
Lafarge Tarmac concrete pour

CONCRETE cements new reputation

Set views about concrete and its sustainability credentials are being challenged. ROGER HUNT examines the evidence and the arguments.

THIS PAGE

ABOVE Lafarge Tarmac pumping concrete

ABOVE RIGHT Concrete beam and block flooring. Aggregate Industries supplies the blocks and the concrete while its joint venture company Charcon Construction Solutions supplies beam and block flooring solutions

OPPOSITE PAGE

TOP LEFT Laying and pouring Cemex concrete

TOP RIGHT Hanson readymix delivery to site

BOTTOM Forticrete's dense concrete masonry range used at Clapham One

The most commonly used building material in the world, concrete, is ubiquitous and an easy target when concerns over sustainability are raised. Understandably some architects, engineers and designers have questioned its use in their buildings. The concrete industry has responded; it contends that it is working to reduce the material's environmental impact and that concrete has very real benefits when creating sustainable buildings. Indeed, many in the industry would argue that concrete is already sustainable.

Environmental concerns about concrete frequently relate to the 'glue' that binds it together: cement.

"Between 5% and 7% of world carbon dioxide emissions have been linked to cement manufacturing," explains Sandy Patience, architect and editor of GreenSpec.

Historically, for every tonne of cement produced, close to a tonne of CO2 was emitted. Those in the industry assert that this is no longer the case and that steps taken to reduce these emissions have resulted in a lower figure of around 750 to 800kg of CO2 per tonne of cement.

Guy Thompson, head of architecture, housing and sustainability at the Concrete Centre, says the cement industry is working hard on a programme of innovation. This has, in turn, reduced the embodied CO2 of concrete.

"While cement is only a small component of concrete (about 10-15% by mass), it accounts for the majority of its CO2 content. The reduction in concrete's embodied CO2 has seen the 1990 figure fall by 22%, from 103kg of CO2 per tonne of concrete to 79.7kg. The target for 2020 is to reduce this figure to 71.8kg of CO2 per tonne of concrete, which equates to a 30% reduction from the 1990 baseline."

Increasingly, recycled materials are being used to replace a proportion of the cement content. Hanson is one company to offer a range of sustainable concretes. Its EcoPlus product features Hanson Regen Ground Granulated Blast furnace Slag (GGBS), a cement substitute manufactured from a by-product of the iron-making industry. This enables the replacement of up to 70% or more of the cement in a concrete mix. The company also offers a 'Concrete Carbon Calculator', an online tool that enables contractors, engineers and specifiers to calculate the amount of carbon they can save by using its EcoPlus concrete mixes.

Both GGBS and Pulverised Fuel Ash (PFA), also known as fly ash, from coal fired power stations, may be mixed with cement in concrete and can improve the durability of the material. Indeed, between 30 and 70% of the cement in concrete is regularly replaced with either GGBS or PFA, depending upon the locality and concrete specification.

Robert Carroll, technical director at the UKQAA, which represents the producers and users of PFA, explains that fly ash cement, at around 670kg/tonne embodied CO2, offers considerable benefits over cement.

"When added directly to a concrete mix, or via composite cement, fly ash creates a cohesive and workable substance which hardens into durable concrete with considerable resilience to chemical attack. This ensures that beyond its sustainability credentials, fly ash concrete is also a robust construction material, suitable for use in a range of applications, including housebuilding," says Carroll.

Further advances could see even less cement being used according to Yassar Altaf, the marketing manager for Sika, a company which supplies concrete admixtures.

"Neither GGBS nor PFA will harden to form solid concrete without the presence of cement and water. However, recent developments have seen the launch of cement free concretes, using GGBS and a chemical activator to replace cement. These products are still new to the UK market, largely untested in practice, and their use has yet to be incorporated into British Standards. However, their development is promising given the suggested environmental benefits."

Chemical admixtures are often used in concrete in low volumes, typically less than 1%, adding to its sustainability, explains Altaf. "They can improve the quality and performance of the concrete significantly,

which extends its service life. The addition of stabilising and special water reducing admixtures also improves quality and performance in concretes where recycled cementitious and aggregate materials are used by allowing lower cement contents or higher inclusion rates of the recycled material."

The proportion of recycled or secondary aggregates used in concrete production is around 6% by mass, according to Guy Thompson. "When specifying recycled or secondary aggregates, the factors to balance are resource depletion, transportation impacts and implications for the mix design. Environmentally, it is preferable to use recycled aggregates close to their origin as their embodied CO2 value can exceed virgin materials if they're transported more than about 10 miles by road. Secondary aggregates, such as stent from Cornwall's china clay industry, have a much lower impact as they're usually transported by rail or ship."

Almost all the aggregates needed to make concrete are sourced within the UK, and only a fraction of the cement required is imported, but responsible sourcing is seen as the key to ensuring sustainability.

"In 2012, 89% of concrete was certified to BES 6001, in no small part due to the fact that it's locally sourced with the average concrete delivery distance just seven miles. This makes monitoring the supply chain much simpler, so we can provide buyers and suppliers with greater assurances of concrete's sustainability," says Emma Hines, senior manager of sustainable construction at Lafarge Tarmac.

Beside the sourcing of components and production, and the embodied carbon that this entails, there is the more nuanced issue of the whole life performance of concrete to consider.

"Concrete's strength, versatility, durability and inherent thermal mass properties enable it to reduce in-use carbon emissions, minimise fire risk and noise transmission, while also delivering structural resilience against severe weather and aggressive environments, and offering the flexibility to adapt a well designed building for alternative uses at the end of its life," explains Hines.

For designers, the inherent thermal capacity or thermal mass of concrete provides the potential to reduce the long-term operational energy use of homes by naturally regulating ambient temperatures and reducing the need for energy-intensive technologies such as heating and air conditioning.

Yassar Altaf believes these thermal mass benefits of concrete, along with other innovations, are now being recognised by architects.

"Recent developments in concrete design are allowing lightweight concretes with high levels of entrained air to be used as an insulation layer in wall construction."

Until now making informed decisions about the impact and whole life CO2 relating to a given product has been far from straightforward but should become easier as more Environmental Product Declarations (EPDs) are produced for concrete products.

Without comprehensive and reliable information perceptions about the sustainability of concrete products can easily be misplaced. At GreenSpec, Sandy Patience cites a report commissioned by Redland in which Ove Arup & Partners revealed that clay tiles use around twice as much energy as concrete tiles to produce.

"If we compare the embodied carbon of clay and concrete we discover the two materials are produced in fundamentally different ways. Clay requires firing at ▶

ABOVE Lignite's carbon negative building block: 'The Carbon Buster'

ABOVE RIGHT Pouring concrete into insulating concrete formwork. Aggregate Industries supplies the concrete while its joint venture company Charcon Construction Solutions supplies the ICF structures

RIGHT Forticrete concrete roof tiles

high temperatures for extended periods whereas concrete's carbon bill is incurred through the cement added to the aggregate mix before curing."

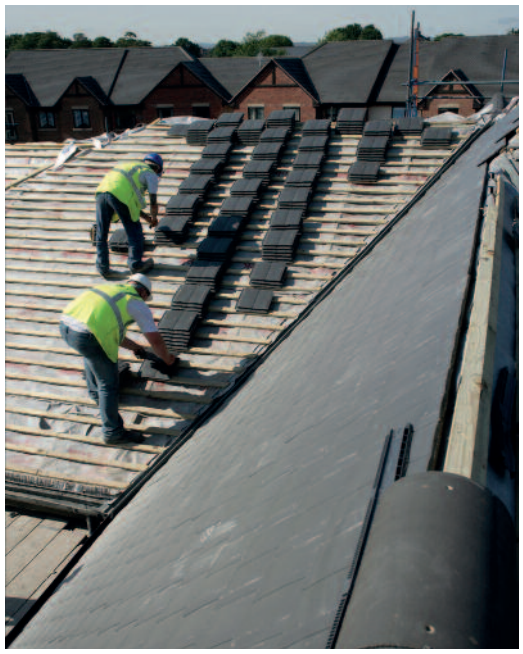
A growing number of concrete blocks are being designed to compete in the sustainability stakes. The blocks within Forticrete's dense concrete masonry range, which form part of the company's EcoBlock masonry solutions, are manufactured using up to 45% recycled content. The company ensures materials are sourced from suppliers capable of demonstrating a legitimate commitment to sustainability, explains John Lambert, Forticrete's general manager.

"Forticrete's BES 6001 compliant cast stone range of blocks – a sustainable alternative to natural stone – is manufactured from responsibly sourced high grade limestone and sandstone aggregates, cements, pigments and waterproofing agents."

Lignacite, has what it claims is the world's first carbon negative building block: 'The Carbon Buster'. This is a British innovation, which was developed by Lignacite in partnership with Carbon8 Aggregates using their Accelerated Carbonation Technology. The Carbon Buster incorporates more than 50% recycled aggregate and combines this with Carbon8's carbonated aggregates derived from by-products from waste to energy plants. The result is a high performing masonry product which has captured more carbon dioxide than is emitted during its manufacture; 14kg CO_2 per tonne to be exact.

Clearly such products go a long way to enhance concrete's reputation and reinforce the perception that concrete can be sustainable, a view that is likely to grow as the industry continues to research ways of reducing the material's cement content still further.

At the same time there is the assertion that there is a widening of focus from the sustainability of concrete production to the contribution concrete can make to a sustainable built environment. sh



CONTACTS

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Forticrete www.forticrete.co.uk
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