

Zukunft Bau

STRUKTUR / GLIEDERUNG KURZBERICHT

Titel

Langfassung Titel: „Energetic assessment of decentralized facilities for controlled ventilation with alternating operation“

Anlass/ Ausgangslage

Decentralized alternating home ventilation units are becoming increasingly widespread on the market. For heat recovery, heat storages are used with air passing them unsteadily in alternating manner. Axial fans are usually used for propelling the flow, which depends on external pressure differences. Both of these factors involve uncertainties with regard to energy and ventilation compared with other ventilation concepts.

423 Zeichen (mit Leerzeichen) - max. 450 Zeichen (mit Leerzeichen)

Gegenstand des Forschungsvorhabens

For the evaluation of decentralized alternating home ventilation devices, the three research institutes investigate ventilation aspects on the basis of numerical flow simulation (RWTH Aachen) as well as experimental methods for energy evaluation (HLK Stuttgart). From the results, suitable characteristic values for the overall evaluation in norms and standards are derived (ITG Dresden).

With regard to the work related to standards (ITG Dresden), the presentation of a correct and standard-compliant dimensioning of alternating ventilation devices for rooms, possibly also in combination with other ventilation systems, is pursued at the beginning of the project. Based on all findings, proposals for improved or extended consideration in the relevant standards (measurement procedure, dimensioning, energy balancing, labelling) are developed at the end of the project.

First, two typical residential units (two-room-apartment & two-story single-family house) are used to determine the arrangement of the ventilation units and the volume flows. Then an evaluation algorithm including characteristic values for dual use of the air (proposal for dimensioning according to DIN 1946-6) is developed. In addition, a normative approach for the consideration of start-up processes during alternating operation (proposal for dimensioning according to DIN 1946-6) is derived. An algorithm for the consideration of wind pressure stability as a function of climate data (proposal for energy balancing according to DIN V 18599 or EN 13142) and further notes for the current standardization are also being developed.

With the experimental investigations (HLK Stuttgart), the currently applied test methods for determining characteristic values are further developed and evaluated. For this purpose, as a first step a measuring method is developed to measure the effective air volume flow and the imbalance in alternating operation. For the determination of heat recovery, the direct method described in EN 13141-8 and the purge air method used for DIBt approval are analyzed and compared in more detail.

Within the investigation of the measurement methods, strengths and weaknesses are identified and possible optimizations for characteristic measurements of decentralized alternating units are proposed. For the first time it is possible to measure the effective air volume flow relevant for the dimensioning as well as the imbalance in alternating operation with a developed method for air flow measurement in alternating operation. For the two investigated methods (indirect method and purge air method) for measuring the heat recovery performance, boundary conditions are defined which reduce the measurement uncertainty and improve the comparability of the results.

Within the simulation (RWTH Aachen) the focus of the investigations is on the comparison of the ventilation effectiveness. Different criteria are used for the evaluation. Based on the average resident time of the air in the room (age of air), local and global assessment of the flow conditions and the quality of the air exchange is done. Depending on a number of geometric and thermal factors, similarities and differences between the ventilation concepts are identified.

Based on the typical residential buildings previously dimensioned by the ITG Dresden, the effects of decentralized ventilation units on ventilation effectiveness is investigated. Room sizes, positioning of the ventilation units and properties of the ventilation units are varied. In addition, the total transported air volume flows are examined. They are a function of the pressure conditions on the building facade and in the rooms as well as the infiltration. The total volume flow rates are obtained in a pre-simulation which, similar to a duct network simulation, calculates volume flows as a function of different pressure levels. Taking into account wind effects and overflow openings between individual rooms, the disbalances of the air volume flows at the individual units and in the entire housing unit are quantified.

4055 Zeichen (mit Leerzeichen) - max. 4.300 Zeichen (mit Leerzeichen)

Fazit

Within the flow analysis, short-circuit flows due to alternating operation could be excluded, mixing ventilation dominated. However, the pressure simulation showed that under strong wind conditions and partial load the total volume flows can decrease to zero. Within the measurement procedures, volume flows in alternating operation could be resolved time-dependently for the first time and recorded with sufficient accuracy. Further optimizations of the measurement methods allowed a better comparison with those in continuous operation. All aspects were prepared in such a way that they can be incorporated as proposals into the current national and European standardization work.

682 Zeichen (mit Leerzeichen) - max. 700 Zeichen (mit Leerzeichen)

Eckdaten

Kurztitel: EwWalt

Forscher / Projektleitung: E.ON ERC / RWTH Aachen, HLK Stuttgart, ITG Dresden

Gesamtkosten: 239.932,76 €

Anteil Bundeszuschuss: 159.932,76 €

Projektlaufzeit: 24 Monate

BILDER/ ABBILDUNGEN:

Bild 1: Bild1.png

Modelica simulation environment for the determination of total air flow rates.

Bild 2: Bild2.png

Age of the air in an apartment with alternating ventilation at different cycle times

Bild 3: Bild3.png

Local air change efficiency in the apartment

Bild 4: Bild4.png

Example of volume flow curve measured in alternating operation

Bild 5: Bild5.png

Qualitative visualization of the temperature distribution at the outlet of an alternating ventilation unit

Bild 6: Bild6.png

Schematic representation for finding a compromise between practice and standards by dual use of the air