



AALBORG UNIVERSITY
DENMARK

Aalborg Universitet

CLIMA 2016 - proceedings of the 12th REHVA World Congress

volume 6

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Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

Citation for published version (APA):
Heiselberg, P. K. (Ed.) (2016). *CLIMA 2016 - proceedings of the 12th REHVA World Congress: volume 6*. Department of Civil Engineering, Aalborg University.

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INTEGRATED PERFORMANCE-BASED DESIGN APPROACH FOR LABORATORY INTENSIVE BUILDINGS: A CASE STUDY IN SINGAPORE

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The building's performance-based design approach is most effective when applied at the initial stages of the design processes. This philosophy was gradually understood and accepted by building owners and ESD (Environmental Sustainability Design) consultants for commercial buildings. Particularly, design of a laboratory intensive building still poses a tremendous challenge since energy savings should only be pursued without compromising the user's safety. This study will demonstrate the effectiveness of integrated performance-based approach to design a high-performance laboratory building in Singapore. To comply with Singapore's GreenMark (building certification scheme), this project aims to achieve above and beyond GreenMark Platinum standard.

To achieve this target, design charrette was conducted during the initial stages of the design to develop performance goals and to assess possible technology/system performance. Comprehensive modelling and simulation were conducted for this study aiming at maximizing energy efficiency, include (i) Computational Fluid Dynamics (CFD) for optimization natural ventilation design, (ii) daylighting and glare simulation for optimum natural daylighting throughout the building and (iii) energy modeling to estimate facility energy consumption and to develop energy-efficient measures. The use of these computerized simulation tools help to validate building system performance and to support decision-making for recommended strategies by establishing payback costing for each innovative technologies. In addition to the modelling and simulation process, metering studies were carried out to benchmark laboratory and office plug load. Measurement and verification studies were also conducted to establish energy savings through metering actual implementation device.

With proposed strategies and technologies, the total building energy consumption is expected to reduce 44.12% yearly. From this study, an integrated performance-based design approach is proven to be most effective to explore the most energy efficient strategies and to design a high performance laboratory building. This study is also the first exemplary case study to demonstrate at least 40% energy savings for a laboratory intensive building in Singapore. It is

hoped that this energy efficient measures and strategies from this study can be applied for other similar projects in future. Furthermore, the benchmarking and measurement practice can also provide solid evidence for simulation model input for a laboratory intensive building. Finally, this study could be a good reference for other building owners, developers, facility managers, architects and building engineers to design a high performance building.

Key Words: building simulation, building performance, design integration, laboratory intensive building