Cement & Concrete

What is it and why do we use it?

We all know the words, but what are they and how are they made and why are they used in structures as diverse as single family homes, bridges, dams and even the Sagrada Familia.

What's in a word?

The words cement and concrete are not interchangeable, but they are intrinsically connected. Cement is a key ingredient of concrete. It is the binding agent that holds everything together.

Early forms of cement were first used thousands of years ago. No one knows for sure who first came up with the idea to use a cement substance to bind materials together to make concrete, bricks, and other building materials. The process can be traced back to Ancient Macedonia, but was more widely popularized during the Roman Empire. Early forms of cement used things like lime and pozzolana, a type of volcanic ash. The Romans were able to produce massive structures like the Pantheon and the Roman aqueducts using this formula.

The most common cement used in the making of modern concrete is Portland cement. Joseph Aspdin, a British stonemason patented the process in 1824. He heated a mixture of finely ground limestone and clay and then ground the mixture into a powder that hardened with the addition of water.

Concrete is a mixture of cement, water and aggregates. Aggregates make up

approximately 70-80% of the mixture and cement and water make up the rest. Aggregates are usually inert coarse materials like gravel, crushed stone, sand or recycled concrete. The type of aggregate selected depends on the local availability and the application of the concrete.

Why we use concrete?

Concrete is widely used for architectural structures, foundations, walls, pavements, bridges, motorways, roads, runways, parking structures, dams, reservoirs, pipes and staircases. It is used to make furniture and even in ships.

There are many good reasons why concrete is so widely used all over the world:

STRONG AND DURABLE
Concrete is used for its strength that actually increases over time, and is not weakened by moisture, mould or pests, which reduces maintenance.

LOCAL AND AFFORDABLE
In relation to other alternative building materials, concrete is less costly to produce and remains extremely affordable as all of its raw materials are sourced locally.

FIRE-RESISTANT
As it is naturally fire-resistant, concrete forms a highly effective barrier to fire spread.

EXCELLENT THERMAL MASS
Concrete walls and floors slow the passage of heat, reducing temperature swings, making buildings more energy efficient.

SUSTAINABLE
Concrete is a low carbon construction material compared to steel etc. Concrete is made from materials that are abundantly available and can contribute to the circular economy by integrating industrial by- products or waste as raw material. When the structure reaches the end of its useful life, concrete can be recycled.

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The industry favourite

Concrete is the most commonly used manmade material in the world, its production equivalent being almost three tonnes of concrete per person, twice as much as all other construction materials put together.

Concrete is inherently a low carbon constructional material that can be produced just about anywhere in the world using local resources, which lower transport emissions. However, volumes are very large. In 2011, global cement production totalled 3.4 billion tonnes, cement representing only 10 to 15% of the concrete mix.

It is predicted that its unique qualities will make concrete ever more popular, and as developing countries and emerging economies expand their infrastructure and building stock, more and more concrete and, thus, cement will be needed. Cement production is estimated to reach over 5 billion tonnes by 2050.

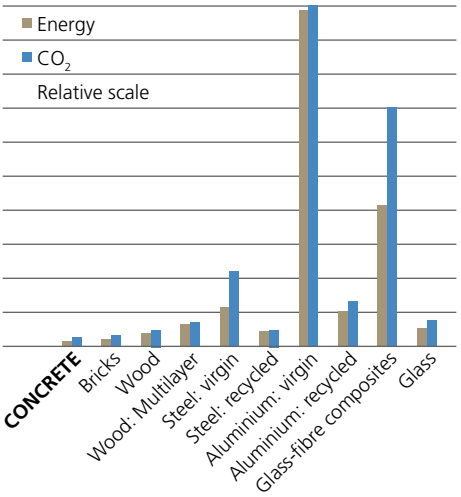
The emissions paradox

Compared to other building materials concrete has a low carbon footprint, i.e. it emits less CO_2 per tonne. And yet, the enormous volumes used mean that concrete production accounts for about 3 - 8 percent of the man-made CO_2 emissions worldwide.

COMPARATIVE RELATIVE ENERGY AND CO_2 PER CONSTRUCTION MATERIAL

Material	MJ/kg	kgCO_2/kg
CONCRETE	**0.95**	**0.13**
Bricks	3.0	0.22
Wood	8.5	0.46
Wood: Multilayer	15	0.81
Steel: virgin	35.3	2.8
Steel: recycled	9.5	0.43
Aluminium: virgin	218	11.46
Aluminium: recycled	28.8	1.69
Glass-fibre composites	100	8.1
Glass	15.0	0.85

Source: ICE version 1.6a Hammond G.P. and Jones C.I 2008 Proc Instn Civil Engineers



However, given the very large volumes, total emissions are considerable. Because a small reduction in emission can make a real difference, our team of researchers can punch well above their weight and lay the basis for a global reduction of millions of tonnes of CO_2 annually.

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