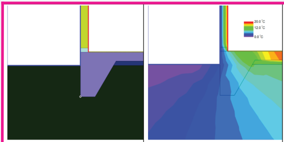
Increasing thermal bridging effects:



	Total Heat loss	Heat loss thermal bridge	percentage of total heat loss	fRSI
Detail 1	48.709	0.97	1.99	0.361
Detail 2	40.509	0.919	2.27	0.400
Detail 3	36.993	0.965	2.61	0.427

(percentage per m length of detail)

Increasing vapor pressure:
Generating the same amount of humidity inside buildings coupled with better insulation and the capacity to maintain higher temperatures leads to an air pressure difference in buildings to the exterior.
Higher pressure from the inside to the external will cause air to move outwards, via convection, or diffusion, and must therefore be considered when increasing insulation particularly in colder climates.

Increasing airtightness:
New buildings are naturally becoming more airtight, due to a combination of airtight components and stricter weathertight detailing. Adding more insulation creates larger buffer zones, and installation practices minimize air gaps.
Previous construction methods, poor installation practices and air leakage across the whole building managed to distribute internal moisture across the gaps in the building, and prevented condensation and mould within the building fabric, partly because the internal environment and surfaces were cold enough for condensation on these visible surfaces.
Increasing insulation will increase the temperature of the internal surfaces but move the condensation risk into the structure where mold and condensation occur without becoming visible for a long time.

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Leaky Building NZ 2.0

Why increasing minimum insulation R-Values alone will lead to more problems

Definition thermal insulation

All structural measures aimed at lowering energy costs (for example by reducing the heating requirement) and improving the comfort of the room, be it by "keeping warm" or protecting against overheating, count as thermal protection. A distinction is made between winter and summer thermal insulation.

To put it more loosely, in winter it is about keeping the heat in the building, i.e. as little heat as possible is lost, while in summer as little heat as possible should be introduced into the building. The essential structural measures for winter heat protection are the use of heat insulation materials and the avoidance of thermal bridges versus the use of shading elements and sun protection glasses for summer heat protection.

Winter

Thermal bridges, condensing water and mold.

The winter thermal insulation has the task of reducing the heat loss in a building or preventing the heat flow to the outside as much as possible. This enables the residents to live a hygienically perfect way of life, and ensures permanent protection of the building structure against the effects of climate-related moisture. The prerequisite is that the rooms are adequately heated and ventilated according to their use.

The structural minimum thermal insulation is regulated in NZBC Clause H1. Minimum R-Values (wall, ceiling, roof structure) are currently defined and being reviewed for improvement. However these only address the R-Values of the components, but in reality building services components (heating, ventilation, air conditioning) and the thermal insulation (type, thickness, properties) must be taken into account. The component combination of insulating materials, structure, weathertightness and finishes, exterior and interior, make the system complex and require more careful consideration than a simple addition of thermal resistances.

The various building physics processes that play a role in the area of winter thermal insulation cannot be easily separated from one another thematically. For example, it is essential to avoid condensation, as above a certain amount this will inevitably lead to the formation of mold.

Avoiding condensation

Currently there is no specific method covering compliance with E3 but with proposed increases for H1, the follow-on effects will lead to a new wave of leaky buildings – from the inside.

Avoidance of thermal bridges = avoidance of mold

An important requirement for winter thermal protection is to avoid or minimize thermal bridges. Thermal bridges are places in the building envelope that have a significantly lower thermal resistance than the neighbouring wall and ceiling parts. Thermal bridges, for example in the form of balcony structures that are connected to the wall structure without insulation, should be avoided.

Often, however, the corners of the room also represent thermal bridges. The geometry of a corner means that the respective outer, heat-radiating wall surfaces have a much smaller area on the inside. This small area cools down much faster than a comparable area in the middle of the wall. Accordingly, problems with the surface temperature occur more frequently in the corners of the room.

Protection against the damaging effects of moisture in components with subsequent mold formation. The target is a surface temperature (on internal surfaces) of at least 12.6°C. If the temperature is lower, the air can no longer absorb the moisture it contains at a normal room temperature of 20°C and a relative humidity of 55%.

As a result, water precipitates in a drippable form. A permanent relative humidity of 80% in the area of the cooler surface of the wall is sufficient to stimulate mold to grow.

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Airtightness

All heat-transferring external surfaces of buildings must be made airtight in the areas of joints, connections and penetrations. In this way, an uncontrolled exchange of air due to pressure differences between inside and outside can be reduced.

Insufficient airtightness leads to unnecessary heat loss and structural damage from condensation. The so-called blower door test can be used to determine whether a building envelope is airtight.

Vapour control
Water vapor diffusion

In terms of building physics, water vapor diffusion represents gas diffusion and is a transport process due to a concentration or partial vapor pressure gradient of the water vapor. An exchange of gas molecules takes place between rooms with air of the same total pressure but different partial pressures until the same partial pressures prevail. Temperature, air pressure, relative humidity and vapor tightness of the separating components influence the speed of the exchange and the amount of diffusing vapor.

This moisture transport occurs regardless of airtightness and is a material dependant property. Large temperature, or humidity differences lead to larger forces of vapour diffusion. The process is dynamic and while colder climates have larger vapour pressure from the inside of the building to the outside (from warm to cold) hotter climates (or seasons) reverse the process from the exterior to the interior.

Managing indoor environments - comfort and prevention of building damage

The goals of room ventilation are essentially to ensure comfort in the rooms and to avoid structural damage due to condensation. This means that pollutants, odors, moisture and heat must be removed through the ventilation.

These groups of substances accumulate quickly within the limited air reservoir "space". The Ventilation effectiveness depends both on the volume of the room and on occupancy, but also on the method of ventilation, e.g. window, mechanical.

Moisture removal

Moisture in buildings arises from various internal or external sources. Due to these sources, the absolute moisture content inside a building is always higher than in the outside air.

Since air can only absorb a certain amount of water vapor, which is dependent on the air temperature, the moisture content is also described by the relative humidity. Depending on the surface material, a relative humidity of approx. 75% can lead to the formation of mold.

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