Energia
Concepts and technologies for an energy conscious and comfortable built environment

DII research group

BETA_Lab: Building Energy Technology Assessment

Angelo Zarrella
angelo.zarrella@unipd.it
Phone: +39 049 8276871

Michele De Carli
michele.decarli@unipd.it
Phone: +39 049 8276870

Assisted by:
Giuseppe Emmi,
Research fellow
Jacopo Vivian,
Research fellow

www.dii.unipd.it

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Main research topics

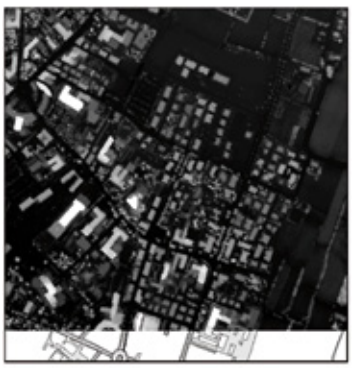
- Modeling and Field Measurements of Radiant Systems
- Ground Source Heat Pumps
- Solar Systems Design for Heating and Cooling
- Double Skin Facades
- Energy Analysis and Temperature Distributions in Large Spaces
- Simulations and Measurements in Buildings
- Energy Efficiency of Building Plant System
- Nearly Zero Energy Buildings (nZEB)
- Low Exergy Systems in Buildings
- Thermally Activated Building Systems
- District Heating and Cooling Networks
- Thermal Comfort
- Modelling and Development

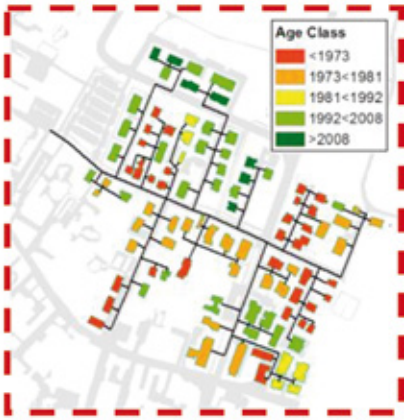
Evaluation of the Heat Load in District Heating Networks: a Simplified Approach

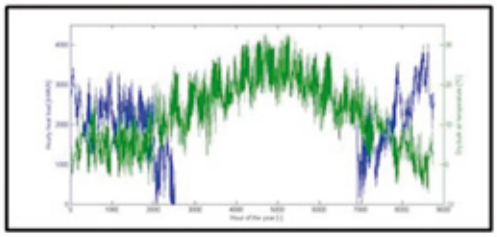
Simple, reliable building models have been receiving quite a bit of attention recently particularly with regard to diverse applications, such as building design for inexpert energy modellers, simulation of neigh-bourhood or city districts and model predictive control. The International Standard ISO 13790 and the German Guideline VDI 6007 use two different lumped-capacitance models (5R1C and 7R2C, respectively) based on deterministic, analytical procedures to identify their parameters.

The current research investigates the suitability of these models in calculating peak loads and seasonal energy needs and their accuracy in estimating buildings' dynamic behaviour. A room and an apartment were thus simulated using simplified models and with the benchmarked software TRNSYS. Four reference envelopes with different thermal insulation and heat capacities were examined in four climatic conditions. Each of the models was able to estimate quite precisely energy needs in both the heating and cooling modes, although the 7R2C model was slightly more accurate. The 5R1C model was, however, unable to follow the thermal response of the buildings during the cooling season, which in turn implied a systematic underestimation of the cooling peak load. The 7R2C model identified a significant reduction in the root mean squared error (RMSE) both in the indoor air temperature and in the heating/cooling loads with respect to the reference profiles. That model would seem then more suitable for the dynamic simulation of single thermal zones with hourly time steps in both heating and cooling modes.

In conclusion, both lumped-capacitance models appear to reliably calculate the overall energy needs of buildings in both heating and cooling seasons. As far as transient behaviour is concerned, the first-order model of ISO 13790 model seems inappropriate to calculate neither the hourly cooling load profile nor the cooling peak load. The second-order model proposed by VDI 6007 is more accurate in both the heating and cooling modes.







Hourly heat load of the district