This Master's thesis deals with the application of bioclimatism concepts to urban designs, with focus on thermal environments. Inspired by vernacular architecture techniques, bioclimatism comprises, in a systematic way, studies of climatology, biology, technology and architecture. It seeks harmony between already built and natural spaces for human comfort. As a multidisciplinary area of knowledge, it brings the progressive systematization and evolution of its original goals, i.e., building not only with focus on comfort, but also on using the energy potential of a given location.

While constituting its habitat, the perception of climatic phenomena was fundamental to humanity in order to find adequate responses in search of protection, comfort and thermal balance, which are essential items to humanity's well-being and survival. These responses were materialized in the architectural and urban expressions of human settlements, characteristic of various regions of the world and eras of civilization. This evolution took place according to the degree of knowledge, technological development and culture of the regions.

A healthy environment, with efficient use of natural resources, is one of the main goals of a sustainable city. The bioclimatic urban project is inserted in this concept and can contribute to improve the well-being and enhance the sustainability of contemporary urban spaces. Studies show that the urban climate is directly related to the form of a city. Performing urban designs without taking environmental impacts into consideration often has negative consequences for the environment and, consequently, for the health and comfort of the inhabitants.
The objective of this study is to contribute to the grounds of project decisions and urban planning, related to the general characteristics of the urban fabric taking climatic and thermal comfort aspects into consideration. We assess the principles of architecture and urbanism suited to the climate and their application in the step of defining action plans.

The research methodology consisted of a bibliographic review of the works of authors who deal with bioclimatism under multiple approaches, and conditioning factors that involve bioclimatic urban projects. We address the characteristics of climate, such as its constitution, scales and classification, which allows knowing the main factors that interact in its formation, and the preponderance of each one of them according to the scale of study. Human thermal comfort is influenced by a set of variables, which are differentiated between personal and environmental. The models of thermal comfort—such as the bioclimatic chart—developed on the basis of the local reality allow identifying the environment variables, such as temperature, humidity and air movement, and radiation, which can be modified or exploited from the listed strategies, establishing design principles according to the climate in order to obtain the desired comfort conditions. By studying the interaction between urban space and climate, a local-scale climate is identified, which is typical of urban areas (urban climate) resulting from the effects of urbanization. It is observed from the comparison with the surrounding rural environments, presenting in general higher temperatures, special wind regimes and lower humidity. Its most characteristic phenomenon is the heat island. We address the factors that interact in its formation, being the urban form one of them.

The methodology used for the case study was adapted from methods of the authors referenced in this research, in order to observe to what extent the climatic and thermal comfort aspects are considered in the their definition in areas of expansion and urban renewal. To this end, we established a set of categories, which are based on the characteristics of urban form, identified as determinant of urban climate; in accordance with principles and strategies of the bioclimatic urban project. They are suitable for a project analysis, as a preliminary study, and for an intermediate scale of neighborhood/area/sector. This set of categories enables both the analysis of the project and the indication of general guidelines for
establishing an urban fabric corresponding to the climatic context in which it is inserted.

Each category is related to a number of aspects, which are observed in the projects according to the expected benefits. They refer to: soil occupancy rate; spacing between buildings; height averages and differentials; speed and movement of air; access to sunlight and wind in the urban fabric; water infiltration into the soil; and distribution and location of green areas. They are defined as: building density; roughness; porosity; orientation; soil permeability; public open spaces; and vegetation. Their main controls should aim at: reducing the absorption of radiation and heat production; increasing heat loss by evaporation and convection; increasing air movement; and favoring ventilation and shading.

The application of the method aimed at assessing the consideration of bioclimatic aspects in the definition of the urban form within the set of projects. It was specifically oriented to aspects related to thermal comfort, which enable greater adaptation to the local climate and contribute to improve its unfavorable conditions.

The case study refers to the first four projects classified in the public tender Porto Olímpico do Rio de Janeiro (Olympic Port of Rio de Janeiro). The choice of this case study regarded the fact that this is an urban renewal area. Most of the project area is made up of lands of the former port area, in the central area of the city of Rio de Janeiro, which has hot-humid climate. The renovation plans for the port area generate a great expectation of remodeling and the incorporation of sustainability concepts into the city. The interest of the City Hall of Rio de Janeiro manifested in the tender protocol, that new buildings and the urban sectors created should be clear indicators of a new level of environmental quality in the city, represents an opportunity for the application of the analysis methodology. Since these are new projects, regarding the same program and designed under the paradigm of sustainability, the public tender offers a homogeneous and well-qualified sampling for the development of the study.

The analysis of the set of projects, developed in accordance with the methodology defined, enabled to assess information concerning bioclimatic aspects, able to contribute to the improvement of thermal comfort in the urban environment. It showed, at an early stage of the project, the degree of consideration of these aspects in the definition of the urban fabric, enabling to
identify the need for further assessments, grounding project decisions in the direction of a most suitable urban form for the local climatic conditions.

It was possible to observe a positive trend in the consideration of bioclimatic aspects, both in the definition of the morphology of urban sets proposed and the presentation of techniques and tools for surveying local climate conditions. On the other hand, many aspects are not yet explained in the projects through specific studies, objective local climate data or simulations. This fact points out to the need for specific standardization in order to enhance the inclusion of this theoretical framework in current actions.

Keywords

Bioclimatic urbanism; urban project; thermal comfort; urban form.