THERMAL MASS
The smart approach to energy performance

What is thermal mass?

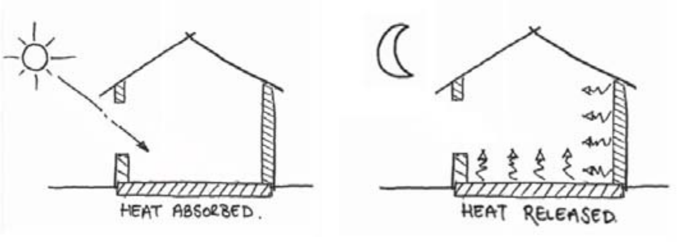
Thermal mass is a property unique to heavyweight materials such as concrete, which allows for lower heating and cooling costs in buildings. Not only does it mean that buildings use less energy, but it also reduces peak power demand, as well as CO_2 emissions when the building is being used. In addition, the health and comfort of occupants is improved and the risk of overheating in summer is reduced. As thermal mass is a material-inherent property, it comes "for free" - at no extra cost! - with any concrete structure. However, its effect can be enhanced, as will be seen below.

How does it work?

When it is warm, concrete absorbs unwanted heat, slowing the rise in temperature in indoor rooms. When temperatures fall in the evening, concrete releases the heat which it has absorbed during the day, keeping indoor rooms at a comfortable temperature. This heat storage effect results in more comfortable internal temperatures all year round. In modern buildings, the thermal mass effect can be greatly enhanced when linked with natural internal ventilation, triple glazed windows, shading, combinations with insulation etc. What's more, "thermally activated" building systems, with hot or cold water pipes embedded in the concrete, can further boost the effect.

Thanks to thermal mass, the "payback time" for the **embodied CO_2** of a concrete building is **as little as 11 years**![1]

Did you know that concrete can store energy and that, later on, this energy is then released? This effect, which is due to the high 'thermal mass' of concrete, makes buildings more energy efficient, lowers CO_2 emissions, and improves wellbeing and comfort.



How much energy can be saved thanks to thermal mass?

Thermal mass complements other measures such as better insulation, renewable energy, heat pumps etc. Although the benefits of thermal mass vary according to the type of building and where it is located, it can lead to savings of anywhere between 5% for heating and 20% for cooling. In the case of thermally activated building structures, almost twice as much can be saved!

Why haven't I heard of this before?

Thermal mass is not new – it is already a feature of many traditional buildings across Europe. Despite this, when designing buildings, thermal mass is often not used to its full potential. Moreover, very often energy performance calculation methods do not take this potential benefit fully into account

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This sounds great! So what should policy-makers consider?

Because it can store energy and then release it at a later stage, thermal mass is a dynamic, or time-related, property. Therefore, to take advantage of thermal mass, methodologies for calculating the energy performance of buildings must take these dynamic effects into account. The Energy Performance of Buildings Directive (EPBD) and its related standards already include this to some extent – but this could be improved.

Thermal mass should also be considered in other energy legislation, and as a way to cover social, environmental and economic aspects in policy on the sustainability of buildings. It should be remembered that thermal mass in buildings can promote occupant wellbeing and productivity as well as help tackle critical social issues such as fuel poverty and rising temperatures due to climate change. Clearly, it's more than just a matter of building physics.


[2]

Conventional buildings consume 150-200 kWh/m^2/year. By contrast, today's **concrete buildings**, thanks to **thermal mass** and other measures, can be designed to use **50 kWh/m^2/year or less**!

POLICY RECOMMENDATIONS

1. The Concrete Initiative recommends that *all* EU policies dealing with the energy efficiency of buildings should recognise the potential of thermal mass in the same way as other solutions (insulation, heating and cooling systems, renewable energy).
2. Sustainability policies should include social aspects such as wellbeing and comfort.
3. National methodologies to implement the EPBD must be sophisticated enough to take into account dynamic effects.

Case study: Office building of Gamba Acoustic in Labège, France

Thermally active concrete floors provide the thermal mass, with benefits increased by the use of "free cooling" with a geothermal heat pump and night cooling. The building was designed deliberately to prevent overheating during summer - without using air conditioning systems. The result is total measured energy consumption of just 38 kWh/m^2/year!

Summertime overheating, which affects wellbeing and comfort, will become a real problem in many countries due to climate change. **Thermal mass effectively combats** this issue.

[1]Source: "Embodied and operational carbon dioxide emissions from housing: A case study on the effects of thermal mass and climate change", Hacker et al., 2008

[2]Gemeentekantoor Groningen (MVSA Architects)
Photo: Ronald Tilleman

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