



Background

The Energy Performance of Buildings Directive has set a zero energy goal for all new buildings by the end of 2020. A relatively new concept that has gained popularity in several European countries is the plus energy house, which uses renewable energy sources in order to produce more energy than it consumes. These houses are generally ventilated by MVHR systems. However, concerns have been expressed over the performance of such systems in terms of indoor air quality, thermal comfort and total carbon emissions in new dwellings with high standards of airtightness, such as plus energy houses.

Recent research has shown that natural ventilation could be a satisfactory alternative to MVHR in airtight dwellings in mild climates. A determinant factor for the success of a natural ventilation system is the way it is controlled. CIBSE recommends the use of CO₂-based demand control ventilation in non-domestic buildings. While these systems are not widespread for residential applications, this is expected to change.

Aim

To investigate whether appropriate advanced control algorithms can make natural ventilation an integral feature of plus energy houses in Central Europe and explore the possibility for a wider implementation of the proposed control strategy.

Results and discussion

The proposed control strategy resulted in an annual energy surplus of 1,299 kWh for home+ in Stuttgart and 1,662 kWh in London

All control strategies that did not include night cooling or shading failed to meet the overheating criterion in summer

Adopting seasonal control strategies can reduce energy consumption

Increasing the resolution of the controller gives the opportunity to increase the set-points

Sizing the ventilators correctly is crucial in finding a balance between energy use and occupant comfort

Methodology

Case study

Home+ is a plus energy house which is located in Stuttgart, Germany. It won the third place of the first edition of Solar Decathlon Europe.



Steps

Dynamic thermal and airflow modelling

Window positioning and sizing

Designing control strategies

Setting performance criteria

Testing control strategies in different locations

Conclusions

- Natural ventilation can be an integral feature of plus energy houses in Central European climates, even with simplified control strategies.
- Night cooling and shading are considered to be crucial components for the success of natural ventilation in such dwellings.
- Adopting different control strategies in winter and summer can tackle the seasonal risks of poor ventilation. Sizing the openings correctly for each season is essential.
- There is a large potential for a wider implementation of the proposed control strategy for plus energy houses in other regions with mild climates (e.g. in the UK).

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