UNICAMP 2030

A plan for increasing a university campus in a sustainable way and an example of integrated use of CAAD simulation and computational design strategies

G. CELANI; L. MEDRANO; J. SPINELLI
State University of Campinas, UNICAMP
School of Civil Engineering, Architecture and Urban Design
celani@fec.unicamp.br;
medrano@fec.unicamp.br;
spinelli@fec.unicamp.br

Abstract. This paper describes a set of proposals targeting the increase of a university campus’ density in a sustainable way. The plan also aims at increasing the quality of life on campus and diminishing its impact on the environment. The integrated use of computer simulations and computational design methods was important for the development of a sustainable building system.

1. Introduction

The State University of Campinas, UNICAMP, is a public university in upstate São Paulo, Brazil, ranked the second best in the country. It was founded in 1966, and its main campus started to be built in 1967, in the suburbs of Campinas, nowadays a two-million people city. The area of the campus is almost 3 million square meters (300 hectares), with a total built area of 522,000 m² and a population of 40 thousand people - 30 thousand students, 2 thousand faculty members and almost 8 thousand staff members. The campus’ gross population density is 133 people per hectare. Less than 6% of the total campus area is presently occupied.

The design of UNICAMP's campus is based on concepts that were typical of the modern movement, with reminiscences of corbusian urbanism, in which preference is given to cars and buildings are spread apart on the territory, with little concern to the circulation of pedestrians. The standard
building type that has been built on campus since the 1970's is based on non-recyclable materials, and has a poor thermal performance.

UNICAMP is expected to double its number of students by the year 2030. The campus density is thus expected to grow from 600 people per hectare to almost 1,000 people per hectare. The need to construct new buildings is seen as an opportunity to correct certain characteristics of the campus that are now seen as mistakes, according to sustainability principles.

This paper describes a set of proposals targeting the increase of the campus' density in a sustainable way. The plan, which is being developed by the Model Studio (Celani and Medrano 2009), also aims at increasing the quality of life on campus and diminishing its impact on the environment. The main targets are:

- Reducing the average temperature by 2°C;
- Reducing the average displacement time by 15 minutes;
- Increasing the campus' density by 100%;
- Reducing the CO2 emissions by 50%.

2. The proposal being developed

In order to achieve the goals above, the following actions have been proposed:

2.1. A NEW CAMPUS' OCCUPATION PLAN

By filling up under-utilized urban areas in the campus with new buildings, it is possible to make a better use of unused infrastructure and decrease the distance between buildings. Figure 1 shows in red the areas that
can be occupied in the next 20 years, in order to double the capacity of the campus.

Figure 2. Present land occupancy of the campus and expected occupancy in 2030

The objective of this occupancy proposal is to duplicate the number of students in the University without having to double the footprint of the built area, which means to increase the average density of the campus. To achieve this we have proposed to increase the maximum number of floors from three to four floors, in order to optimize the use of the existing infrastructure without increasing the cost of the buildings’ structures. The increased density will also reduce distances within the several activities of students, faculty and staff. A bicycle-path is also part of the proposal for the entire campus, as well as other improvements such as planting trees and laying down new sidewalks and pedestrian-ways.

2.2. A NEW STANDARD BUILDING

Since UNICAMP is a public university, the construction process involves a long bidding process, which requires very detailed construction documents. These documents need to be readily available whenever there is a funding opportunity to add a new building. This has been solved since the late 1970’s with the use of a standard building design. However, this design does not fit all necessities. Besides, the standard building is based on a pre-cast concrete technology, which is not considered sustainable nowadays.

In order to solve these problems, a new standard building is being developed. The new building type is much more dynamic, introducing the possibility of layout variations. The construction is based on a metal frame, steel deck slabs, dry wall partitions and cimentitious board facades, all of which are recyclable. Figure 2 shows one of the possible layouts of the new standard building, which is already being developed for the Language
In this instantiation of the type it is possible to see how the new building can easily adapt to the existing topography.

The new standard building type incorporates many sustainability issues, such as the use of renewable and/or recyclable materials, the installation of rainwater storage tanks, the use of natural ventilation for cooling, sitting the buildings in such a way to decrease thermal gain, and other issues that are required for sustainable buildings' international certifications. To assess the performance of the new standard building, different simulation software were used, such as CFD for checking ventilation, light simulation software to assess energy consumption, and so on.

Simulations in the lighting software Dialux have helped determining, for example, the best distance between the vertical windows in order to avoid dark areas between them. The ventilation software EasyCFD, on the other hand, allowed us to evaluate the positions of the windows in each facade, optimizing air circulation and minimizing the need for air-conditioning, since Campinas has a long Summer and a very short, mild winter.

Figure 3. Computer model of one of the possible layouts of the new standard building

Figure 4. Software simulation for sunlighting and ventilation.
Also, the new design can have different configurations, as the project does not define a single construction, but a system of modules that can be grouped to result in the best building for specific necessities. The same system allows constructions to be expanded later, according to university’s needs. This contributes not only to flexibility and adaptation of uses but also to the quality of campus planning and growth.

By proposing a system with a limited number of modules but various possibilities of combinations, we have created a model building that is industrialized but not standardized – an example of “mass costumization” (Duarte, . As a result, the building can be adapted to different site conditions, such as sun aspect and topography. This approach is based on current concepts such as Generative Design and Parametric Design. A shape grammar is being developed to guide the possible combinations of the modules, in order to assure also the aesthetical quality of the many possible outcomes.

2.3. BICYCLE PATHS

Proposing new bicycle paths in and outside campus, and proposing changes in the existing bicycle path to improve its safety can help reducing the CO2 emissions both from private cars and public transportation. The plan includes the installation of bicycle racks and water fountains along the paths. Besides, the new buildings will have showers installed at the ground floor restrooms, to encourage students, staff and faculty to ride their bicycles to the campus or to keep them on campus for local circulation. A system of rental bicycles, similar to the one that is offered in some European cities, such as Barcelona, is also being studied at this moment.
2.4. LANDSCAPE DESIGN

Another measure that is being proposed is the development of a new landscape design plan. The new plan aims at shading pedestrian ways and bicycle tracks, in order to encourage these forms of circulation on campus. Besides, the plantation of trees with the objective of shading buildings on the correct sides to minimize sun exposure on summers and maximize it on winters.

2. Discussion

The sustainable campus project presented above has been developed by a group of students from UNICAMP’s Undergraduate Architecture Program, under the advice of the authors. Besides its obvious consequences of allowing for a better environment for all the community, the project has been an important experience for both faculty and students to develop sustainable solutions and to put in practice ideas that have been extensively taught at the course. In regards to CAAD education, the project is an example of the use of both computer simulation software (in this case for lighting and ventilation) and innovative computational design strategies (in this case a combinatorial system, guided by a shape grammar) in an integrated way.
Acknowledgements

The authors acknowledge the students who have been taking part in the studies for this sustainable campus project.

References

