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Abstract

Effects of the use of DIN 18599 on the energetic assessment of residential buildings – reflection on the calculation approaches

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The responsibility for the content lies with the author.

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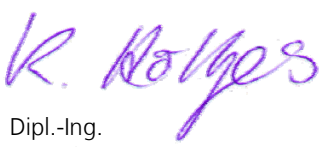

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1 Objective of the research project

Within the framework of the research task, a reflection on the calculation approaches of DIN V18599 will be made with the objective to improve the normative basis of energetic assessments of residential buildings.

The methodological analysis of the calculation approaches and the defined boundary conditions will serve as a foundation. Based on this, creating variants and comparative calculation will follow, as well as the use of more specific engineering procedures - primarily thermal simulation calculations – to verify the methodology of DIN V18599.

The objective of the research project is the improvement of the calculation approaches and the boundary conditions as well as the manageability and the transparency of the method.

The following items represent the range of the different research fields within the project.

Modelling

- Method to evaluate renewable energies
- Criteria for setting system boundaries

Method and application

- Adjustment of the calculation approach for the energy need for cooling of residential buildings
- Calculation approaches for heat pumps in general
- Improved consideration of single room heating
- A more precise formulation on the interaction with DIN EN ISO 13370
- Examination of the pipe length for heating and hot water circuits
- Development of indices and methods to increase transparency

Boundary conditions

- Energetic conditions for air change rates
- Standard allowance for thermal bridges
- Updated climate data
- Boundary conditions for residential buildings in general

2 Research work

The following list summarizes the starting points of the content-related areas of the research project and outlines the extent of topics originally covered by the research proposal.

1. Modelling

    1.1. An improved adjustment of the methods for the quantification of the use of renewable energies to specifics of the residential building area, e.g. when using thermal solar energy.
    Development of a method to depict renewable energies, concerning the demand of heating energy, according to German EEWärmeG (Act on the Promotion of Renewable Energies in the Heat Sector).

    1.2. The unheated staircases, typical for multi-storey buildings, are a good example for the need of better criteria concerning setting the system boundaries, which is important also for cellars and subterranean garages.

2. Method and application

    2.1. Adjustment of the accounting approach of the energy need for cooling of residential buildings with a potential extension of the balance by rewarding structural measures ("avoided cooling energy need").

    2.2. The calculation approaches for heat pumps, especially in relation to residential ventilation systems, have to be revised, especially against the backdrop of discussions about their efficiency. Furthermore, there is a need of taking care of the heat emission of residential ventilation systems.

    2.3. Development of technical rules for improving single room heating (individual combustion plant), relevant in the residential building area.

    2.4. The interaction with DIN EN ISO 13370 (heat transfer to the ground) has to be expressed more precisely.

    2.5. Pipe length for heating and hot water circuits have to put on a reliable basis, the method and the characteristic dimensions have to be examined. Problems occur especially in non-residential buildings. However, using analogue approaches includes the danger of transferring these problems to residential buildings.

    2.6. Development of indices (expenditure factor) and methods (balance sheet parts, energy flow), to better comprehend the energetic influence of different methods in a more transparent way in order to improve the planning process.

3. Boundary conditions

    3.1. Evaluation of the boundary conditions for the energetic air change rate, especially for residential buildings with a low energy need. Derivation of data that better depict the use and the annual process.

    3.2. Examination of values for the standard allowance for thermal bridges, especially the reference level concerning energy certification purposes.

    3.3. Evaluation of the application potentials of updated climate data.

3.4. In the course of both demographic changes and changing ways of living, there is a need to adjust the boundary conditions to residential uses, e.g. times of use, occupation density, criteria for the specification of single and multi family houses.

The list and description of the particular topics are oriented towards the state of the proposal. Since working on the project is closely connected to processing the norm - or standard - and since the standardization committee often has to react quickly to current questions, the topics at hand are constantly changed and renewed. To take this into consideration and to document the working on the project – with assisting in terms of standardization as a prime target – the results will are present hereafter in a structure that is oriented towards the structure of standards from DIN V 18599.

Topics exceeding the framework of the project and the standardization that have to be treated additionally are summarized in the following paragraph.

DIN V 18599-2:

- Room temperature and building insulation level
- Calculation of infiltration and value of building airtightness
- Ventilation controlled by demand in non-residential buildings
- Solar protection
- Boundary condition of determining the thermal time constant
- Determination of maximum heating power

DIN V 18599-5 and -8:

- Storage of domestic hot water

DIN V 18599-10:

- Non-residential buildings: determining the day and night hours
- Non-residential buildings: mixed usage

In general:

- Adjusting the symbols of formula in DIN V 18599
- comparing energy need for cooling according to DIN V18599 vs. thermal building simulation

3 Summary of results

The results will be presented below in an outline oriented towards the outline of the standard of DIN V 18599. This takes account of the fact that the topics that had to be dealt with have to be adjusted in the course of the parallel project work and the standardization. The text summarizes the changes of the reissue of the standard, which will primarily be covered in the research project at hand.

3.1 DIN V 18599 - part 2: energy needs for heating and cooling of building zones

DIN V 18599-2 gives the basis for the balance calculation of the energy need for heating and cooling of building zones. The essential changes of part 2 of DIN V 18599 are summarized in the following.

Transmission heat transfer coefficients, temperature in adjacent rooms and temperature correction factors.

Within the simplified approach to determine the temperature in adjacent unheated zones via F_x-values (temperature correction factors), a definition gap is closed, concerning the choice of thermal resistance of components bordering the ground. Furthermore, a specification was made concerning the choice of geometrical boundary conditions for determining the characteristic size of base plates, meaning the determination of the area and the perimeter of the floor slab. The reverence to DIN EN ISO 13370 will be done without date of issue, which takes the new version of the standard into consideration with some adjustments at the nomenclature.

Furthermore, the "constructive thermal transmittance" from DIN V-4108-6 was included, which closes a regulatory gap concerning the calculation of the U-value of components bordering the ground.

Determination of the infiltration air change rate

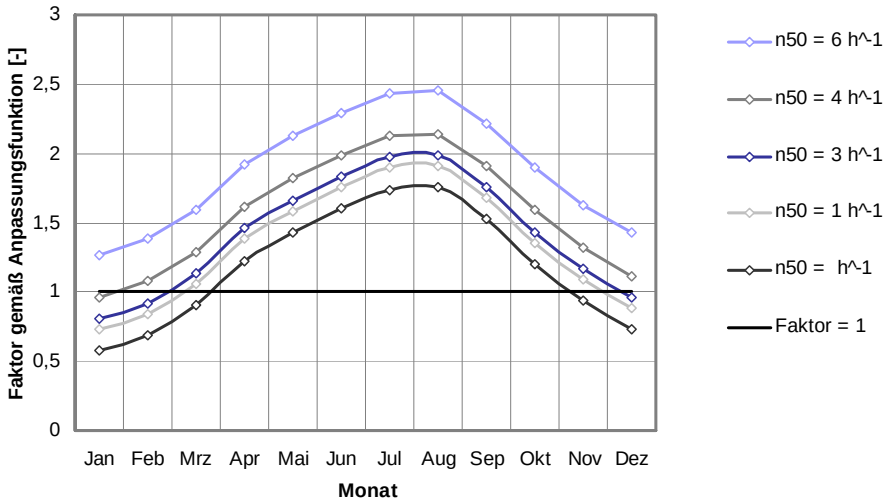
When determining the design values for the airtightness of buildings with a net volume higher than 1500 m³, the approach q_{50} that takes the building envelope into account has to be used, which better outlines the relations for large buildings.

The revision of determining the factor of assessing the infiltration at mechanical ventilation systems now contains a calculated consideration of air transfer devices, corrections of non-balanced systems (exhaust air and supply air) and the expansion to residential ventilation systems.

Window airing

The calculation approach to determine the energetic effectively air changes rates of window airing was revised to take into account the effect of the behaviour of window airing, depending on the outdoor air and the annual values for residential buildings resulting from this. The seasonal approach is based on assigning the window air change rate n_{win} with an annual process, meaning with monthly diverse values. There, a correction factor will be introduced which, depending on

the airtightness (n_{50} value) and the external temperature, permits a seasonal correction of the window air change rate (Picture 1).



Picture 1 - Monthly correction factor for the window air change for different n_{50}-values.

In some usages of non-residential buildings, the fraction of the minimum outdoor supply-air volume flow rate depending on occupancy in case of window ventilation is corrected by an partial-operation factor (see fig. 2), analogue to category presence detection in DIN V 18599-7.

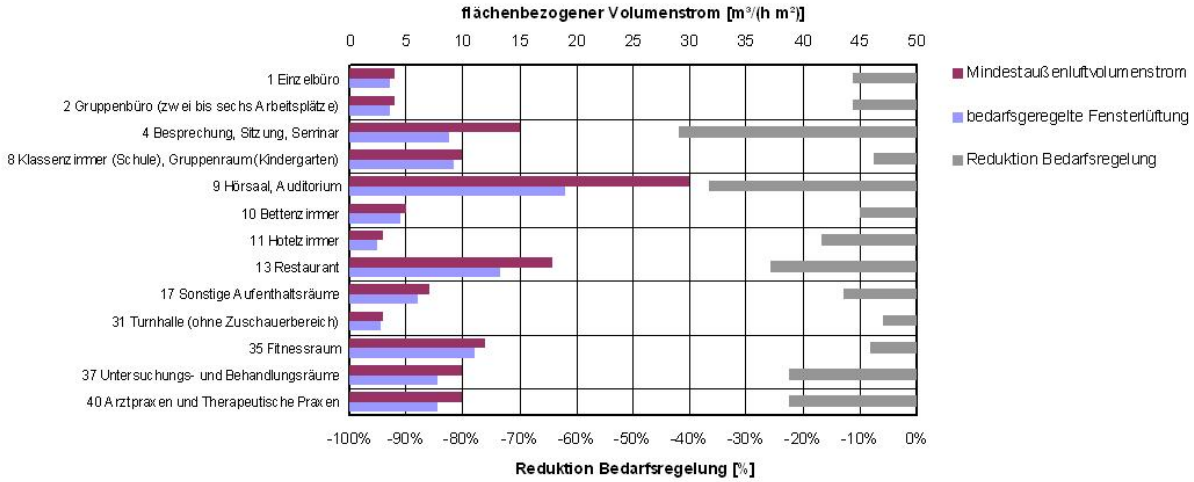


Fig. 1 – Influence of the consideration of an partial-operation factor to the amount of the minimum outdoor supply-air volume flow rate depending on various usages in non-residential buildings.

Heat sources and sinks due to solar radiation, internal heat sources and sources of cold

The default values for characteristics of glazing and solar protection devices in DIN V 18599-2 were determined considering the current version of DIN 13363-1. In addition, further parameters for heat protection and solar protection glazing were included.

Enhancements were made concerning the calculation of glass double façades. For double facades with a distance of both facades of more than 50 cm there is a calculation approach, described for determining the heat transfer coefficient for ventilation.

Against the backdrop of defining the boundary conditions of calculation of cooling in residential buildings (see changes part 10), variable solar protection devices can be estimated. Furthermore, cooling and heating mode of non-residential buildings can be calculated with different boundary conditions concerning the performance and control of solar protection. This applies when there is an outer solar protection used in the summer half year and an interior glare protection in the winter half-year.

A newly incorporated calculation procedure controls the division of heat and cold input between workday and weekend.

What is further expanded is the treatment of the effective heat capacity, which is specified in a way to impute equipment and with to deposit a standard value for hall-style buildings.

Specific transmission heat transfer coefficient

A new normative amendment of part 2 contains a definition to determine H_T', adopted from EnEV 2007.

Maximum heating power

In amendment B, the equations for determining the maximum heating power are modified to enable a better accordance with the calculation results of DIN EN 12831.

3.2 DIN V 18599 – part 10: boundary conditions of use, climatic data

DIN V18599-10 provides both boundary conditions for residential and non-residential buildings as well as climatic data. The boundary conditions of use can be used as a basis for the verification under energy certification purposes and offer further information for the application in terms of energy consulting.

The revision of part 10 of DIN V18599 involves some parts of the content, apart from editorial changes and adaptations of the nomenclature, which will be summarized in the following.

Boundary conditions of use, residential buildings

For the calculation of the cooling mode – energy use for cooling – of residential buildings, the boundary conditions will be completed. Furthermore, a specification and an additional simplified calculation of the heated living space will be made, which some boundary conditions are referring to.

Boundary conditions of use, non-residential buildings

The types of usage in DIN V 18599-2 will be amended with the indications that are important for part 7, meaning the relative absence, the partial-operation factor of the building operation and the minimum outdoor supply-air flow rate of buildings. Moreover, in the types of usage a sophisticated description is included for some values, i.e. the set-point of monthly average indoor temperature, temperature reduction for set-back operation, the internal set-point temperature for cooling operation and the minimum and maximum temperature (design rating) in case of heating and cooling. Further changes affect the usage profile of sports halls as well as minor corrections of the daytime and nighttime hours of all types. In general, the types of usage will be amended with the following usage types:

- Commercial and industrial hall-style buildings, heavy/moderate/easy work
- Saunas
- Fitness room
- Laboratory
- Examination and treatment rooms
- Special nursing rooms
- Corridors of public maintenance area
- Medical and therapeutic offices
- Warehouses, logistic halls

A new appendix D describes informatively the procedure of creating a usage profile, using the example of a production hall.

Building automation

To consider the use of building automation, the types of usage will be amended with two new parameter for residential and non-residential buildings. The "addend for considering building automation" and the "factor of adaptive heating" influence the determination of the reference internal temperature in the heating mode.

Climatic data, reference climate

The design values for determining the cooling power are changed and adjusted to the new state of development of VDI 2078. In the future, the data of the reference location 4 (Potsdam) of the TYR regions shall be used as reference climate.

Climate regions

A new informative appendix now contains - analogue with DIN V 4108-6 – the solar irradiance and outdoor temperature of the 15 reference locations/climate regions of Germany, which were updated by the German Weather Service (Deutscher Wetterdienst) in 2010. As an alternative to the reference climate, these can be assessed outside of energy certification purposes. Additional

new parameters are monthly average values of wind speed, which are needed for the evaluation of wind power plants in DIN V 18599-9.

Picture 3 - Climate regions of the test-reference years in Germany.

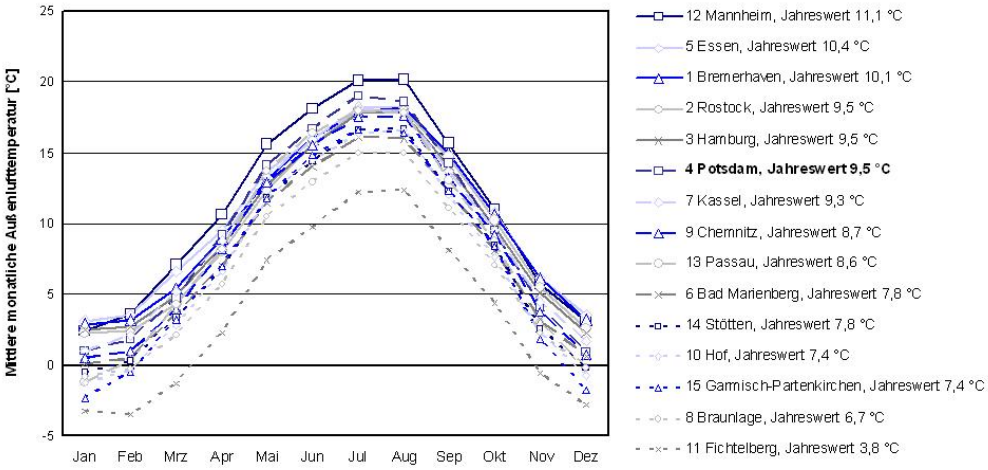


Fig. 2 – Characteristics of he average monthly outdoor temperatures of the 15 TRY reference locations of Germany.