The Ideal Solution for Residential Buildings

Convection and Radiation

On average, a typical Central European spends 90 % of his life indoors. A bad indoor climate can have a negative impact on our performance and well-being. Therefore, it is important to create an optimal indoor climate to promote your own health.

Underfloor heating works quietly and is integrated in the floor. In addition, it is suitable for low-temperature operation. Due to the comfortable warmth, it is often used as a preferred solution in houses and apartments.

The market share of underfloor heating in new buildings is around 50 % today. However, the underfloor heating not only brings benefits. The disadvantage is that it is very sluggish and thus slowly reacts to changing conditions. Due to this inertia, a temperature change for heating or cooling is converted very slowly and there may temporarily be an uncomfortable room climate.

In addition, a high energy loss may occur because the temperature must be lowered or increased. Energy losses especially occur when underfloor heating is used in buildings with a high proportion of glass, as part of the electromagnetic waves generated by the radiant heating of the underfloor heating system leaves the room via the window glass.

One solution to counteract the deficits is a combination of underfloor heating and floor trenches with heating by convection. The underfloor heating can be installed in the floor as before and is therefore invisible.

The floor trenches are connected to the same distribution circuit as the underfloor heating and also disappear hidden in the ground. In such a case, the underfloor heating is the basic system and the floor trench system serves as a fast, dynamic system that can respond quickly to temperature changes.

Thus, the space is divided into an area-wide underfloor heating by radiation and a convective floor trench system, whereby the cooling or heating is achieved faster.

Energy Transport

There are basically three different types of energy transport: heat conduction, heat radiation and convection. The latter two are relevant terms in the HVAC industry.

Heat conduction occurs when different temperatures occur at different locations. In such case, the heat energy is conducted to the colder point. It sets a state in which the temperature difference from the warmer and the colder point decreases evenly.

The transport of heat energy by electromagnetic waves is called thermal radiation. This means that the heat transfer is not bound to any material carrier. In such a case, energy in form of electromagnetic radiation is emitted or absorbed by a body.

Accordingly, the body emits when it has a higher temperature than its surroundings. The body cools down and the room absorbs the heat given off. Subsequently it can be said that a body cools when it emits more radiation than it absorbs and heats its surroundings by absorption. The same is true in reverse conditions.

Convection describes the heat transfer through the transport of particles and is thus bound to a medium. This energy transport can be initiated by external influences, such as pumps or fans. On this basis, natural and forced convection are distinguished.

In natural convection, the particles are excited only by temperature differences and moved by the resulting density difference. If a medium is heated, the temperature of the ambient air increases at the same time. The air can be heated by a convector and rises due to the natural convection when it is surrounded by colder air.

The result is a buoyancy air movement, cool indoor air flows in from below, an air circulation is created within the room.

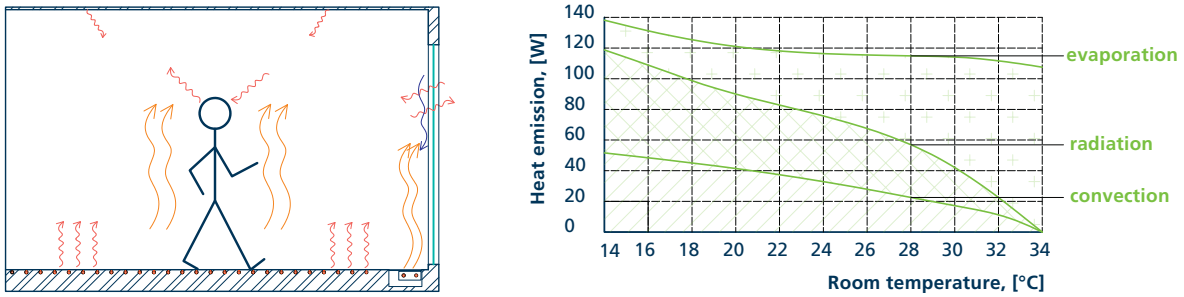
In forced convection, as previously described, particle transport is initiated by external forces, e.g. by fans.

The heat balance of a person and air circulation in the room

The human body generates heat at all times. Through the skin, about half of it is delivered to the environment by heat radiation (radiation via electromagnetic waves) and half of it by convection (air as a heat transfer medium). If this type of heat release is insufficient, for example due to heavy physical stress, sweating is used as a means of dissipating heat.

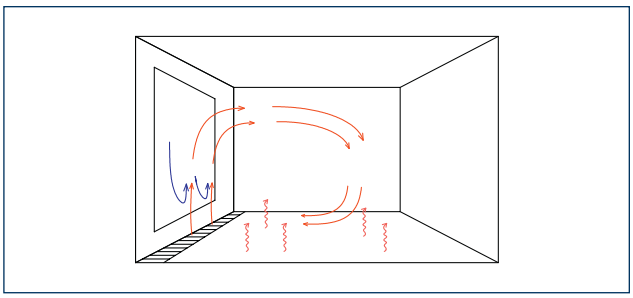
The amount of heat release depends on the type of activity and the size of the person. This is called evaporation, which contrasts with dry heat release (convection and radiation). The indoor climate is perceived by humans to be particularly pleasant if their natural heat transfer paths are also used in building air conditioning systems.

Heat exchange in the room by radiation and convection

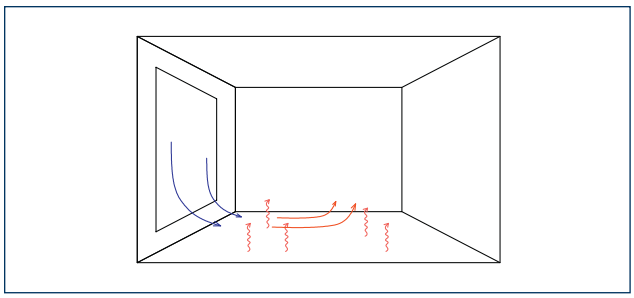


A room is divided into different zones. One zone is the interior part of the room, another is the area along the external façade. To ensure that no uncomfortable room air condition arises, air façade by a convective system, the circulation is optimal due to the room air flow pattern.

Circulation within the room should prevail. Since hot air only rises or circulates in cold air, any heat emitter should be placed at the window. Near the windows there is colder room air, which allows the warm air to rise and thus circulate. To counteract energy losses through the windows, a system only with radiant heat should be avoided here. When heating along the The interior room does not always have to be cooled – depending on internal losses. Here, a surface system such as underfloor heating heating may be used. In contrast, along the façade it should always be possible to both heat and cool. Ideal would be the possibility to also provide the room with fresh air.



Favourable arrangement of convectors, favourable combination of convectors and underfloor heating

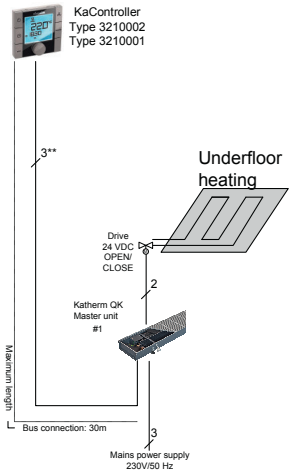


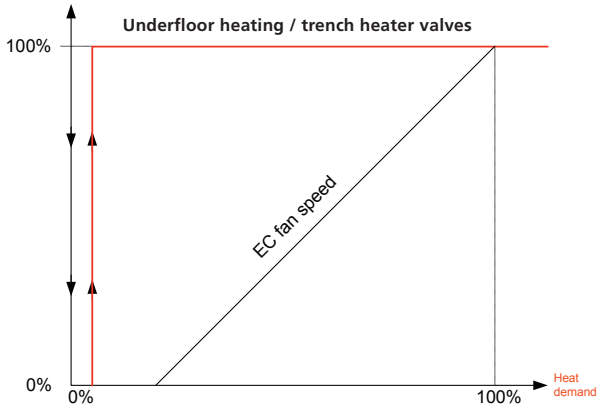
Unfavourable case with underfloor heating as the only heating system – Draught effects within the foot area

Solution

The combination of underfloor heating and floor trenches represents an ideal solution for an optimal room climate. The installation, but also the retrofitting of a convective floor trench system in addition to an underfloor heating system is easy to implement. Both systems can be installed concealed and thus meet architectural requirements for the aesthetics of the room. Both solutions may also be integrated into a single water circuit and one control system.

Functional description





Automatic mode

When the heat demand increases, the valves of the underfloor heating and those in the Katherm QK are initially opened in order to cover the heat load in the room.

If the underfloor heating and the natural convection of the trench heater are not sufficient to cover the heat load, the continuously adjustable EC fan will start running.

If the heat load decreases, the EC fan automatically slows down and the heat load is again only covered by the underfloor heating and the Katherm QK without fan assistance.

The underfloor heating ensures a basic temperature setting while the floor trenches can quickly implement temperature changes and ensure a consistently comfortable indoor climate. In addition, the convective floor trenches offer all the features needed to compensate for the underfloor heating deficiencies. Energy losses are minimized and the room climatisation is made more flexible. A floor trench system for heating and cooling with additional fresh air connection provides the ideal air conditioning solution for all areas of application.

As final point it should be said, the combination of radiation and convection not only makes energy sense, but comes closest to the natural energy balance of humans and thus ensures a comfortable temperature sensation.

Maciej Danielak
Export Sales Director

T +49 591 7108-241
M +49(0) 151 292 685 95
E maciej.danielak@kampmann.de