CO_2 and the Built Environment

The positive role of concrete

Concrete is a versatile, durable and resilient building material that is locally available across Europe. What is more, concrete buildings can deliver the lowest overall CO_2 impact. This is because, in order to realistically quantify the CO_2 tag of a construction material such as concrete, it is important to look at the whole-life impact. This includes extraction of raw materials, production & transport, building in use, lifetime and durability, and end of life.

Building in use

When it comes to CO_2, the use phase of a building has a very important role to play. Buildings are responsible for 36% of CO_2 emissions in the EU and 40% of energy consumption. When looking at the whole life cycle of a building (including material production and construction), the use phase (heating, cooling, lighting etc.) often accounts for up to 80% of the CO_2 emitted. This is where concrete can make a very positive contribution, as its durability, thermal mass and air tightness qualities help to reduce energy consumption and CO_2 emissions.

Durability

Concrete is a very durable construction material. Indeed, concrete buildings can last 100 years and more and require very little maintenance. But why is this relevant? If we compare a building with a life span of 50 years to one with a life span of 100, almost twice as many resources and embodied CO_2 are associated with the building lasting 50 years, since it would need to be built twice in order to last the same length of time.

Air-tightness

Concrete also keeps buildings air-tight due to the fact that concrete structures have very few joints. In addition, its stable structure means that fewer gaps are likely to appear over time.

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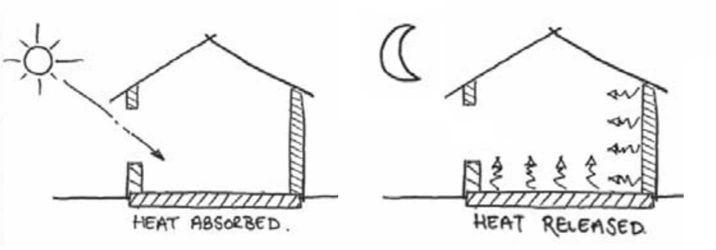
Thermal mass

Did you know that concrete can store energy and that, later on, this energy is then released?

Thermal mass is a property that is unique to heavyweight building materials: when it is hot outside, concrete can absorb any unwanted heat and help prevent the building from overheating. This heat is then released in the evening when it is cooler outside. Thanks to this effect, room temperatures remain relatively stable throughout the year, and as a result, less energy is required to heat or cool rooms.



Conventional buildings use 150-200 kWh/m²/year. By contrast, today's concrete buildings, thanks to thermal mass, long-lasting air-tightness and other measures, can be designed to use 50 kWh/m²/year or less!

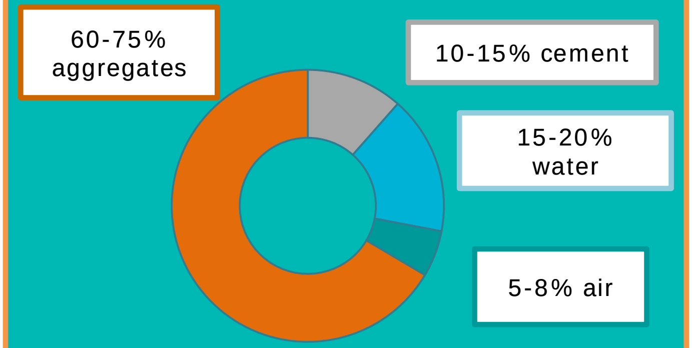
End of life

Concrete is 100% recyclable!
The processes associated with the end of life of a building, such as disposal or recycling, must also be given due consideration. By reusing and recycling the various components, many potential negative environmental impacts can be eliminated. Fortunately for concrete, recycling is not technically difficult. Concrete can be 100% recycled after demolition. Recycled aggregates from demolition concrete are traditionally used in unbound applications such as road base, and they are also used as aggregates for new concrete.

Concrete carbonation
During and after the lifetime of concrete structures, the concrete absorbs CO_2 from the air. This phenomenon, known as concrete carbonation, means that the net CO_2 emissions associated with concrete products over their whole life are less than they would appear if only the CO_2 emitted during production were taken into account. The quantity of CO_2 taken up will depend on the type of application and also its treatment after demolition. Carbonation can be particularly relevant after demolition and crushing, when the surface in contact with air increases very significantly.

CO_2 and concrete - Overview

1 unit of concrete contains:



= 50-150kg CO_2 per tonne

Concrete is a mixture of cement, water and aggregates. Aggregates make up approximately 60-75% of the mixture by volume, and cement and water make up the rest. When the CO_2 emitted during the extraction, transport and manufacturing of all these ingredients is taken into account, a typical concrete has an embodied CO_2 of around 50-150kg per tonne. This embodied CO_2 is fully "paid off" early in the lifetime of a concrete building thanks to greater energy efficiency. According to studies[1], this payback period can be as little as 11 years!

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

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