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PhD Thesis: Bolig+ Zero Emission Building Concept. Aalborg : Department of Civil Engineering : Aalborg University, Unpublished

Abstract: Energy use in buildings globally accounts for a major part, close to 40%, of the primary energy use and, 24% of the green house gas emissions. Of course, the level of energy use varies by country due to climate, population density, building standards and use of renewable energy sources. Irrespectively of the location, buildings can be both direct (on-site use of fossil fuels) and indirect sources of emissions (grid use from electricity, district heating/cooling systems and energy used for fabrication of construction's materials). High energy use in the building sector has been a constant issue of discussion over the last couple of decades. Already, in late 80s in order to reduce buildings energy use the concept of 'passive houses' was developed, which in time and with progressing technology evolved into ultra low-energy building, zero emission building and finally into zero energy building concepts.

The aim of this PhD-thesis is a comprehensive investigation of the 'Zero Energy/Emission Building concept' (ZEB). The first part will focus on review and analysis of existing ZEB definitions and already constructed Zero Energy/Emission Buildings: main design principles, technologies and solutions in order to select the best methods for saving and producing energy from renewable energy sources in a building. Afterwards, based on previous studies working definitions will be developed, separately for 'zero energy' and 'zero emission' concepts and, for three scenarios: Autonomous (off-grid) building, Autonomous (off-grid) group of buildings and On-grid building will be developed.

In order to analyse the potential of ZEB performance in Danish context the created definitions will be applied to a study case - Bolig+ building. The analysis will be realised using thermal building simulation software and EnergyPLAN model. The results of the simulations will allow carrying out Life Cycle Cost evaluation of the above mentioned ZEB definitions in order to verify their financial viability in Denmark. Finally, suitable definition for 'Zero Energy/Emission Building' in Danish context will be recommended.

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Employed: 01.11.2008 - 31.10.2011