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PhD Thesis: Energy optimization of PCM-concrete element configuration. Aalborg : Department of Civil Engineering : Aalborg University, Unpublished

Abstract: Due to the fact that energy use for cooling demand in the building sector has been increasing over last years, new energy saving and environment friendly technologies such Phase Change Material (PCM) are becoming more and more interesting alternative to traditional cooling solutions. Globally, energy use in buildings accounts for a major part, close to 40%, of the primary energy use and 24% of the green house gas emission. It is essential to stress that until year 2020 it is expected that the demand for cooled floor area will double compared to 2000.

The aim of this PhD-work is to energetically optimize both the PCM-concrete element configuration and the whole building's energy performance. The main purpose of the optimization of PCM- concrete element is to create a competitive technology. In order to achieve this, the project work will focus on developing a methodology for most effective activation of PCM and thermal mass. Furthermore, for different PCM-element constructions, measurements of static thermal heat conductivity and heat capacity will be conducted. Due to the PCM nature and thermo-active building system (TABS) that is meant to be integrated, steady-state calculations of heating and cooling capacity is not sufficient to evaluate cooling/heating capacity in practice. Therefore, development of a test method for dynamic heat capacity is essential to the project. Results obtained from the measurements and the advanced heat simulations based on Finite Element Method in COMSOL software will be used as a source to further develop the BSim software. Updated design tool - BSim will be available to consulting engineers.

It is essential to stress that this PhD project is focused on the energy improvement of PCM-concrete element whereas other projects' stakeholders (Danish Technical Institute, BASF, Spæncom), will be responsible for the development of raw PCM product, test of physical and chemical characteristics, factory implementation, full scale application and preparing for market implementation. In this manner, the project will cover all disciplines that must be controlled to ensure that the product fulfil standards and building regulation requirements.

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