Innovations in Radiant Heating and Cooling Systems: Use of Phase Change Materials (PCM)

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I C I E E

Introduction

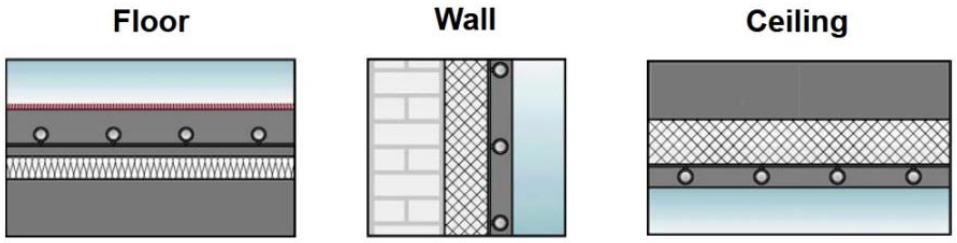
- We spend most of our lives indoors
- Buildings are built for people, not to save energy
- Comfort, health, and productivity should be achieved with the lowest possible energy use
- Heating, cooling, and ventilation systems
- Radiant water-based heating and cooling systems

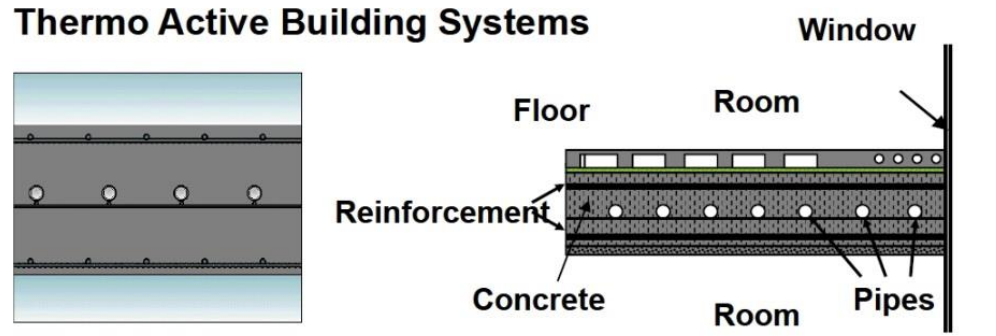
Radiant heating and cooling systems

- Low temperature heating and high temperature cooling
- Mostly water-based
- Floor, wall and ceiling can be used
- Three main types
  - Radiant heating and cooling panels
  - Pipes isolated from the main building structure (radiant surface systems)
  - Pipes embedded in the main building structure (Thermally Active Building Systems - TABS)

Radiant heating and cooling systems

Source: www.zent-frenger.de





Source: Olesen, 2000

Radiant heating and cooling systems

- Integration of renewable energy resources
- Transferring peak loads to off-peak hours, and peak load reductions
- Favorable operating conditions for heating and cooling plants
- Smaller-capacity heating and cooling plants, and downsized ventilation systems
- Reduced total energy use
- Less space requirement, lowered construction heights and saved building materials
- Free use of space, no cleaning requirements, quiet operation
- Uniform temperature distribution, reduced risk of draught, and reduced vertical air temperature differences
- Initial, operational, and energy cost savings

Radiant heating and cooling systems

- Similar system to TABS
  - With similar benefits
  - Can be used both in renovation cases and new buildings?

- Radiant ceiling panels with Phase Change Materials (PCM)

Phase Change Materials (PCM)

- Organic or inorganic materials
- Utilization of latent heat (mainly)
- Passive or active use
- Thermal mass enhancement
- Temperature control of indoor spaces
- Management of the cooling load
- Potential use in light-weight buildings and renovation of buildings

Main goals

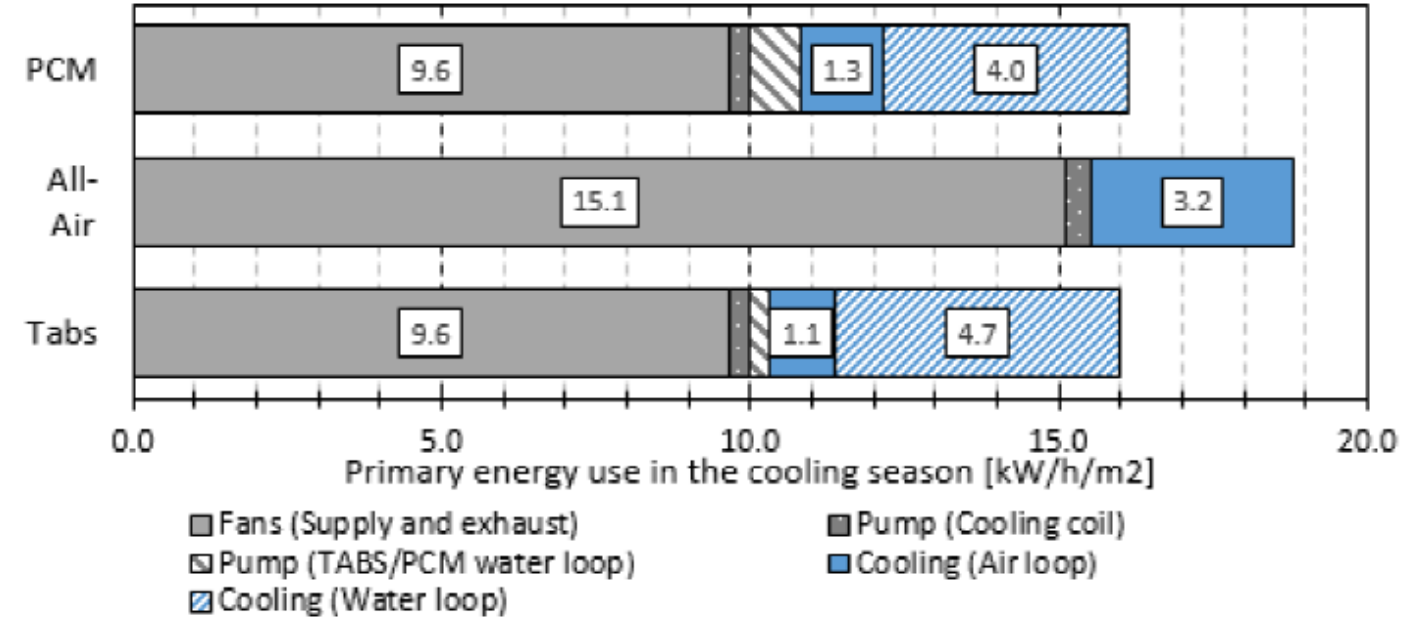
- Development of a new product (Phase Change Material-PCM ceiling panels)
  - To address implementation limitations and constraints in new buildings and renovation

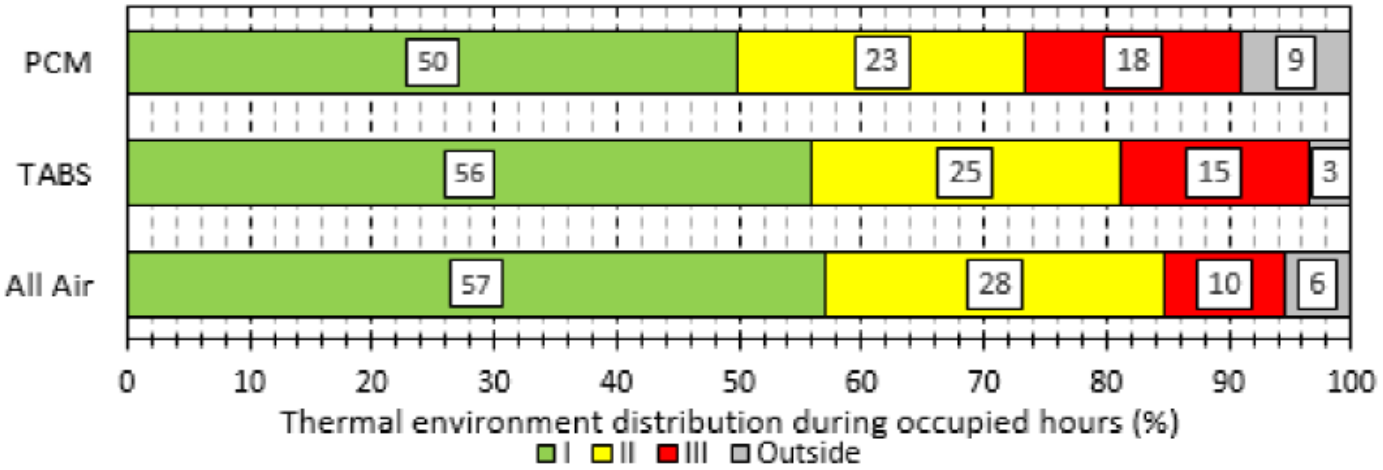
- Characterize the performance of the new PCM panels
  - Climate chamber measurements
  - Parametric analyses through validated simulation models

The new PCM panels

Performance of the new PCM panels - simulations

- ”PCM ceiling panels work like TABS”





Ongoing work

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Summary and future outlook

- PCM ceiling panels work like TABS
- Similar benefits to TABS
- Applicable in renovation of buildings
- Possibility of coupling with renewable energy resources (i.e. PV/T in our case)

- Design, dimensioning and control methodology needed
- Working & successful examples needed
- Long-term measurements needed
- Detailed economic analyses needed

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Thank you for your attention!

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