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Project Information
(Brief Description)

Analysis of the limitation of natural and forced transmission and ventilation heat consumption by users' information and means of controlling and heating technologies

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Introduction

The research project "**Analysis of the limitation of natural and forced transmission and ventilation heat consumption by users' information and means of controlling and heating technologies**" is occupied with evaluation and interpretation of consumption data of low energy houses (multi- and single-family dwelling houses). The buildings are examined due to different aspects and influences on the energy balance, for instance the influence of utilisation as well as (supplementary) quality assurance and management of the controlling, heating and ventilation technology.

It will be investigated whether the energetic ventilation consumption can be limited by adapted heating and controlling concepts as well as intensive instructions of the users. This includes a planned conducted quality assurance of the installation technique, especially. It shall be demonstrated, that an excess consumption of energy in buildings might not be a mistake of the user, but rather a deficiency of the today's installation concepts. Those concepts might cause a so called "forced heat consumption" or provide a "waste potential". Both, "forced heat consumption" and "waste potential" are expressed by increased transmission and ventilation heat losses (compared with a theoretically possible ideal case) and caused by a lack of quality management, especially of planning and realisation of the house installation.

With examination of concrete consumption data consequences for planning and realisation and their quality assurance as well as the instructions of use are deduced. The extracted rules are valid for new and existing buildings including their installation systems. They should be considered as basic support for future "integrated concepts for building, home installation and use".

Basics and Energy balance methods

Prior to the balance different methods of balancing energy have been examined according to their applicability for a detailed data analysis. The advantages of the different methods have been summarised and advanced. Two new balance methods evolved: the so called "total energy balance" and the "ΔQ-method".

With the last mentioned method the quality assurance of the home installation and the utilisation can be visualised. This method does not need to apply a utilisation ration for recoverable heat, as most of the common energy balances do.

Results of the field project

Three multi- and a single-family dwelling houses (new buildings as well as modernised buildings) have been analysed detailed. The buildings have been evaluated with three different methods of calculating the (theoretically) energy demand. After that the measured energy consumption has been analysed and adjusted to German standard climate.

For the different buildings a correlation between averaged room temperature and air change rate has been examined based on the annual consumption data, because there have been no measuring of the temperature. The air change rate depends - as considered - on the (supposed) room temperature. An air change rate of 0,6...0,7 h^{-1} during the heating period seems to be realistic for a multi-family-dwelling house and room temperatures of about 20°C.

The monthly examination of the consumption data reveals comparatively high air change rates during Mai and October at the beginning and the end of the heating period. The user causes very high ventilation losses, although the outside temperature lies definitely below the room temperature. The heating system is demonstrably operating during those month, although the theoretical heating limit is already reached (it lies at much lower outside temperatures). The radiators compensate the additional losses. Because of a lack of quality assurance of the installation technique, the heating elements have a high potential of emission and the user accepts this potential. During the cold month a minimum air change rate of - nearly constant - 0,4...0,5 h^{-1} seems to be comfortable for the user.

In addition to the investigations on room temperature and air change rate the potential of energy savings - based on a ideal (minimum) air change rate and a ideal (minimum) room temperature - has been examined. With a predefined air change rate of about 0,4...0,5 h^{-1} (derived from the winter measuring) and a room temperature of about 20°C (both values might be still acceptable to the user), the possible amount of saved energy averages 15...25 kWh/(m²a). The highest potentials can be found in spring and autumn.

The examined multi-family dwelling houses show a final thermal energy consumption of 90...120 kWh/(m²a). About 63...85 kWh/(m²a) have been used for room heating and about 23...37 kWh/(m²a) as final energy for hot water preparation. The precalculated energy demand miss the real consumption by about -20... -25 % (calculation with the German Standard DIN V 4701-10 and the German Ordinance EnEV 2002) respectively +5...+10 % (calculation with the German guide-line Hessischer Energiepass and the newly developed total energy balance).

Furthermore the examinations prove that approximately two thirds of the input energy in a multi-family dwelling house is useful energy, that means it can be quantified with measurement instrumentations (heat emitted by the radiators or tapped hot water). Within the heated zone of a building about 60% of the needed heat are emitted by the radiators, the other 40% emanate from other sources.

Transfer on other projects and consequences

An examination of the existing building structure as well as common installation systems reveals, that the problems caused by lacking quality management (of the home installation) and the resulting excess energy consumption are typical for the German dwellings.

A number of definite rules for planning new buildings and the modernisation can be deduced:

- Pipe systems have to be planned much shorter in size and much better insulated.
- In case of modernisation pipe systems have to be subsequently insulated as well.
- The installation of a ventilation system might be useless, if the user is forced to ventilate in addition, because of the high amount of uncontrolled heat release (e.g. from the pipe system) within the heated zone.
- Different means of quality management are essential in new buildings, for instance the project planning of the pipeline network, a correct hydraulic adjustment of the pipe system, the correct choice of heating elements, the documented setting of the controllers and an users' instruction.
- Those rules are valid for existing buildings as well, for instance in case of a modernisation of the cladding: system temperatures, the hydraulics and the controlling has to be adapted to the new heat load.

Summary and prospects

A realistic averaged air change rate for a low energy house (on today's technical standard) can be assumed between 0,6 and 0,8 h^{-1} in a dwelling house without special quality management of home installation and utilisation. This value can be reduced to about 0,4...0,5 h^{-1} with means of quality assurance.

In new and modernised buildings a limitation of transmission and ventilation heat consumption can be realised only with both, users' instructions and (supplementary) quality management of the installation system at the same time.

The results of the examined objects confirm the necessity of an integrated, that means conjointly, planning of buildings from both sides: civil engineering and the installation technology. The already existing quality management and qualification for the building and its practical realisation should be expanded to controlling, heating and ventilation engineering.