

Concrete and material efficiency

The latest data from the Concrete Industry Sustainable Performance Report provides insights into the material efficiency of concrete. Did you know that 210 times more waste is consumed during the manufacture of concrete and its constituent materials than the industry sends to landfill? Guy Thompson of MPA–The Concrete Centre reports.

Material efficiency can be defined simply as doing more with less. The target is to use less material resources in the most sustainable way while minimising the environmental impact and at the same time addressing the application of circular economy outcomes by extracting maximum value by providing buildings, infrastructure, resources and materials that maximise long-term use.

Thus, the reduction of waste and the use of recycled content are just one part of material efficiency when considering the built environment. Just as embodied CO₂ does not by itself represent a true carbon footprint, assessment of material efficiency should not be limited to just a single life-cycle stage.

If not considered holistically, opportunities for whole-life efficiencies may be lost or misguided along with a host of co-related design criteria such as addressing the principles of a circular economy, whole-life carbon, whole-life costs, climate change mitigation and adaptation, fire resistance and other standard design drivers. As with so many aspects of sustainable development, the most effective solutions require a holistic, joined-up whole-life approach.

Much is made of the quantities of concrete used by society to achieve its aims and objectives for the built environment and infrastructure, but when reviewed against the many material efficiency benefits concrete and masonry can offer it is not surprising that clients, design and construction teams depend and rely on a material that provides material efficiency benefits from cradle to grave and a range of opportunities to do more with less.

Concrete's use, as with all materials, needs to be considered carefully, but with the awareness of the full potential that it provides for long-term material efficient design solutions.

Material efficiency through responsible sourcing

Concrete is an inert material created primarily from natural minerals that can be locally and sustainably sourced throughout the UK, thus reducing imports, transport costs and carbon.

The Concrete Industry Sustainable Construction Strategy⁽¹⁾ reports annually on a range of metrics that demonstrate sector

Summary of Concrete Performance Indicators

This report summarises performance from 2008 to 2016 against 2020 targets for a range of performance indicators. The full version of the 10th report will be published in Summer 2018, and will be available from www.sustainableconcrete.org.uk.

Sustainability Insights

Performance proven – The 10 sectors that form the concrete manufacturing supply chain have worked together for 10 years on the Concrete Industry Sustainable Construction Strategy. It is this commitment to data collection, an agreed performance indicator framework and annual reporting that enables all stakeholders to have a transparent view of the concrete industry's sustainability performance.

Source smarter – Concrete and its constituent materials are produced by a UK supply chain providing ethically and responsibly sourced materials certified to BES 6001. The latest data shows that **90% of concrete is certified to BES 6001**. To find out more about specifying responsibly sourced concrete download *Specifying Sustainable Concrete*, published by The Concrete Centre.

Materials matter – Minimising waste and using resources efficiently is common sense in the production of concrete and the design of buildings. **The concrete industry is a net user of waste, using 116 times more waste and by-products than it produces.** To understand how to design material efficient buildings using concrete download *Material Efficiency*, published by The Concrete Centre.

Cutting carbon – Embodied carbon can be reduced by the energy efficiency of manufacture and a designer's specification of concrete. Operational carbon can be minimised through the use of concrete's inherent thermal mass and natural ventilation to avoid air-conditioning. **The industry has reduced the embodied carbon of a standardised mix of concrete to 73.7kg per tonne, a reduction of 28% from the 1990 baseline.** To find out more about specifying low carbon concrete download *Specifying Sustainable Concrete*, published by The Concrete Centre.

Long-lasting and long-life – Concrete is a robust and durable material that can be designed to achieve the longest of life-cycles. It is the obvious choice for long-lasting infrastructure projects such as Crossrail, and is able to provide a range of construction solutions to meet 150-year design life with the flexibility and adaptability to meet future occupant needs. The Concrete Centre has published a range of guides which aim to assist with the specification of concrete for a long-life, including *Whole-life Carbon and Concrete and BREAM*.

For more information and links to a range of resources visit www.sustainableconcrete.org.uk. Downloads of The Concrete Centre documents are available at www.concretecentre.com/publications.

... TCC Performance report summary cover.

performance, with many indicators that provide insight into the material efficiency of concrete.

Performance indicator: recycled/secondary aggregates

The inclusion of recycled and secondary aggregates in concrete is a balance of resource efficiency, transportation CO₂ and the implications on mix design and concrete performance. Consequently, these aggregates should be used in concrete production where it is technically and environmentally beneficial to do so. The industry continues to operate on this principle and uses recycled materials where possible and appropriate. In 2017, 8.3% of aggregates used in concrete were from recycled or secondary sources.

Performance indicator: additional cementitious materials

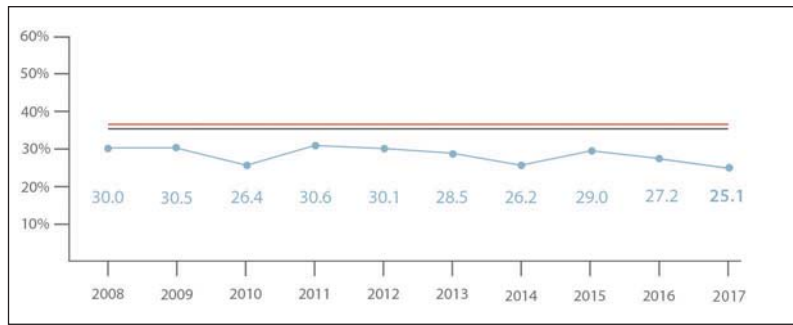
There are significant volumes of by-product materials such as GGBS and fly ash that can act as part of the cementitious binder in concrete. These materials have a lower embodied carbon than cement and can also influence the appearance and performance of concrete. In 2017, 25.1% of the total cementitious materials used were additional cementitious materials.

Recycled steel reinforcement

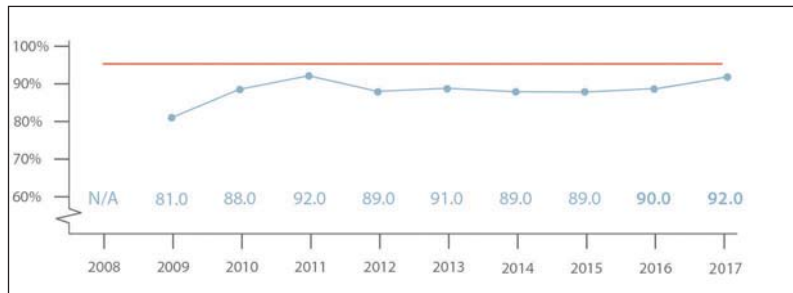
Steel reinforcement manufacturing BAR (British Association of Reinforcement) members used approximately 96% of recycled ferrous metal waste as a proportion of the raw materials consumed in their electric arc furnaces (EAFs) in 2017. The BAR members who are reinforcement fabricators used more than 95% EAF material in producing and supplying reinforcement bar for use in concrete.

Performance indicator: BES 6001

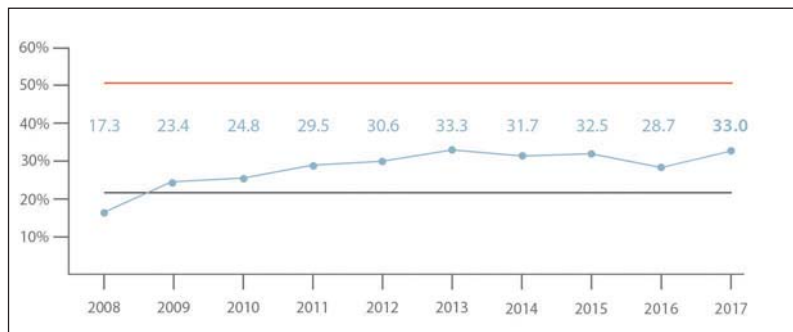
During 2017, certification of concrete products to BES 6001⁽²⁾ reached 92% of production tonnage. Over 90% of this certified tonnage achieved a performance rating of 'Very Good' or 'Excellent'. Of key interest to construction being rated to BREEAM assessment schemes, is a rating of responsible sourcing used in calculating credits under this aspect. This is now demonstrated by the Responsible Sourcing Certification Scheme (RSCS) score, which is shown on each product BES 6001 certificate (available at www.greenbooklive.com) and which is often higher than the generic score allocated to BES 6001 in BREEAM. The majority of certified concrete production attracts an RSCS score of 7 – currently the highest value for any scheme.



Percentage of additional cementitious materials – GGBS, fly ash, etc as a proportion of total cementitious materials used.



Percentage of production certified to responsible sourcing standard BES 6001.



Materials diverted from the waste stream for use as a fuel source as a percentage of total energy use.



Waste to landfill as a proportion of production output kg/tonne.



Material efficiency through waste consumption

Concrete is manufactured using efficient, low-waste processes and can be supplied in the precise quantities required, limiting waste. The concrete industry is a net user of waste: 210 times more waste is consumed during the manufacture of concrete and its constituent materials than the industry sends to landfill.

Performance indicator – waste to landfill

The indicator for waste minimisation relates to waste disposed to landfill per tonne of concrete production and includes waste related to the constituent materials attributed by their proportion in the concrete. During 2017, the value was 0.6kg/tonne of concrete produced, which is significant progress towards the 2020 target of a 90% reduction from the 2008 baseline, equivalent to 500g (0.5kg) of waste per tonne of concrete produced. Our longer-term aspiration is for zero waste to landfill.

Performance indicator: replacement of fossil fuels

The industry requires high temperatures for production, primarily in cement manufacture, and this is an opportunity to

safely use alternative combustible materials as fuel instead of non-renewable fossil fuels. The concrete industry indicator shows the proportion of energy derived from materials diverted from the waste stream as a percentage of total energy use. In 2017, 33% of total energy use was from waste-derived fuels, which is the highest value recorded since the strategy was launched in 2008. For cement production, this increases to 44%.

Concluding remarks

The industry report demonstrates the material efficiency of the concrete and its constituent materials. Designers also have a role to optimise material use through structural design and the selection of construction systems that help reduce wastage rates on-site. And not to be forgotten, at end of life, concrete is 100% recyclable and when crushed reabsorbs some 20% of its embodied carbon. ■

References:

1. SUSTAINABLE CONCRETE FORUM. *Summary of Concrete Performance Indicators, 2017 data*. MPA-The Concrete Centre, London, 2019.
2. BUILDING RESEARCH ESTABLISHMENT. BRE Environmental & Sustainability Standard BES 6001. *Framework Standard for Responsible Sourcing*. Issue 3.1, BRE Global, Watford, 2016.



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4th April 2019
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Keynote Address
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