The Concrete Centre™
PART OF THE MINERAL PRODUCTS ASSOCIATION

Concrete Credentials: Sustainability

A quick reference guide to the sustainable and performance benefits of concrete

mpa
essential materials
sustainable solutions

CONCRETE CREDENTIALS: SUSTAINABILITY
OVERVIEW

The concrete industry consists of nine sectors: cement, aggregates, admixtures, ground granulated blast furnace slag (ggbs), fly ash, mortar, ready-mixed concrete, precast concrete and steel reinforcement. In 2008, the UK concrete industry embarked on the implementation of a sustainable construction strategy. This agreement to a number of sustainability objectives included the commitment to produce an annual report of the industry's sustainability performance.

The individual sectors and companies had already established initiatives and reporting structures. The commitment to a comprehensive industry strategy has required further development of sector and company processes and this will continue as the framework is developed and refined. In addition, the industry performance indicators were developed to support the UK Government's sustainable construction strategy. In March 2009 the industry published its first report.

In March 2010 the concrete industry published its second performance report. This signifies another key milestone for the concrete industry, leading other material sectors by publishing sustainability performance targets. With 12 targets published and more in development, this reflects the industry's commitment to transparency and continual improvement. For a full list of targets visit www.sustainableconcrete.org.uk

Cover Image - Joseph Chamberlain School, Birmingham. This post-tensioned concrete-framed school achieved top marks from the Prime Minister for inspiration in design. Concrete provides environmental, social and economic advantages for school design.

Accurate information about the sustainable benefits of concrete is essential to inform the collaborative effort needed to make any new build or refurbishment/upgrade project sustainable, both in construction and operational use. The quick reference tables within this document present the performance benefits of concrete in a format for designers to easily interpret the sustainability credentials. The product and material data provided in this publication is sourced from the concrete industry's second report and specific sector reporting.

RESPONSIBLE SOURCING AND LOCAL PRODUCTION

The concrete industry has already taken significant steps to achieve and exceed the UK Government Sustainable Construction Strategy target that at least 25% of construction materials should be supplied from suppliers with responsible sourcing certification by 2012. For the latest information on what products have certification visit www.greenbooklive.com

The concrete industry is the first industry to link its sustainable construction strategy to the responsible sourcing standard developed by the Building Research Establishment (BRE), BES 6001 - "Framework Standard for the Responsible Sourcing of Construction Products". The local nature of concrete's production and the well integrated supply chain has been an advantage for concrete companies to gain accreditation. Designers can now easily source accredited material and gain maximum credits in sustainability assessment tools such as the Code for Sustainable Homes and BREEAM.

Concrete is the local material and this leads to social, economic and environmental benefits; for example, local skills development, local employment and local accountability for environmental impacts. Over 33,000 people are directly employed in the UK concrete industry. The concrete industry is committed to engaging with and supporting local communities and 86% of relevant sites have community liaison activities.

The average delivery distance of ready-mixed concrete to the construction site is just eight kilometres, and just over 150 kilometres for precast concrete products.

The average road delivery distance for aggregates is only 38 kilometres. 50 per cent of ready-mixed concrete plants are located at the aggregate extraction site helping to reduce the impact of transportation.

WASTE AND MATERIAL EFFICIENCY

The concrete industry diverted over 5 million tonnes of material from the waste stream and used them in place of primary materials. Waste is used as a source of fuel and also used in concrete manufacture. By-products from other industries, such as fly ash from power stations and ggbs from the iron industry reduce demand on primary materials and also reduce the embodied CO_2 of concrete, when used as additional cementitious material. For detailed estimates of the CO_2 emissions associated with an 'average' tonne of concrete, suitable for use in a carbon calculator, which also include data for water and steel reinforcing bar, visit www.sustainableconcrete.org.uk

Research shows that virtually all the recycled aggregates in the waste stream are already being re-used, and have replaced around 25% of virgin aggregate use. This is the highest level achieved amongst all European Countries.

ENERGY AND CO_2

The energy-intensive sectors in the industry have a well-established record of reducing carbon and greenhouse gas emissions. The cement sector has improved its Climate Change Agreement performance by 33.7% between 1990 and 2008, exceeding the agreement target. The ground granulated blast furnace slag sector has achieved a 19% energy reduction between 1999 and 2008.

As well as the energy used in product manufacture and construction (embodied/embedded) the more significant energy use is in the operation of our homes and buildings. Residential buildings alone are responsible for 27 per cent of UK CO_2 emissions.

The thermal performance properties of concrete as a construction material can provide considerable in-use (operational) energy savings over the life-time of a building. In housing for example, this operational energy saving can offset the slightly higher embodied CO_2 associated with concrete and masonry homes within a decade of use. To find out more visit www.concretecentre.com

CONCRETE CREDENTIALS: SUSTAINABILITY
THE PERFORMANCE BENEFITS OF CONCRETE

FIRE RESISTANCE

Environmental
Concrete does not burn and therefore it reduces noxious emissions from a fire, and wastage of materials.

Social
The resilience of concrete reduces damage and limits the potential loss of livelihood or homes through a fire. During construction there is no risk to neighbours of the concrete frame being a fire hazard.

Economic
Regulations require safe evacuation of occupants but not property safety. Concrete structures comply with life safety regulation but can also resist fire to enable cost-effective repair and re-use.

THERMAL MASS

Environmental
Concrete's thermal mass allows it to be used to reduce heating and cooling energy of buildings.

Social
The thermal mass of concrete can be used to reduce overheating in a building. Occupants affected by public funding and CO_2 targets, in social housing and schools, are at risk of overheating if energy use cannot be reduced by no cost options.

Economic
Using the thermal mass of concrete will lower running costs of a building. It will also reduce the plant needed on site, leading to reduced maintenance costs.

DURABILITY

Environmental
Due to the long life of all concrete structures, material impacts on the environment are kept to an absolute minimum.

Social
The durability of concrete structures means that, once built, they are rarely out of use for maintenance and hence have minimum social disruption.

Economic
Concrete is a very stable and durable material with an extremely long life. As a result, maintenance costs are minimal for concrete structures.

ACOUSTIC ISOLATION PERFORMANCE

Environmental
Concrete has good acoustic performance and there is less reliance on finishes and materials which have a short lifespan. Hence less material is used and potential waste is avoided.

Social
Concrete's mass absorbs sound, ensuring quality of life, particularly in high density living, where dwellings are prone to acoustic break-in.

Economic
Concrete walls and floors provide required acoustic separation with minimum finishes, hence minimum cost and maintenance.

ROBUSTNESS/SECURITY

Environmental
Concrete structures are robust, reducing risk of damage to finishes, hence less use of materials through the whole life-cycle of structures.

Social
Solid concrete party walls provide safe, secure buildings. Prevention of intruders helps to build safer communities.

Economic
Concrete structures, particularly if finishes are minimised, will suffer less damage and cost less to repair and maintain.

FLOOD RESILIENCE

Environmental
The flood resilience of concrete means it retains structural integrity, resulting in minimum wastage of materials following a flood event.

Social
A concrete structure will resist water penetration, keeping inconvenience and disruption to business, homeowners and the community to a minimum following a flood event.

Economic
Downtime of businesses, homes and essential community services, is minimised if flooded buildings are constructed in concrete.

CONCRETE CREDENTIALS: SUSTAINABILITY
CREDENTIALS OF SPECIFIED PRODUCTS

Precast concrete products	
CO_2	A commitment to use additional cementitious materials where performance requirements permit exists throughout the industry. Transport distances for the average delivery of precast concrete products are just over 150 kilometres.
Recycling	Recycling systems capture virtually all process water, slurry, aggregates or cement and these are re-used in the production process. 85 per cent of the waste produced by the precast sector is recycled or re-used.
Resource depletion	23 per cent of aggregates used in the precast sector are recycled or from secondary sources. The sector has set a target to increase the use of additional cementitious materials to 25 per cent. Precast products can often be re-used in their entirety.
Waste	The precast concrete sector uses more waste than it produces. A tonne of precast product uses 218kg of secondary materials and by-products and produces only 6kg of waste that goes to landfill. Concrete buildings can be designed with less finishes reducing the associated material waste.
Water	Dependency on mains water supplies is being drastically reduced across the industry as companies adopt recycling systems and alternative water sources such as rainwater harvesting. 180 litres of water are used per tonne of precast concrete product; 38 per cent of which is from licensed non-mains sources. Water-reducing admixtures also minimise water use.
Emissions	The precast concrete sector is closely regulated by the Environment Agency. In 2008 the sector achieved an increase in the percentage of sites with Environmental Management Schemes (EMS) to 80 per cent. A target has been set to increase this to 85 per cent.
Biodiversity	Companies with factories in more rural areas are increasingly committed to protecting and enhancing the natural environment. A site in Yorkshire was the first manufacturing site to attain The Wildlife Trust's "Biodiversity Benchmark".
Health and safety	The comprehensive British Precast health and safety scheme (CT2010) has helped members reduce their overall incidence rates by two thirds compared to 2000. Admixtures are used to produce self-compacting concrete which does not require vibration leading to quieter working environments.

Ready-mixed concrete	
CO_2	Additional cementitious materials and admixtures are used by most concrete manufacturers to optimise cement content and can reduce the embodied CO_2 of the concrete. Transportation CO_2 is minimal with the average delivery distance of ready-mixed concrete being 8 kilometres and 50 per cent of ready-mixed plants are located at the aggregate extraction site.
Recycling	At the end of the life of a structure, all cured concrete waste can be recycled to create new construction materials.
Resource depletion	Every tonne of ggbs or fly ash used in concrete mixes saves about 1.4 tonnes of raw materials and fossil fuels. Aggregates are abundant the world over and the UK has enough aggregate reserves to last for hundreds of thousands of years at current rates of usage. (i)
Waste	Modern formwork systems and efficient site management minimise ready-mixed wastage which is estimated at less than 2 per cent. Systems are available to re-use 'returned ready-mixed concrete' and this does not go to landfill. Concrete buildings can be designed with less finishes reducing the associated material waste.
Water	A cubic metre of fresh concrete contains 140 to 190 litres of water. The use of admixtures can reduce the water content by up to 30 litres per cubic metre. 90% of ready-mixed concrete already includes water reducing admixtures.
Emissions	All ready-mixed plants have dust suppression systems in place.
Health and safety	The ready-mixed sector is an increasingly safe place for people to work and is working towards a target of reducing injuries per 100,000 direct employees by 13% year on year from 2008 levels.
Sustainable formwork	Formwork suppliers and contractors have responded to the sustainability agenda by, for example, increasing the number of re-uses of formwork on site, refurbishing forms with surface treatment rather than replacing, and using vegetable-based release agents.

Reinforcement	
CO_2	Manufacture of steel reinforcement bars for reinforced concrete could be a source of significant energy consumption and a large contributor to embodied CO_2. However, the UK industry uses the Electric Arc Furnace process, which generates up to six times less CO_2 than those emanating from the Basic Oxygen Steel making system that is used for making other UK steel.
Recycling	UK produced reinforcement for concrete is manufactured from 100 per cent recycled UK scrap steel. Scrap steel reinforcement from demolished buildings is recycled to manufacture new steel reinforcement. Two thirds of reinforcement used in the UK is produced in the UK. The majority of imported reinforcement is also produced from scrap steel by Electric Arc Furnace.
Resource depletion	The use of Electric Arc Furnaces allows reinforcement steel to be made from 100 per cent scrap metal, reducing the specific energy (energy per unit weight) required to produce the steel, but also relieving pressure on the Earth's natural ore resources. The UK is a net exporter of scrap steel.

CONCRETE CREDENTIALS: SUSTAINABILITY
CREDENTIALS OF CONSTITUENT MATERIALS

Cement	
CO_2	Direct annual CO_2 emissions have reduced by nearly 40 per cent since 1990 in absolute terms. The cement industry met the UK's 2010 Climate Change Agreement target four years in advance and is continuing its commitment to improvement. This compares favourably with the UK construction industry, which overall recorded an increase in CO_2 of more than 30 per cent over the same period.
Recycling	In 2008, the sector replaced 26.5 per cent of its fuel from waste-derived material including scrap tyres, pelletised sewage sludge and meat and bone meal.
Biodiversity	All cement plants and quarries have, or are linked to, biodiversity action plans.
Resource depletion	The consumption of natural raw materials needed to make cement has reduced significantly in the last ten years. Between 1998 and 2008 the sector has increased the use of waste-derived raw materials by over 50 per cent.
Waste	The cement sector is a net user of waste. Waste-derived materials are actively sought as replacements for natural raw materials and fossil fuels. The sector uses over 1.4 million tonnes of waste in this way and produces 45,000 tonnes of waste per year.
Emissions	The cement industry has worked hard to reduce its emissions to air by investing in new technologies. From 1998 to 2008 significant reductions have been achieved; SO_X emissions have reduced by 75 per cent, dust emissions by 68 per cent and NO_X by 51 per cent.
Health and Safety	The sector has reduced accident rates of its employees by 80 per cent in the last ten years. The target is to achieve a further 50 per cent reduction in accident rates by 2015.

Additional cementitious materials	
CO_2	The use of 50 per cent ggbs can reduce embodied CO_2 by over 40 per cent compared with a traditional 100 per cent Portland cement concrete mix. 30 per cent fly ash can reduce embodied CO_2 by over 20 per cent . Limestone fines can reduce embodied CO_2 by 15 per cent.
Recycling	The concrete industry recycles by-products from other industrial processes. Ggbs, a by-product of iron production, and fly ash from electric generating plants can both be used as additional cementitious material in concrete mixes.
Resource depletion	Every tonne of additional cementitious material used in concrete mixes saves about 1.4 tonnes of raw materials.
Waste	Ground granulated blast furnace slag and fly-ash are by-products of other industries. These products can be diverted from landfill by being used as additional cementitious material in concrete mixes. As a proportion of total cementitious materials used in ready-mixed and precast concrete 31.8 per cent is additional cementitious materials.

Aggregates	
CO_2	On site CO_2 emissions from aggregates supply are 4 - 6 kg per tonne. 15 per cent of UK aggregates are transported by rail and ship/barge. The average road delivery distance is 38 kilometres.
Recycling	With a growing commitment to recycling construction waste materials, there is now little evidence that any hard demolition and construction waste is sent to landfill (ii). Recycled and secondary aggregates account for 25 per cent of the total market: this is the highest for all countries in Europe.
Biodiversity	Seven hundred sites of special scientific interest (SSSI's) in the UK are current and previous sites of mineral extraction. The aggregates sector is actively involved in site stewardship and biodiversity initiatives, including encouraging exemplar restoration projects.
Resource depletion	Aggregates are abundant the world over. The UK has enough aggregate reserves to last for hundreds of thousands of years at current rates of usage (i).
Health and safety	With improving working practices, year on year aggregate extraction is becoming an increasingly safe industry. MPA is seeking to achieve a 2014 target of a 50 per cent reduction in lost time Incidents (LTI) for direct employees and contractors, with an overarching aim of 'Zero Harm'.

RESPONSIBLY SOURCED CONCRETE

The concrete industry is the first industry to link its sustainable construction strategy to the responsible sourcing standard developed by the Building Research Establishment (BRE), BES 6001 - "Framework Standard for the Responsible Sourcing of Construction Products". The reinforcement sector has both Eco-reinforcement which is accredited to BES 6001 and CARES Sustainable Reinforcing Steel Certification. For the latest information on what products have certification visit **www.greenbooklive.com**

CONCRETE CREDENTIALS: SUSTAINABILITY
CONCRETE PROOF: PROJECTS

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Ashburton Court to Elizabeth II Court - Re-use and recycle

The transformation of this 1960's office was aided by its concrete structure, which provided a solid starting point that could be easily adapted. Reusing the concrete frame saved 50 per cent of the embodied energy required to construct a new building. Space utilisation has improved, with the building now accommodating 1,100 employees compared to 625. The operational carbon footprint has been significantly reduced due to the exposed concrete soffits, solar shading and intelligent lighting and water-saving systems. Concrete from the partial demolition were recycled, crushed and re-used as aggregate. The project has secured a BREEAM "Excellent" rating.

One Brighton - Material efficiency

This mixed use development employs a concrete frame that comprises 100 per cent recycled steel reinforcement, a concrete mix with 50 per cent ground granulated blast furnace slag (ggbs) as additional cementitious material and stent as a secondary aggregate, both are by-products diverted from the waste-stream of other industries. A thinner floor slab has been achieved by using post-tensioned concrete construction; it is calculated that these measures have reduced the carbon emissions associated with the concrete frame by over a third. These savings are over and above operational savings associated with concrete.

Eithinog scheme, Wales - Affordable and energy efficient homes

Concrete and masonry can achieve the highest levels of The Code for Sustainable Homes and BREEAM. This has been proven with projects, design guidance and exemplars. Also concrete and masonry products accredited to responsibly sourcing standard BES 6001 gain the maximum category credits. This social housing project is designed to meet the Welsh Housing Standards of Code for Sustainable Homes level 4*, Lifetime Homes and Secured by Design requirements. The project used high levels of insulation, air tightness and thermal mass to deliver carbon emissions to a level at least 50% better than Part L:2006. These concrete and masonry homes overlook the Menai Straights, offering unprecedented views to Anglesey and providing their occupants an affordable home, with affordable energy demands.

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Ref: TCC/05/20
ISBN: **978-1-904818-72-2**

The Concrete Centre is part of the Mineral Products Association, the trade association for the aggregates, asphalt, cement, concrete, lime, mortar and silica sand industries. **www.mineralproducts.org**

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