UERJ
Programa de Pós-graduação em Engenharia Mecânica (PPGEM)

Seminary Class

Simulation of energy performance of buildings: comparison of computational tools DOMUS and EnergyPlus.

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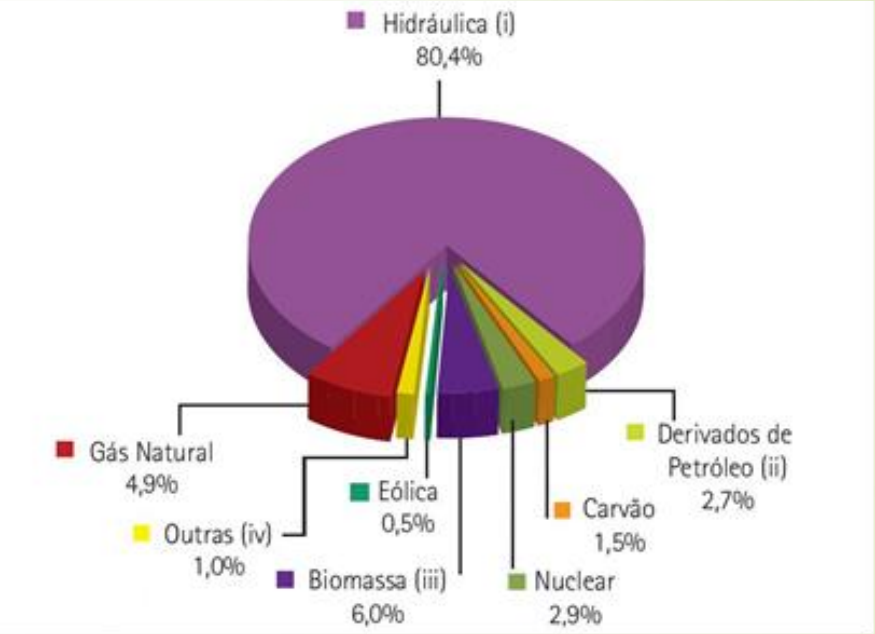
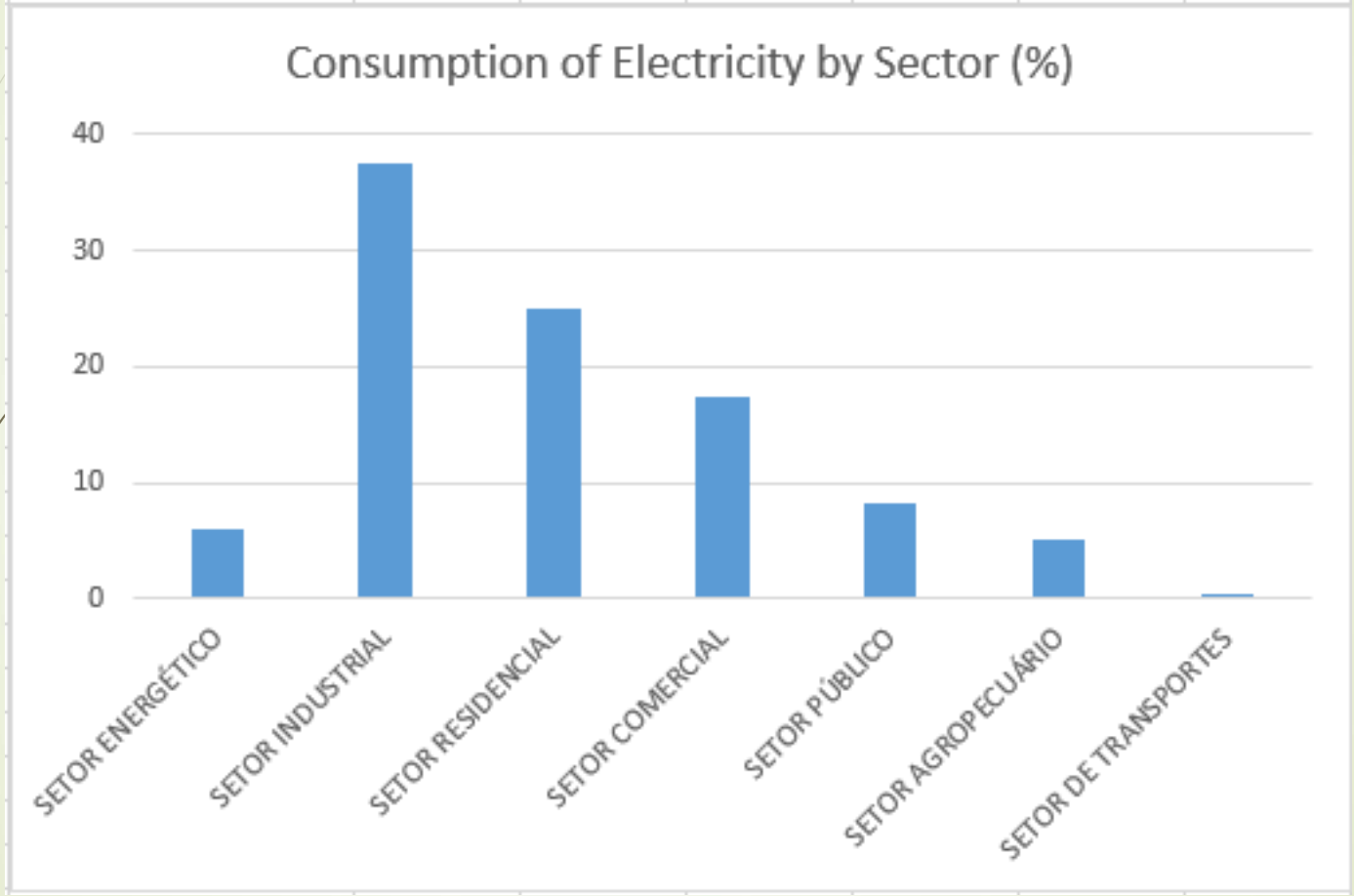
Generation of Electricity in Brazil

- Electricity in Brazil is mainly produced through hydraulic generation.
- Increased consumption of this type of energy provides a greater share of termal generation.



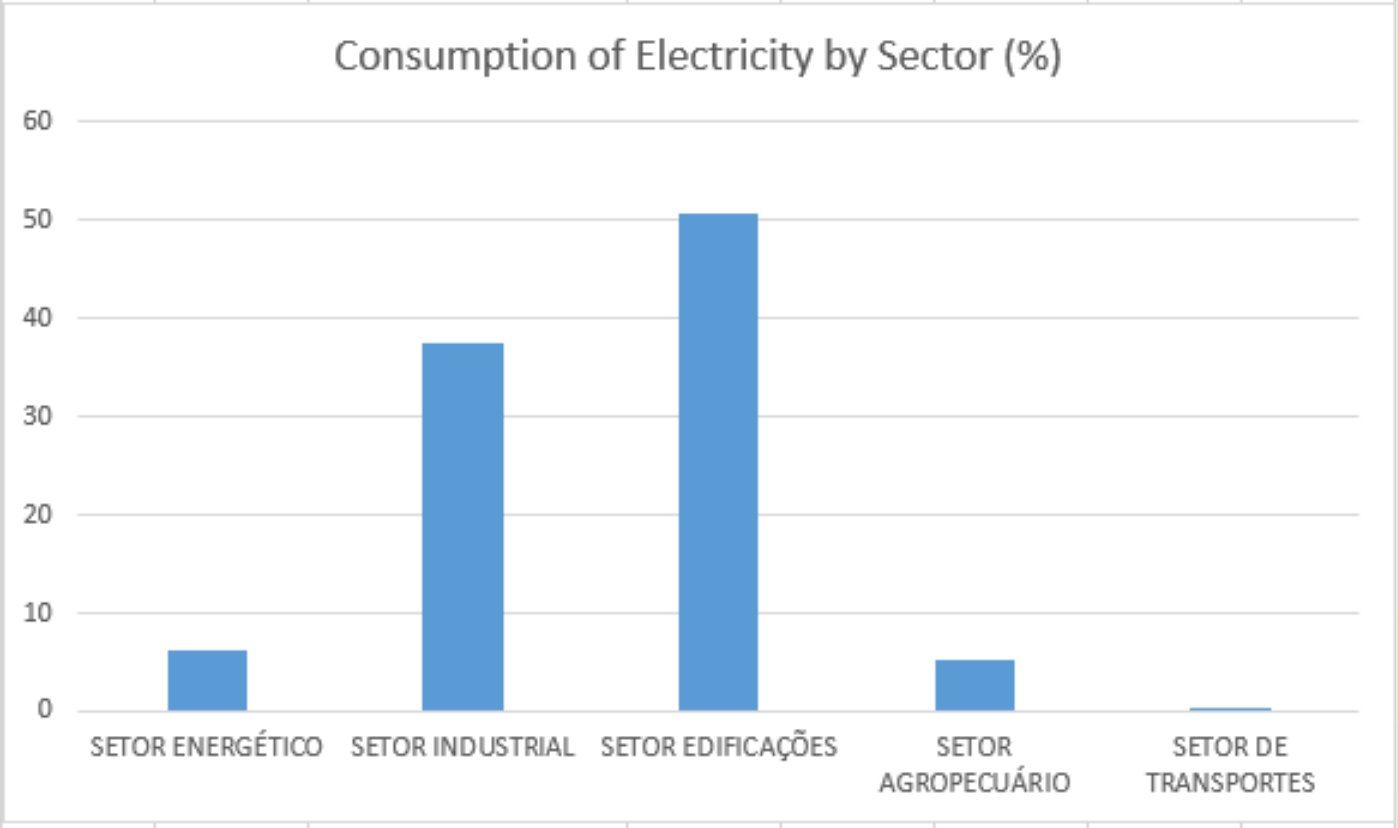
Source: EPE,2012

Consumption of Electricity in Brazil (2015)



Source: BEN 2016

Consumption of Electricity in Brazil (2015)



Source: BEN 2016

Energy Codes

- In Europe, North America and Asia, the buildings are subject to intense campaigns and legal measures, with the objective of making them more efficient in their energy consumption.
- In Brazil, the Technical Requirements for the Quality of the Energy Efficiency Level of Commercial, Services and Public Buildings (RTQ-C) has the objective of providing evaluation mechanisms based on minimum performance criteria.
- RTQ-C uses two methods to evaluate the energy performance of a building: the prescriptive and simulation.

Problem

- A building can be compared to a machine whose energy performance can be optimized (LOMARDO, 2000).

- The determination of the energy performance is not a trivial task, since it involves a great amount of interdependent variables, whose mathematical modeling is complex.

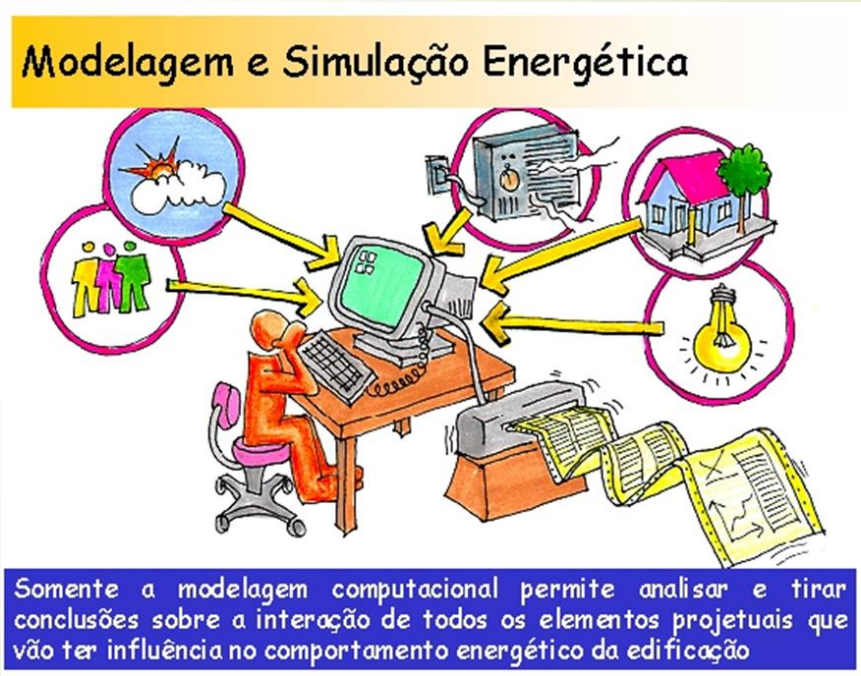
Problem

- Energy building simulation can evaluate the thermal and energetic performance of new and existing buildings, analyzing the different alternatives of architectural design, construction components, lighting systems and air conditioning.

- The simulation must be incorporated into the design routine of architectural and engineering offices with computational tools that are simple to use by architects and engineers.

What is Simulation?

- It is a process of experimenting with a detailed model of a real system to determine how it will respond to changes in its structure, environment or boundary conditions.
- The large number of variables, the need for dynamical behavior analysis and repeated calculations to analyze the design alternatives leads to the use of computational tools to guide the evaluations under study.



Source: Lamberts et al

EnergyPlus

- Developed by U.S. DoE
- No graphical user interface (GUI)
- Open source in C++ language
- Not user friendly
- Inputs and outputs by text file (.txt)
- Download: http://energyplus.net/download

DOMUS

- Developed by the Laboratory of Thermal Systems (LST) of PUC-PR, with agreement of Eletrobras.
- Has graphical interface.
- Evaluate the building by RTQ-C.
- In continuous development.

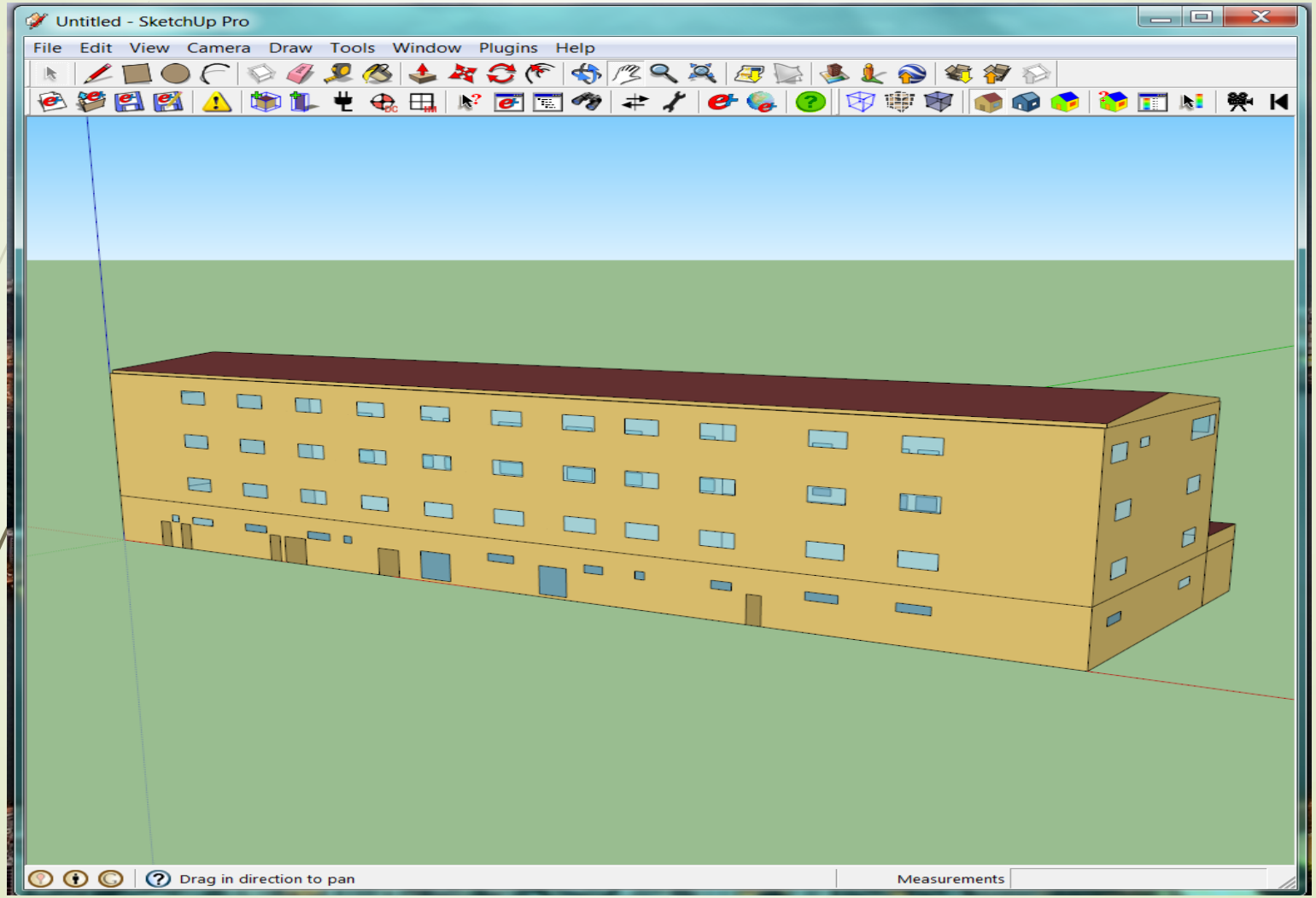
Primary Objective

- To evaluate the RTQ-C Simulation Method, through the comparative analysis of two simulation tools, EnergyPlus and Domus, in the simulation of an existing public building.

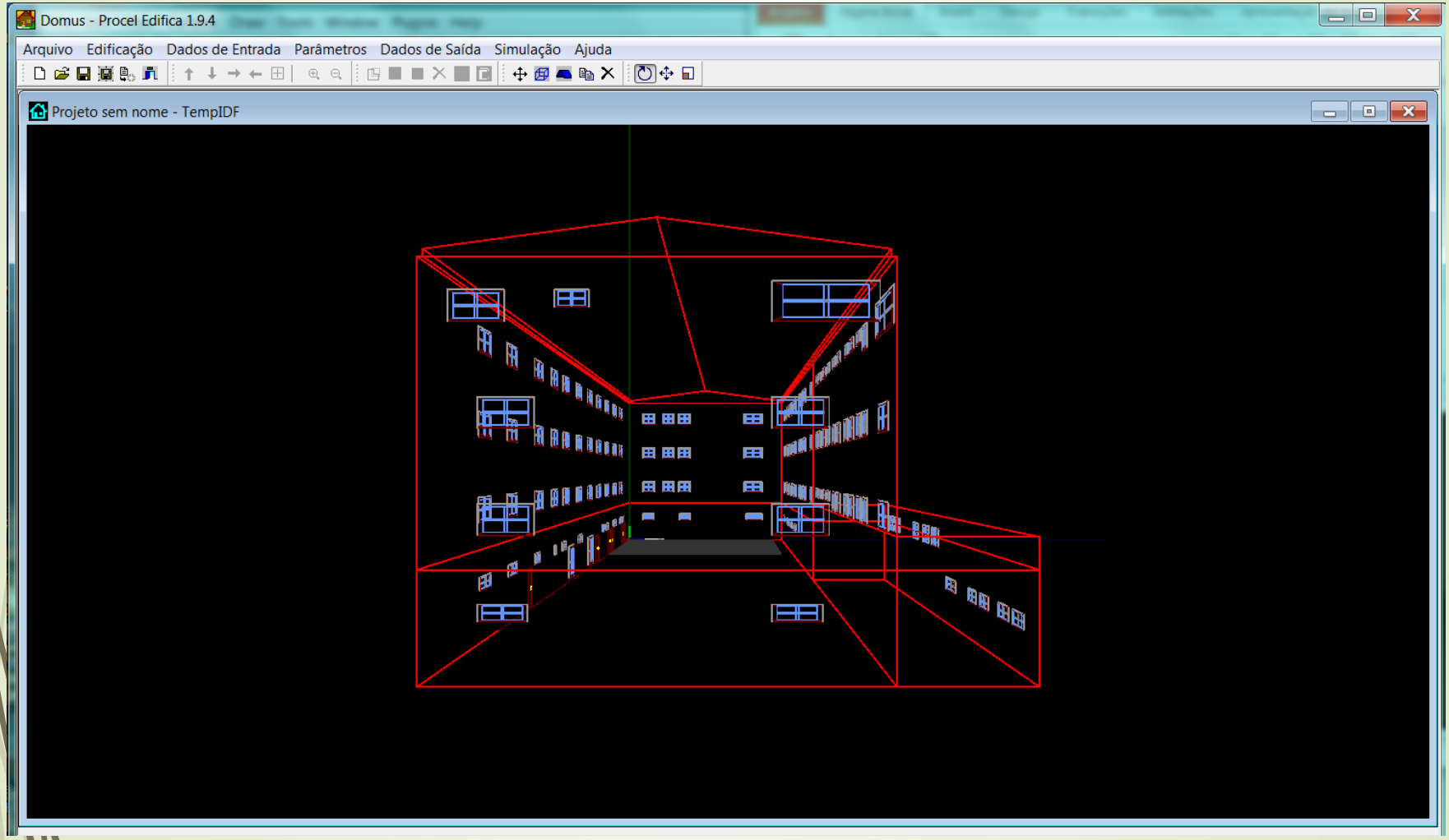
Specific Objectives

- To understand EnergyPlus and Domus software.
- Model a existent multizone building similarly in both software.
- Compare the results of both software and apply them according to the Methodology of the RTQ-C Simulation Method to know your level of energy efficiency.

EnergyPlus


Untitled - SketchUp Pro
File Edit View Camera Draw Tools Window Plugins Help
Drag in direction to pan
Measurements

Domus


Domus - Procel Edifica 1.9.4
Arquivo
Edificação
Dados de Entrada
Parâmetros
Dados de Saída
Simulação
Ajuda
Projeto sem nome - TempIDF

Instituto de Cartografia Aeronáutica - ICA

- Located in the Santos Dumont Airport Complex, in Rio de Janeiro - RJ.
- Existing public building belonging to the Comando da Aeronáutica.
- 3.800,0 m² built área, with four floors.

Instituto de Cartografia Aeronáutica - ICA

Source: by the Autor

Methodology

- Modeling the actual building (baseline), with all the characteristics.
- Modeling the referenced building according to the required energy efficiency levels (A, B, C and D).
- Consumption of the proposed project (real) is compared with the consumption of the reference project. It must be demonstrated that the energy consumption Of the proposed project must be equal to or less than the consumption of the reference building.
- For buildings with simulation for natural ventilation will also be analyzed the percentage of hours occupied in comfort (POC).

Expected Results

- Determination of the level of energy efficiency of the building with the two simulation tools.
- Evaluation and comparison of the inputs and outputs datas required by the two simulation tools.
- Evaluate if the RTQ-C Simulation Method is easy to understand for use in project offices.

References

- INMETRO. *Requisitos Técnicos da Qualidade do Nível de Eficiência Energética de Edifícios Comerciais, de Serviços e Públicos*. Instituto Nacional de Metrologia, Normalização e Qualidade Industrial. Rio de Janeiro, 2010.
- INMETRO. *Manual para Aplicação dos Regulamentos: RTQ-C e RAC-C*. Instituto Nacional de Metrologia, Normalização e Qualidade Industrial. Rio de Janeiro, 2012.
- LAMBERTS, Roberto; DUTRA, Luciano e PEREIRA, Fernando O. R. *Eficiência Energética na Arquitetura*. PW Editores. São Paulo, 1997.
- LOMARDO, Louise Land Bittencourt. *Estudo para uma regulação de estímulo à eficiência energética dos edifícios*. Rio de Janeiro: UFRJ; COPPE, 2000.

Thank you all!