How to Model Indoor Thermal Conditions to Support Your Weight Loss Program

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- Introduces the model to map the indoor hygrothermal condition for different housing topology with the hourly weather data
- Shows the model to achieve a healthier indoor environment while considering energy usage to anticipate global climate change
- Highlighting the need to review regulation on the recommendation of healthy indoor thermal value.

1 Introduction

80-90% spent indoors

Global Climate Change

Heating and hot water the biggest energy use

Non energy efficient house topology in UK's dwellings

Current Standards: BS EN 15251:2007 Indoor Environmental Input Parameters for Design and Assessment of Energy Performance of Buildings
ANSI/ASHRAE Standard 55-2017 Thermal Environmental Conditions for Human Occupancy

The current standards shows a gap connection between the healthy house (humidity) , the comfort temperature, energy use and housing topology.

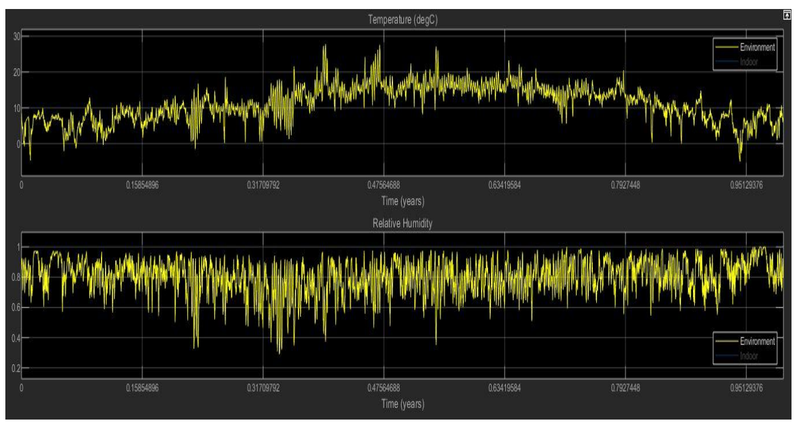
Previous Research: The study of thermal modelling started prior 1920s', 1970s' (Fanger PMV-PPD), Adaptive Approach, and latest study also revealed that the **cold exposures can help to decrease the body fat**.

2 Research Goals

Develop model and simulation to give a better view and understanding of the problem and its potential solution.

Recommendation for the indoor thermal settings to achieve healthier indoor condition and to support the body fat reduction.

3 Methodology



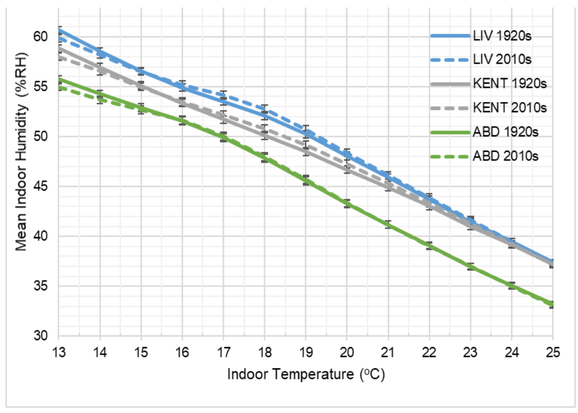
- Develop the hygrothermal model in Simscape MATLAB
- Using **hourly real weather data** from CEDA 2017 data (from **Liverpool** – avg., **Aberdeen** – cold and **Kent** - hot) to represent the whole UK
- **Verify** the model using **ASHRAE Global Thermal Comfort Database II** all available UK data (1994, 1995, 1996, 1998, 1999, 2011 and 2012 = 14,187 data)
- Using the construction data from LJMU **BRE houses from 1920s' and 2010s' topology**
- Running the whole year simulation using real data

4 Results

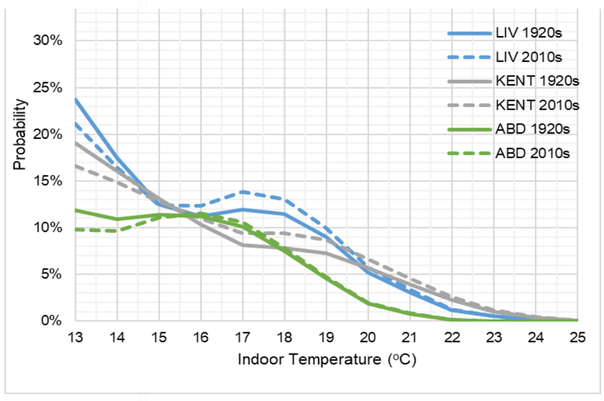
- Model is validated using ASHRAE Global Thermal Comfort Database II with the deviation about **5%**
- The number of occupants did not significantly reduce the energy for heating in the 1920s dwelling, unlike in the 2010s dwelling, especially with lower setpoint temperatures.
- There is **the possibility to achieve the healthy indoor environment** with the lower temperature range between 16 ºC - 20 ºC, **highlighting the need to review regulation.**

Comparison indoor parameters for the 1920s and 2010s housing topologies in Liverpool, Aberdeen and Kent over the entire year of 2017 with 2 occupants and air flow 0.025:

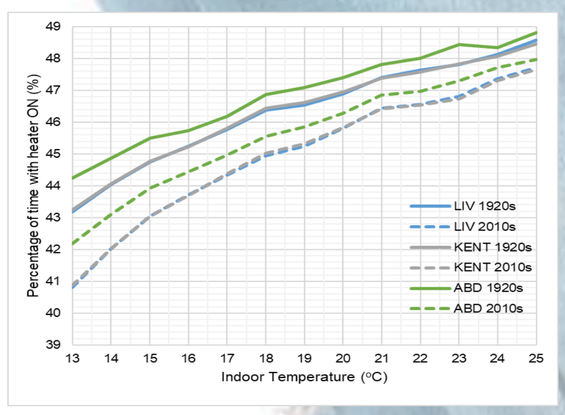
The relation between the comfort temperature set point, the humidity and energy use are shown in the right charts.



mean indoor relative humidity (% RH)



the probability of indoor RH exceeding >70%



the percentage of time when heating needed

5 Conclusion

The cold exposures can help to decrease the body fat, **lowering an indoor setpoint temperature** will have an extensive health effects shown in this work. This work also shows the advantage of lower energy use which is highlighting the environmental benefits.

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