Concrete, thermal mass, and avoiding overheating in buildings

In the summer, and especially during the recent heatwaves experienced in Europe, the problem of overheating in homes receives a lot of attention. It is a problem that will only grow with increasing peak temperatures due to climate change.

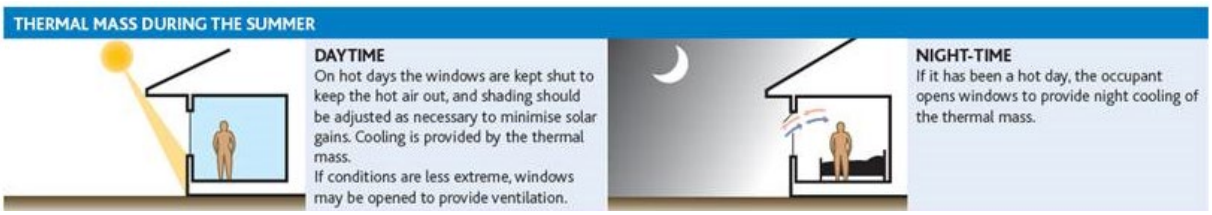
As homes in Europe, particularly in northern Europe, are typically not fitted with mechanical cooling, we are generally reliant on our homes' passive ability to keep from overheating. Luckily, concrete buildings, thanks to concrete's thermal mass property, are uniquely suited to avoiding overheating.

What is thermal mass?

Thermal mass is a property unique to heavyweight materials such as concrete, which can soak up and store heat – or cold. This 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.

How does thermal mass help avoid overheating?

When it is warm, cool concrete can make people inside feel cooler and more comfortable. Concrete also absorbs unwanted heat, slowing the rise in temperature in indoor rooms. When temperatures fall overnight, cooler night air is used to ventilate the building. This releases the heat which the concrete has absorbed during the day and cools it down, ready for the next day. This heat/cold storage effect results in more comfortable and stable internal temperatures.



Source: The Concrete Centre

This benefit of thermal mass has been used traditionally in dwellings in southern Europe for many years, and will become more relevant to other regions where the impact of climate change is leading to more frequent overheating. It also has benefits in commercial buildings as a way of reducing mechanical cooling costs.

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As thermal mass is a material-inherent property, it comes “for free” - at no extra cost! - with any concrete structure. Its passive effect can be enhanced, through both natural ventilation and smart design features such as shading, orientation and correct placing of insulation. It can also be actively enhanced through the use of thermally active building systems, where cooling is delivered through pipes embedded in the concrete. This can be the most energy efficient, and comfortable, form of active cooling, as no large temperature differences or cool air drafts are created. Thanks to thermal mass, this active cooling can use energy during periods when there is low demand for electricity, for example during the night. This energy storage effect reduces the need for energy at peak times, which helps balance the electricity grid and can boost the uptake of fluctuating renewable energy sources.

Policy recommendations

1. Passive, “fabric first” design should be promoted as the most cost-effective way of avoiding overheating for citizens.
2. Sustainability policies should include social aspects such as health, wellbeing and comfort.
3. National methodologies to implement the Energy Performance of Buildings Directive must be sophisticated enough to take into account dynamic effects, to capture the thermal mass effect.