HCU HafenCity Universität Hamburg

ENERGY EFFICIENT RETROFITTING OF BUILDINGS IN BRAZIL

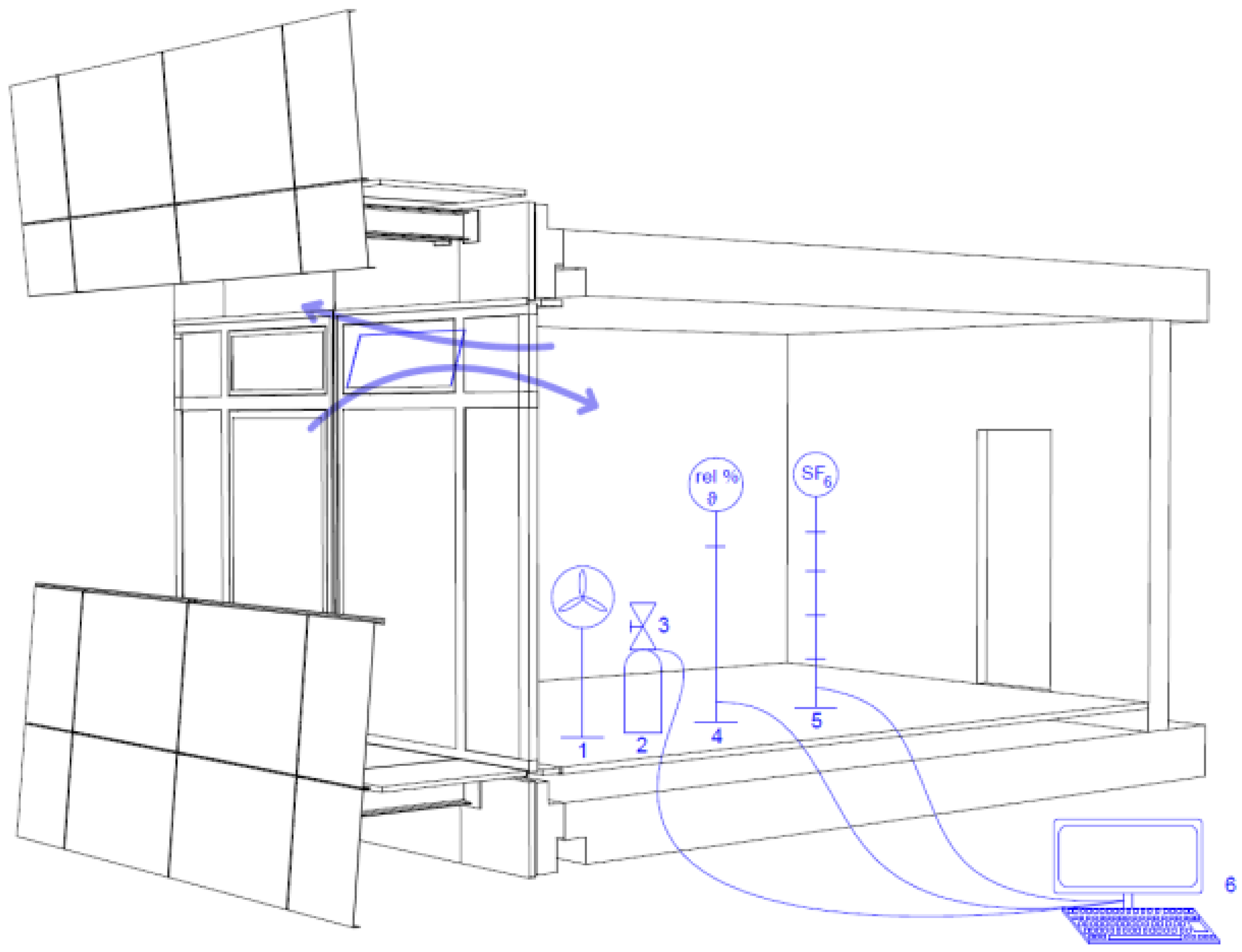
CHALLENGE

Energy consuming air conditioning (AC) systems are often used for building climate control. In Brazil, AC is responsible for 47% of the energy consumption from the building sector. Due to the steadily increasing energy prices and climate change effects, methods and tools for sustainable architectural design must be developed. External shading in combination with natural night ventilation is an efficient method to reduce the required cooling energy for buildings. Typically, the energy cost of naturally ventilated buildings is 40% less than that of a building with AC. As the total lifetime of buildings is usually 2 to 4 times longer than the lifetime of the façade system, a huge potential is given in retrofitting existing buildings with energy efficient façade systems and well designed natural ventilation of the building.

Although the effectiveness of natural ventilation depends on outdoor air temperatures, an intelligent designed façade prevents against overheating during the day and allows passive cooling during the night.

Simplified design methods for natural ventilation of buildings with approximated opening sizes related to the ground floor are in most cases insufficient. Important parameters like local weather data, window geometry and window types have a huge influence on the air exchange rate.

The general objective of this research project is to provide an appropriate design guideline for retrofitting of existing facades in different climate zones for buildings with natural ventilation.



Test setup for tracer gas measurements with SF_6 tracer gas in the HafenCity University, Hamburg, Germany

APPROACH

Market relevant window systems from Brazil, provided by MGM Produtos Siderúrgicos Ltda, as well as from Germany, provided by Christophe Lenderoth GmbH, will be tested in the wind tunnel of the State University of Campinas.

Overview of the wind tunnel in the Laboratory of Environmental Comfort and Applied Physics (LaCAF) in Campinas, Brazil

Brazil window installed in the wind tunnel

The results of these tests will be used to calculate discharge coefficients – the ratio between the actual air flow and the ideal air flow. With additional tracer gas measurements the air flow rate will be determined at the HafenCity University Hamburg. Both, discharge coefficients and air flow rates will be used to validate computational fluid dynamic (CFD) simulation models and the field of window systems can be extended by a numerical parameter study.

Discharge coefficients are required as an input for multi zone building simulations of the energetic and thermal performance of buildings to develop the above mentioned design guideline. Recommendations for the geometry of the window openings with maximum discharge coefficients can be given based on the successive testing and numerical analysis.

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