used for various activities, such as a soccer field [14].

It presents some factors that can make difficult its implantation, which are: need of space, that normally is scarce in already consolidated cities; cost of land and real estate speculation; more frequent maintenance in the city; types of vegetation [15].

3.6 Planting of Native Trees

Planting vegetation on urban roads is an effective strategy in mitigating heat islands, as they help in the evapotranspiration process, increasing the relative humidity of the air. They also aid in the pollution filtering the impurities of the air and serve as shading, generating, sensation of comfort and pleasure to the users of the environment [16].

The afforestation replaces any shade system and has a significant social impact, as they reduce the greenhouse effect, disguise noise, filter pollutants gases, reduce carbon emissions, prevent erosion, increase air humidity and they control the temperature [17, 18]. In urban spaces, they protect the buildings against the strongest solar rays, therefore, contributing to their energy efficiency [19].

3.7 Installation of Bicycle Paths

Bicycle path is the space for the trips made by bicycle. These spaces can be made in different ways, among the main ones it can be mentioned: A bicycle path shared with cars, in this case the only separation between the two means is made through different colors in the roads and exclusive tracks for bicycles, where there is a physical separation between the means of transportation. To determine the best option to be implemented, an analysis should be made of the location that will receive such a deployment [20].

Some recent ideologies of urban planning, based on accident statistics, support the idea that the risk of accidents can be reduced by combining various types of traffic on the same street. Bicycle and pedestrian traffic uses less resources and affects less the environment than any other form of transportation, it does not fill the city space and its requirements are very modest, requiring a much smaller space than a car lane [21].

The option for the integration of cycle lanes presents in the current society as one of the best ways of promoting cycling. With the implementation of this network of infrastructures it is possible to see an increase in the use of the bicycle in its various aspects, not only as a form of recreation, but above all, as an incentive and affirmation of cycling as an integral part of a sustainable urban transport system [19].

3.8 Community Vegetable Garden

Its concept encompasses the production, transformation and rendering of services, generating products of all kinds aimed at self-consumption, exchanges, donations or commercialization, taking advantage of efficient and sustainable resources and local inputs [22].

Urban gardens can be considered a typology of green infrastructure. In addition to its benefits and functions provided by vegetation, one of its main benefits is to make green areas productive areas, in addition, it rescues the relationship of the individual with food. They can be planted in diverse and varied places and are communal gardens, where anyone, resident of the place or not, can enjoy it [14].

3.9 Biodiversity Corridors

They are defined as a network of linear spaces serving multiple uses, preferably along ecological corridors, to provide their function at the water's edge [23]. The green structure is not only intended to protect existing resources, but also to reconcile them with human activity, therefore, contributing to a better quality landscape and life of the population [24].

According to Machado J. et al. [25] "Green corridor networks are linear free spaces that link large non-linear areas or large natural spaces. These assemblies are space systems, planned, designed and managed for multiple purposes, including ecological, recreational, cultural, aesthetic and productive objectives, consistent with the concept of sustainability".

These strategies where listed within a wide range of possibilities for improving the quality of life within urban centers, since they are increasingly populous and in need of special care with the environment. The new technologies allow us to make use of previously non-existent resources, which today are vast in the market.

4. Conclusion

The main responsible for the permanence of the users in certain places is the urban comfort, because in it are included the climatic factors that can cause the well-being in the individual. To create more pleasant environments, be they public or private, depends not only about the physical space, but also on the behavior of the people. The work of making the spaces more attractive becomes the idea of favoring the well-being of all, therefore, improving the relationship in the individuals who participate in that environment [26].

These results evidenced in this work serve as a subsidy with the indication of strategies for the elaboration of urban projects that aim to simulate and improve the comfort of the central areas of the city, with the implantation of strategies that can aid in the reduction of heat islands. Adequate urban planning is the first step in reducing the effects of high temperatures, because many of the factors that cause these phenomena occur as a consequence of an accelerated process of urbanization, plant degradation, disordered occupation and high constructive densities.

The strategies go beyond the implementation of green areas and alternative techniques of infrastructure.

Should be explored the incentive to use transport that do not pollute the air, conscious consumption of available natural resources, use of light colors in the pavements and coatings to increase reflectance of the heat. Also, take a careful look with the heights of the buildings so that no canyons of wind are created, systems of reutilization of the waters gray and pluviais, among other strategies of sustainable urbanism.

References

[1] J. J. Mascaróet al., Infraestrutura verde: base de desenvolvimento sustentável para as cidades de médio porte, Relatório Final de Pesquisa 2013, Passo Fundo, 2013.

[2] M. Hostetler et al., Conserving urban biodiversity? Creating green infrastructure is only the first step, Landscape and Urban Planning 100 (2011) 369-371.

[3] J. L. Mascaró, Infra-estrutura da paisagem, Porto Alegre: Mais Quadro Editora, 2008.

[4] K. H. Thokén, "The green poster" A method to evaluate the sustainability of the urban green structure, Landscape and Urban Planning 20 (2000) 359-371.

[5] D. M. Wald and M. E. Hostetler, Conservation value of residential open space: Designation and management language of Florida's land development regulations, Sustainability 2 (2010) 1536-1552.

[6] M. A. Jatobá et al., Formação e medidas de minimização do efeito de ilhas de calor na capital paraibana, *IV encontro de iniciação à docência da UEPB*, Campina Grande: Anais ENID/UEPB 1 (2014) (2).

[7] C. Leite and J. di C. M. Awad, Cidades sustentáveis, Cidades Inteligentes: desenvolvimento sustentável num planeta urbano, Porto Alegre: Bookman, 2012.

[8] N. da C. Silva, Telhado verde: sistema construtivo de maior eficiência e menor impacto ambiental. Monografia do Curso de Especialização em Construção Civil da Escola de Engenharia UFMG, 2011.

[9] D. A. de. Sousa, Estudo da utilização de tintas com alta refletância na envolvente exterior dos edifícios, Dissertação de Mestrado em Engenharia Civil, Faculdade de Engenharia Universidade do Porto, 2014.

[10] L. Gonçalves, et al. Avaliação do desempenho térmico por análise termográfica de tintas refletantes aplicadas em fachadas com ETICS. I Simpósio de Argamassas e Soluções Térmicas de Revestimento, Coimbra, Jun. 2014.

[11] E. M. V. Matos et al., Estudo comparativo da refletância à radiação solar para duas superfícies distintas: asfalto e grama esmeralda (zoysia japonica), in: *XIII Encontro Nacional de Tecnologia do Ambiente Construído- ENTAC*, Canela- RS, 2010.

[12] Associação Brasileira de Cimento Portland (ABCP), Melhores Práticas, Pavimentos Permeáveis, Peças Pré-fabricada de Concreto, São Paulo, dez, 2010, accessed on 2 Mar. 2018, available online at: http://www.oterprem.com.br/site/reportagens/Melhores%20Pr%C3%A1ticas%20para%20Pavimento%20Intertravado%20Perme%C3%A1vel.pdf.

[13] CORSINI, Rodnei. Biovaletas, accessed on 15 April 2018, available online at: https://www.google.com.br/search?q=biovaletas&source=lnms&sa=X&ved=0ahUKEwiH17-8_KrbAhVCmJAKHTFlBtwQ_AUICSgA&biw=1536&bih=711&dpr=1.25.

[14] C. P. Herzog, *Guaratiba verde: subsídios para o projeto de infra-estrutura verde em área de expansão urbana na cidade do Rio de Janeiro*, Rio de Janeiro: UFRJ/FAU, 2009.

[15] E. R. da C. Mano, Estudo de Bacias de Retenção como solução para situações crescentes de urbanização. Dissertação mestrado em Engenharia Civil – espacialização em vias de comunicação, Universidade do Porto, 2008.

[16] A. Lopes, O sobreaquecimento das cidades, Causas e medidas para a mitigação da ilha de calor de Lisboa, Revista da Associação Portuguesa de Riscos, Prevenção e Segurança, n. 15, 2008.

[17] L. R. de. Mascaró, *Ambiência Urbana* (1st ed.), Porto Alegre: Sagra – D.C. Luzzatto, 1996.

[18] M. A. B. Romero, Arquitetura do lugar: uma visão bioclimática da sustentabilidade em Brasília, São Paulo: Nova Técnica, 2011.

[19] J. C. de S. Serro, "Corredores Verdes" – Oportunidade e Estratégias de Integração no Município do Porto, 2º Ciclo de Estudos em Riscos, Cidades e Ordenamento do Território. Universidade do Porto, 2013.

[20] M. T. G. Furuya and R. F. de Lourenci, Plano de mobilidade urbana de martinópolis: ciclovia, *ETIC - Encontro de Iniciação Científica* 12 (2016) (12) 13.

[21] J. Gehl, *Cidade para pessoas* (3rd ed.), São Paulo: Perspectiva, 2015.

[22] C. G. A. Costa et al., Hortas comunitárias como atividade promotora de saúde: uma experiência em Unidades Básicas de Saúde, *Ciência & Saúde Coletiva* 20 (2015) (10) 3099-3110.

[23] M. de A. R. Franco, Infraestrutura verde em são paulo - o caso do corredor verde ibirapuera-villa lobos, *Revista LabVerde*, Edição 1, outubro, 2010.

[24] J. C. Ferreira and J. R Machado, Infra-estruturas verdes para um futuro urbano sustentável, O contributo da estrutura ecológica e dos corredores verdes, *Revista LabVerde*, Edição 1, outubro, 2010.

[25] J. Machado et al., A Estrutura Ecológica do Município de Alcobaça. Relatório Técnico Preliminar, Departamento de

Ciências e Engenharia do Ambiente da FCT/UNL, Monte de Caparica, 2004.

[26] M. L. T. Bestetti, Ambiência: espaço físico e comportamento, Rio de Janeiro, Revista Brasileira de Geriatria e Gerontologia, 2014.