Thermal build up

Somehow every material can conduct heat. Those materials that we call insulators are designed to conduct little heat, while others, like copper will conduct a lot of heat.

Compared to copper air is a bad conductor, but compared to glasswool or polyurthane air is a good insulator.

If air is flowing then it can transport heat. This is the principle of most heaters in our homes: we generate heat by a heat source, the air around the heat source will warm up and rise, giving way to other colder air to warm up and rise in it's term. As long as the flow continues, there will be heat transport.

If we put a heat source in a big room, then there will be a lot of air to warm up and due to the movement caused by the rising warm air, the air will move a long way before it gives off it's heat energy to the surrounding colder air. We can say the heat is diluted in the bigger quantity of colder air. Actually we call this dissipation.

With the dissipation of a certain quantity of heat (Watt) in a big room it may take long time before the room warms up, but if the room is small it will take much less time to warm up the room.
Because every building material conducts heat the room will loose heat through the walls. How much heat energy will be lost depends on the the type of wall material and of the size of the surface of the walls. If the heatsource is small compared to the roomsize then all generated heat will be lost though the walls. If the heatsource is big compared to the roomsize then the heat is less likely to be dissipated through the walls, so it 'builts up' and the temperature in the room will rise.

How much the temperature will rise depends on the following factors:
1. Heat source (expressed in Watt)
2. Volume of the room (m^3)
3. Surface of the walls (m^2)
4. Heat conductivity o fthe walls (Watt/m^2 x °C)
5. Outside temperature of the walls (°C)

As air tends to saturate it's capacity to transport air we need enough moving air to help transporting the air. A very small compartment around a heat source will cause a strong thermal build up, even if the walls are made of a well conductive material (like copper or aluminium). If the air can not flow, then it starts acting as an insulator and the temperature will rise.

Electric transformers are also heat sources by nature. There is some electric energy absorbed in the transformer and dissipated as heat to the outside of the transformer.A good quality transformer will have up to 30% less power loss then others, but there is always some heat to be dissipated. As installer we must make sure that this heat can be transported away from the transformer because the transformer's ambient temperature should be maximum 40°C. We need to make sure there is enough air around the transformer (at least 5 cm between a transformer and a side wall) and the air must be able to circulate. Therefor a too small completely closed cabinet is not good.

To know how hot will be a room with a transformer inside we need to calculate with all the above parameters. We need to start by checking the heat generated by the transformer which canbe read from our tables. Next we need to know the thermal conductivity of the walls, that can be found in catalogues of bulding materials.
Last, we need to know the temperature outside the cabinet. As we already indicated the maximum ambient temperature for a transformer is 40°C. Because heat flows from hotter to colder areas the outside temperature must definitely be substantially lower than 40°C. The smaller the difference, the more difficult the heat transfer will be.

The same formula is applicable as the one used to calculate the capacity of radiators in houses.

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