Building 116$^{3/4}$: design of a net-zero energy building

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INTRODUCTION

The new bachelor education in building design has made new installations for teaching and workshops necessary to complement building 117. Our challenge is to elaborate strategies to design a building containing those facilities by focusing into making a net-zero energy building. By combining the use of innovative and low-energy consuming systems and an optimized architecture, we expect to reach minimal running energy consumption per student. Our goal is to go further than what is set by the future 2020 Danish energy frame. This building is thought to show the potential of new low-energy designs on DTU Campus.

PROJECT DEVELOPMENT

After gathering information and defining the functional requirements linked to the new education, we have, in a first phase, performed iDBuild simulations to do a primary optimization of the different rooms' geometry and indoor climate. This phase has raised some indoor environment problems to solve, especially high cooling loads driven mainly by occupants and equipment. This led us to consider innovative and low-energy HVAC (Heat, Ventilation and Air Conditioning) solutions in a second conceptual design phase.

We have designed the building to use as much as possible natural and passive means to regulate the indoor environment:

- Natural ventilation driven by the stack effect in the central atrium
- Optimization of the solar gains during the heating and cooling seasons
- Harvesting of natural resources (solar electricity and heating, ground-source energy)

The use of Thermally Active Building Systems (TABS) for heating and cooling, combined with a concrete structure, is an energy efficient way to condition the building environment. It is ideal for night cooling, reduces the electricity consumption of ventilation and uses the property of embedded energy in concrete. Using displacement ventilation in high rooms (ateliers) is a highly efficient ventilation process, which specific fan power is lower than that required by the 2020 energy frame.

After a study to support sustainability with low-carbon footprint and minimal strain on resources, and at the same time comply with the requirements linked to the energy systems, a concrete structure has been decided. The building envelope itself uses "Fiberline"-type materials. In accordance to the current DTU buildings layout, the building 116$^{3/4}$ is a modern and optimized design. Software are used for instance to optimize the "niched" windows layout according to the visual environment requirements.

CONCLUSION

The design of building 116$^{3/4}$ intends to demonstrate how high sustainability standards can be integrated in the pursuit of a good learning environment at DTU. The project is also meant to be a base for further expansion of DTU green campus.