

POLITECNICO DI TORINO
SECOND SCHOOL OF ARCHITECTURE
Master of Science in Architecture
Honors theses

Designing an Energy Efficient Family Residence: A Case Study in Brasilia

by Nathalia da Rosa Pires and Isabella Dias Botelho

Tutor: Valentina Serra

Co-tutors: Cláudia Naves Amorim, Michela Buzzetti, Marco Simonetti e Lavinia Tagliabue

This work pursues to analyze the application of sustainability concepts in designing a **house for the middle class**, situated in the city of **Brasilia** in central-west **Brazil**.

The central objective was the development of a project energetically efficient. Was therefore adopted a pragmatic viewpoint, based predominantly on the economy of water and energy and the choice of the construction system, the main elements of environmental impact

The incorporation of **passive technologies** in the guidelines of the project bring sustainable features to the residence. This approach has been followed since the preliminary studies, particularly in the provision of the plan and in the development of its form, which were guided by a detailed analysis of the climate of the site, in order to exploit the local natural conditions.

Among the systems selected, there are: solar systems for heating water for domestic use and photovoltaic power (calculations made using the **RETScreen** software); system for collecting and reusing rainwater; septic tank for biological treatment of domestic sewage; solar screens; typology of glasses studied for every situation and choice of materials, preferably regional, offering thermal comfort with low environmental impact, in terms of lower CO₂ emissions in its production and low embodied energy.

Consider all the aforementioned requirements in the architectural design of the house means combine cleaned building systems with elements of local innovation raised from research on thermal comfort and sustainability of materials, to ensure the essentials: the welfare of the user with minimal impact possible.



Floor Plans and Northeast Facade



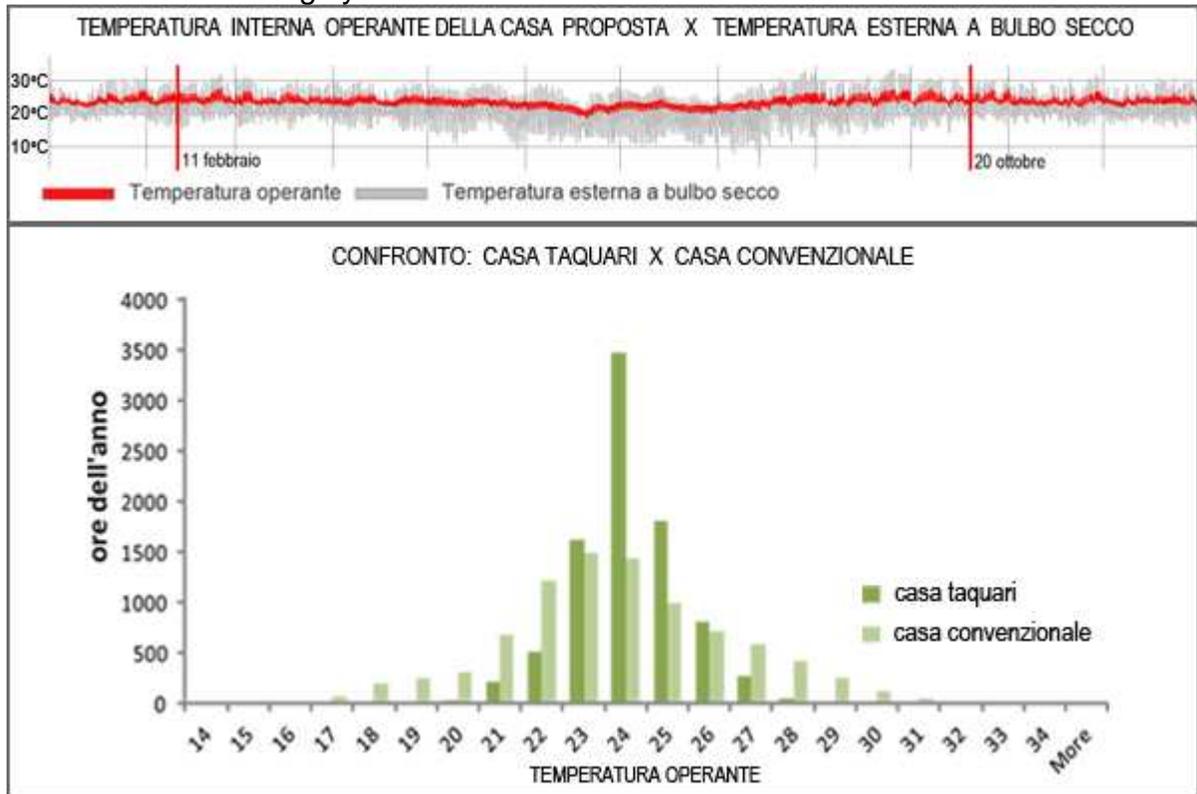
Section and Prospects

The building's thermal performance was evaluated using the dynamic simulation software **Energy+** (with the graphical interface **DesignBuilder**). It is able to assess the thermal dynamics under an hourly basis, detailing the physical characteristics of the overlay and profiles of functioning and occupation, and including the simulation of natural ventilation flows originated from movements of wind and thermal variation.

Based on the results of the simulation it was possible to validate that all rooms of the house fulfill the requirements established due to the human needs of comfort according to the **Givoni's bioclimatic chart** for the city of **Brasilia**.

In parallel, as a form of methodological comparison, was also performed the examination of the thermal performance of the **House** through the application of the standard **UNI TS 11300**, which determines the thermal energy demand of the building for summer cooling and winter heating, according to monthly seasonal data. From the results obtained after a dynamic analysis approach (**DesignBuilder**) and a static approach (calculus **UNI TS 11300**), it was found that the dynamic/hourly method analysis is more appropriate for the specific type of analysis (thermal performance of the House) and for the present climate, where the main feature is the daily temperature range, and not the seasonal one.

The main objective was to demonstrate the superiority of the thermal performance of the **House** developed in relation to a traditional one. To this end, were compared the results of the simulations of the thermal performance of the **House proposed** and those obtained with the same house, though with **conventional** building systems.



The House internal temperature of operation x External dry bulb Temperature
 Annual hourly frequency of the internal temperature of operation (House proposed x traditional house)

Finally, the thesis contains a collection of information on how the issue is approached in **Brazil**, through an extensive and theoretical research of the laws, public policies, certification and standards in the energy sector of **Brazil**.

For further information, e-mail:

Nathalia da Rosa Pires: nathrosa@gmail.com

Isabella Dias Botelho: isabella.botelho@gmail.com