A bit of theory about heating

It'll help you understand how to determine the required output for heating, what heat loss is, why it is sometimes more advantageous to choose large-scale surface heating and sometimes direct heating convectors, if floor heating can really heat the whole house and why electric heating is the most suitable heating system for low-energy houses (LEH).

Approximate determination of heating output

A very popular method of determining the output needed for heating is what is known as cubature calculation – an "expert" determines that xx Watts per 1 m^3 are needed for a given building or room simply by multiplying its width, length and height to get its volume and thus arrive at the necessary output. This method is very simple and easy to understand; unfortunately, it's also rather inaccurate. There are a great many factors influencing real heat loss – not only the materials used in the structure but also the position of the assessed room within the building, the amount of walls of the room that adjoin the outside environment, the type, number and size of the openings in the wall (windows), etc.

An educational example of how this method can be used incorrectly is when the manufacturer/retailer states that their heating unit will heat a room with the dimensions xx m^3 (m^2). In reality, a room which has a 50 cm – thick wall made of solid bricks, is in a corner of the building (two walls adjoin the outside environment), has a cold cellar underneath and an uninsulated loft above it will need an output several times higher than a room of completely the same size which is walled by YTONG blocks, insulated with polystyrene, equipped with plastic-framed windows and located in the centre of the building (apart from one wall with windows the rest of the walls, and also the floor and the ceiling, adjoin other heated rooms).

Because of this the calculation of the output needed for heating in relation to the volume of the room may lead to very uncertain results. Having said that, long years of experience show that approximate output values in W/m^3 can be gained from this method, though it should really be used only for very rough estimations, or as a checking calculation. Under no circumstances should a heating system be designed based upon such calculations, however. The following values can be used as a rule of thumb:

- Old, uninsulated buildings – 40-50 W/m^3
- Old buildings retrofitted with insulation – 30-40 W/m^3
- Current newly-constructed buildings – 20-30 W/m^3
- LEH – 15-20 W/m^3

The values for individual rooms in a given building can be adjusted according to their use and location – for example, a bathroom located in one corner of the building will need a higher value than a corridor passing through the centre of a house. Again, it is necessary to draw attention to the fact that these are only approximate values and that for e.g. large rooms (halls and hallways) it isn't possible to use this method at all – the divergence from real values is too great. The required heating output should be determined for all buildings on the basis of heat loss calculations.

Heat loss calculations

The behaviour of heat in a room can be demonstrated in a simplified way using a container full of water with a hole in the bottom. At the beginning the water flows out under pressure, but once the water level gets lower, the pressure in the water column also drops and the flow of water out of the vessel slows. If we want to maintain a certain water level in the container we have to find a balance between the amount of water flowing out and the amount flowing into the container.

A heated room behaves in a similar manner – the higher the temperature level in the room, the faster the heat escapes through each wall. Heat loss calculations allow us to discover how much heat it is necessary to add in order to keep the room at the temperature we require. The largest heat losses take place through external walls, as it is there that the temperature difference is greatest. No temperature escapes through walls dividing rooms that have the same temperature – the "pressure" of the heat is the same on both sides of the wall – and if your neighbours are heating their room to a higher temperature than you, heat actually "flows" from them to you – i.e. you are benefiting from heat gain.

Each wall in every room is included when calculating heat losses, including the floor and ceiling – their area, the difference between the temperature in front of the wall and that existing on the other side, the material they are made of (heat isn't conducted through all materials in the same way – this characteristic is termed thermal resistance, or the heat penetration coefficient), if there are openings in the walls (windows, doors), how large those openings are and what they are made of, etc. In this way it is possible to find out how powerful a heating unit is needed for a given room. By way of illustration – previously, a typical 150m² family home had a heat loss of approx. 12-15kW, current new buildings of the same floor area lose around 6-8kW, sometimes even as little as 4-6kW (low energy houses). In the case of passive houses of that size the required heating output is around 1-2kW.

Floor heating tests

After the installation of the floor heating has been completed, "heating tests" are performed. This term refers to two different tests – a "heating test" and the "first heating".

The heating test is basically just a test to determine if the heating system is functioning correctly – i.e. whether the floor heats up at all locations where the heating is installed, whether there are no significant differences in surface temperatures for an individual heating surface, whether the regulation system reacts to temperature changes in the floor and/or the air. As a rule, heating tests should be carried out for all large-surface systems – ECOFLOOR as well as ECOFILM.

First heating is only carried out for ECOFLOOR floor heating systems, in situations when a heating mat or a heating cable is placed into a concrete or anhydrite slab – i.e. so-called semi-storage or storage systems. For example, in the case of a concrete floor, a 4 – 6 week long break (depending on weather conditions) should follow after the pouring of the concrete mixture, after which it is possible to lay the floor covering or start the floor heating. However, concrete still has a moisture content of approx. 30% even after a 30-day curing period. Floor heating (both water and electric) will, understandably, significantly accelerate the loss of the remaining moisture when brought into operation. It is therefore necessary to heat the newly made floor structure (slab) gradually and slowly in order to prevent it from drying out quickly and unevenly through the cross section, leading to the cracking of the floor slab and possibly to mechanical damage to the cable. The temperature start-up is carried out in the following way:

- The heated floor is brought into operation only after the concrete has hardened properly (after 4 – 6 weeks)
- On the first day, set the floor temperature to the temperature present in the room (18°C maximum)
- On the following days, increase the floor temperature gradually by 2°C/day up to 28° C
- Maintain the floor temperature at 28° C for a period of three days
- Subsequently, lower the temperature by 5°C per day until the starting temperature is reached
- Afterwards, the floor temperature can be set to the required value and the floor brought into standard operation

The whole "first heating" process usually lasts 10-15 days; however, some types of regulation unit (e.g. FENIX TFT thermostats) contain the "First heating" function, which carries out this process automatically.

For heating systems with ECOFILM foils, "first heating" is not carried out as a standard procedure because these involve dry structures. Ceiling heating systems in which ECOFILM heating foil is under plasterboard or plaster fiberboard may be an exception. These boards contain plaster, which absorbs air moisture easily. Depending on how they are stored, such boards may contain a relatively high level of moisture, or they can have low moisture but have the ability to absorb moisture subsequently released from other structures (floor and walls). It is therefore advisable to run the ceiling heating for 3 – 5 days, maintaining the room temperature at 20-23°C. After switching off the heating and cooling the plasterboard structure to the temperature of the surroundings, carry out cementing and the grinding of edges. If the ceiling heating is started after the final finishing of the ceiling structure (cementing and grinding of edges) has been performed, there is a danger that cracks/fissures may appear in the joints of the individual boards of the suspended ceiling due to subsequent drying.

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