Karlsson Klimat AB

Energy Education!

1 Heating necessity

2 Edge insulation

3 Heat recycling

4 Measuring heating need

5 Heat pumps

6 How a heat pump works

Karlsson Klimat AB, Spårgatan 13, 282 72 Sösdala, e-mail: kurt@karlssonklimat.se ,
Tele: +46 70 664 1150

HEATING NECESSITY

The necessity of energy in a house consists of three parts: Heating, hot water and household electricity.

Hot water consumes about 3,500 – 4,500 kWh annually depending on the family size and so on (4,000 kWh is approximately 75,000 litre hot water the same as about 200 litre per 24 hrs). Hot water will be analysed and discussed more in a later chapter.

Household electricity (lights, kitchen appliance, TV, computer and so on) is about 4500 to 5500 kWh annually in a small house, the variations can be big. For example if you have an old freezer or a car engine heater it can increase your power usage substantially. This is also the case when using a ventilation system with bad fans which could result in an increase of 1,500 to 2,000 kWh annually.

According to the Swedish National Board of Housing, Building and Planning a newly build house heating necessity should be about 9,000 to 10,000 kWh annually and 2,500 kWh for ventilation heating. The rest are so called transmission lost, meaning heat leaking thru floor, walls, windows and doors.

Old small houses often have a poor insulation and are often without a recycling of the ventilation heat. This could easy result in an increase of the double or more, about 20,000 to 25,000 kWh annually. In larger houses it is not unusual with a heat necessity of about 30,000 to 40,000 kWh annually.

The location of the house is also of course of matter. In the north of Sweden Kiruna the heating necessity is 60% larger then a house in south of Sweden Malmoe.

When using oil for heating you have to remember the efficiency. One cubic meter of oil gives about 10,000 kWh but due to loses when burning it the amount decreases to about 7,000 kWh per cubic. Thus a house with a consumption of 14,000 kWh electrical heating needs two cubic of oil for the same consumption.

A buildings necessity of bought energy for heating differs from the buildings loses. The important total energy balance in the building comes from the considerable addition of heat from household appliance, people in the building and the sun. This free heat gives nearly 15% differences between bought heat and buildings lose in old houses. In a newer house it could give nearly 15%, in extreme cases with houses with windows turned southwards it could give up to 25%.

With water floor heating circulating continuously during the year a larger percent can be achieved. The heat is then transferred to the different rooms and moved around as the floor works as a heat absorber in warmer rooms. This so called division of heat reduces the need of bought heat with 10% or more.

A common way of calculating the heat necessity of a building is to indicate the need at one degree Celsius temperature difference between indoor and outdoor. A modern small house with an area about 110-120 sqm has a need of about 70W/K due to transmission. This means that for keeping one degree Celsius higher temperature indoor compared to outdoor you need 70 W. As follows you need 70x40= 2,800 W when there is a 40 degrees difference between outdoor and indoor.

The need for ventilation air is 25 W/K if you have heat recycling otherwise it is 50 W/K. Further more you need 5 W/K for air leakages thru badly insulated walls and even more if the ventilation system is badly done (see further information on the chapter Heat recycling).

The total sum comes to 100 to 125 W/K for a modern small house. In older houses the need can be significantly higher. The easiest way of checking is if you have electrical heating, see the chapter Measuring H N.

The entire energy consumption in a building depends on the addition of heat and way of living and not only on the condition of the building. Thus it is important to know the buildings necessity of heat when doing energy calculations or energy saving calculations for a building.

Karlsson Klimat AB, Spårgatan 13, 282 72 Sösdala, e-mail: kurt@karlssonklimat.se ,
Tele: +46 70 664 1150

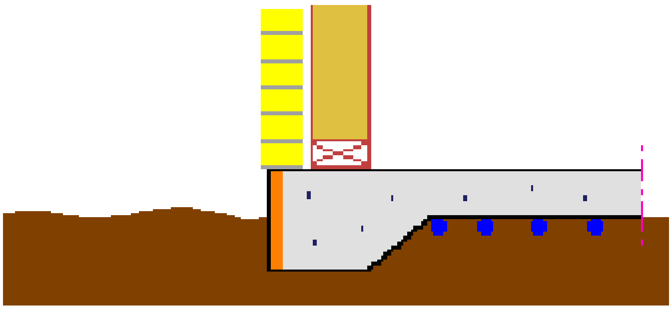
It is especially important to know the need when calculating the size of the heat pump, as it is important to get the optimal size. Note that it is no good business buying a too large heat pump.

Karlsson Klimat AB

EDGE INSULATION

A buildings weakest area!

A building is often done with concrete on the ground. In such cases it has been shown that a substantial heat lose is done thru the edge. This also includes buildings with floor heating.

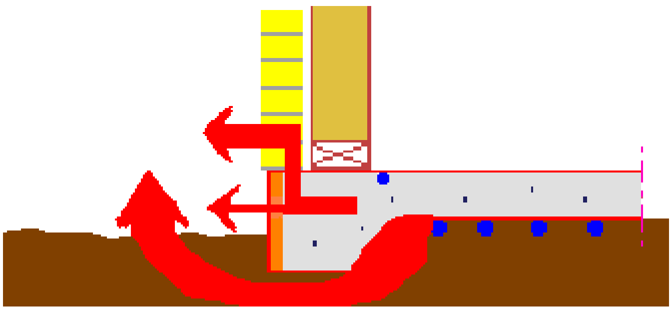


The figure shows a concrete plate (flat on the ground, gray). On the outer façade of brick and then invokes a mineral insulated wall. Octopus recommends giving the floor loops (blue) in the bottom or below the concrete while others are floor heating manufacturers prefer to add loops in the concrete top.

Let us first look at the conditions if you **do not** have floor heating. Experience shows it is known that there will be very cold in the angle between the plate and wall, eg to room air can easily be standing there, especially in such as a bed placed against the outer wall. It has therefore been the practice (and still is) to put a hot wire in a groove in the floor next to the outer wall surface. If you have electric heating, a heating cable, when water heating, a heating tube.

Where does the heat from the heating tube go? First run through the concrete horizontally to the open air and the heat goes down to the ground but through that it is so close to the edge is the heat in a half cirkel and out into the open.

One can show that the specific heat loss horizontally is 15 W/K for a house with measurements of 15 x 8 m, which compares with the maximum transmission 70 W/K. If the edge of the beam is isolated (usually isolated only 5 cm foam electricity etc.) are loss of approximately 4 W/K.



Heat flow downwards and in a semicircle to the outdoor air can be demonstrated on 1 m wide 'strip' in from the outer facing 50 W/K if no insulation is. With insulation 5 cm specific loss drops to 21 W/K and with 10 cm insulation to 14 W/K. Even if the insulation is increased to 20 cm is still loss of 8 W/K.

Heat losses from the edge of the beam is very large. Even with a very good insulation, the losses will be more than 10% of the total transmission losses.

Consider now the cases that arise if you have floor heating. Losses are increasing as is the floor plate is heated to between 5 and 10 degrees higher temperature than other heating systems. This means that the specific losses increase by about 50%, which in turn means that even with good insulation around the edge of the beam is the transmission through the edge about 15% of the total transmission.

Konklution: It is not enough to isolate the edge of a plate on the ground. This applies to both heating and for other heating systems. The insulation must be at least 10 cm thick, preferably 20 cm, and it must extend at least 1 m downward or horizontally out from the facade. The part of the plate which is over land must LIKEWISE be isolated.

Unlike the edge of the insulation is less important as insulation during the remainder of the plate where the groundwater is several meters (more than 3

m) over the plate. In such cases, the soil in an isolation and build up a heat pad under the house.

Ventilation and heat recycling

All buildings need ventilation for renewal of breathing air and change of air when doing activities and to prevent rotting and fungus. Heat recycling saves energy, unfortunately it turns out that heat recycling through ventilation air has a bad efficiency in small houses compared to larger buildings. The low efficiency is caused by the small flow (40 l/s) of air done by the fans in small houses. The recycling unit consumes about 1000 kWh electricity annually and is only able to recycle 2000 to 2500 kWh of heat annually. The same saving is possible by making the insulation better or use the heat of the sun and so on.

There are three types of ventilation systems:

- Type S draught by itself
- Type F mechanical exhaustion
- Type FT mechanical suction and exhaustion

Type S meaning the ventilation is done by the natural way of heat leaving the house thru the roof. Thus the indoor air is warmer (in Sweden) during long periods of the year the draught works fine by itself.
Type F is a fan that exhausts the same level of air constantly, the air is renewed through valves beneath windows and so on. Type FT meaning fans are used to suck and exhaust air, this system is mainly used in houses with heat recycling.

From energy stand of view type S and FT have a lower efficiency than F. The inflow of air is more or less large when using type S and FT. Type F does not stop the inflow of air but instead becomes a part of it and controls the amount of air flowing, thus Type F is the most energy efficient of the three systems.

Karlsson Klimat AB

Measuring heat need

To measure your heating need is quite easy, especially when using electrical heating. Do as follows:
This should be done when you are away with the family for a couple of days and the outdoor temperature is less then plus five degrees Celsius, for example during a winter weekend vacation.

1. Power off the refrigerator, freezer and all electrical appliances even the hot water boiler.
2. Transcribe the electricity meter.
3. At your return to the house transcribe the electricity meter once again.
4. Note down the outdoor temperature and the variations during the days you where gone.

Now calculate the average temperature during the days you where gone. Calculate the difference between the first transcription and second of the electricity meter, turn it into Wh by adding three zeros. Calculate your heat necessity by dividing the Wh with (20 minus the average outdoor temperature) (we assumed that you kept 20 degrees Celsius during you time away). The result is consumption in W/K.

The result could be compared to 100 W/K (ventilation included) which should be normal for a newly build house 120 sqm.

If your house necessity for heat is larger, you should analyse how to lower the consumption.

Karlsson Klimat AB, Spårgatan 13, 282 72 Sösdala, e-mail: kurt@karlssonklimat.se ,
Tele: +46 70 664 1150

Karlsson Klimat AB

Bedrock, soil, exhaust air, lake water and outside air heat pumps

Heat pumps are often described by the way of extracting energy. Thus a bedrock heat pump extracts heat from the rock (water running and trickling in the fissures in the rock) and an outdoor air heat pump extracts heat from the outdoor air.

The difference in principle of where to extract the heat is depending on the amount of heat that can be extracted. A bedrock heat pump extracting heat continuously from the running water in the fissures nearly always keeps a temperature above zero degrees Celsius. If the flow is bad it could result in the water freezing, the ice (insulation) then deteriorates the heat extraction. This can not happen to a ground water heat pump with enough flow of water from the well.

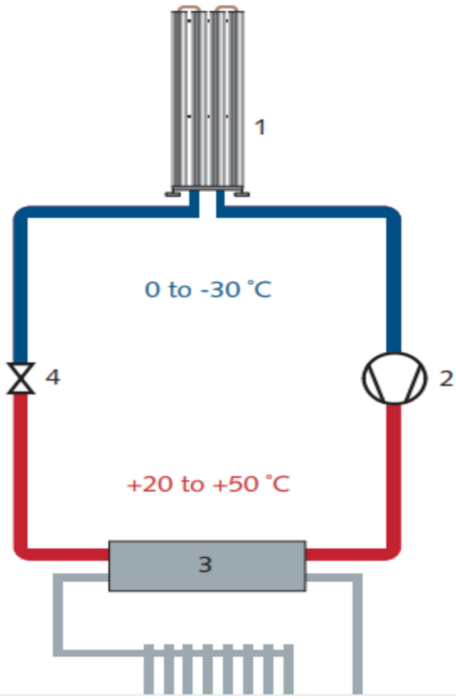
A soil heat pump extracts heat from the earth by freezing it, due to this it performs less the longer a cold period is. This is also the case when using a lake heat pump if the lake water is not circulated.

An outdoor air heat pump is very dependent of the temperature outdoor and its efficiency drops substantially during a cold period. Even though you save a lot it is important to keep auxiliary heating as oil, electrical, wood and so on when the temperature drops, this applies on all heat pumps.

When choosing the size of the heat pump it is important that it covers 50 to 60 percent of the maximum necessity of heat and thereby covering 80 to 90 percent of the annual need of heating.

Karlsson Klimat AB

THIS IS HOW THE HEAT PUMP WORKS



1. The Heat absorbing section - Low pressure
This part of the heat pump is called evaporator. The evaporator runs a refrigerant with a very low temperature and the boiling point. The evaporator is heated by the surroundings and this causes the refrigerant to evaporate inside.

2. Pressure boost part - High pressure

This part consists of a compressor. The heated refrigerant is compressed and pressure rise means that both the temperature and the condensation point rises sharply.

3. Heat emitting portion - High pressure

This part of the heat pump transfers the heat to the house and is called, the condenser. The refrigerant passes through the condenser with a very high temperature and condensing point. In the condenser, the refrigerant is cooled by the heating system (eg radiators, floor heating), causing the refrigerant to condense.

4. Pressure Lowering part - Low pressure

This part consists of an expansion device. The liquid refrigerant expands and the pressure reduction means that both the temperature and its boiling point falls sharply.

Karlsson Klimat AB, Spårgatan 13, 282 72 Sösdala, e-mail: kurt@karlssonklimat.se ,
Tele: +46 70 664 1150

Karlsson Klimat AB

Karlsson Klimat AB, Spårgatan 13, 282 72 Sösdala, e-mail: kurt@karlssonklimat.se ,
Tele: +46 70 664 1150