

Sustainable steel construction

Building a sustainable future



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Staythorpe Power Station, Newark
(photograph: Severfield-Reeve Structures Ltd)

Contents

- The steel construction sector – introduction . . . 03
- Steel sector commitments 04
- Steel: the ultimate sustainable material 06
- BCSA Sustainability Charter 08
- Sustainable procurement 09
- Delivering the triple bottom line 10
- Design guidance 12
- Target Zero 13
- Mitigating climate change 14
- Thermal mass and CO₂: facts and figures 16
- Innovation in steel 18

The steel construction sector

Sustainable champions for the UK building industry

Buildings are responsible for almost half of the UK’s carbon emissions, half of its water consumption, around a third of its landfill waste and a quarter of all raw materials used in the economy.

This means that the UK’s sustainable development targets cannot be met without a fundamental change to the way in which buildings are constructed. The national targets for greenhouse gas emission reductions and the drive for buildings that generate zero carbon in operation present a huge challenge to the building industry – a challenge which the steel construction sector is playing a major part in overcoming.

The steel sector – comprising the British Constructional Steelwork Association (BCSA), Corus and the Steel Construction Institute (SCI) – is delighted to be leading the way in developing a more sustainable construction industry for the UK. Our commitments range from producing design guidance on creating buildings that meet the Government’s zero carbon objectives to researching the environmental impact of steel in buildings and developing products and processes to reduce that impact.

Sustainability has what is often known as a ‘triple bottom line’, comprising environmental, social and economic factors. Environmental issues receive the most attention, but social and economic factors are also of vital importance, and this document sets out the benefits of steel to all three issues. It also underlines the steel industry’s commitment to sustainable development, the unequalled sustainable benefits of steel as a building material, the achievements of the sector to date and its vision for the future.

Lakeside Energy from Waste Plant, Colnbrook
(photograph: Ros Orpin)





Steel sector commitments

Reducing the carbon footprint of buildings is set to remain a top priority for the steel construction sector

Sustainability is already high on the agenda for all companies involved in the construction sector. The importance of sustainability will only increase in the coming years as Government legislation comes into full force and the subject is better understood thanks to continuing research and development.

The growing role of steel

The steel construction sector in the UK wholeheartedly embraces the push towards greater sustainability in construction. Steel itself is an inherently sustainable building material and is destined to play a significant role in helping the construction sector achieve its ambitious sustainable objectives.

Looking to the future

Today, and for the years to come, the steel construction sector is committed to:

- Working with Government to meet the objectives of its sustainable construction strategy
- Providing design guidance and information that allows designers to create buildings which reduce the whole-life costs and environmental burdens associated with buildings
- Providing design guidance and information that allows designers to create buildings that can achieve the highest BREEAM ratings and which meet Government aspirations for zero-carbon building operation
- Developing patterns of sustainable procurement consistent with the requirements of emerging standards in this area
- Continuing to invest in research and development to reduce the carbon footprint of its processes and products
- Providing industrial companies in the sector with the means of improving the performance of their businesses through sustainable business practices
- Giving specifiers and procurement agencies the opportunity to identify key supply chain partners that share a commitment to sustainable construction.

Steel: the ultimate sustainable material

The sustainable qualities of steel are built in to the material. Simply choosing steel as a building material enables specifiers to deliver unrivalled sustainability performance – for life, and for all its subsequent lives.



Offsite construction – the sustainable choice

The nature of the steel construction process is the source of numerous sustainable benefits. All of the fabrication, testing and certification takes place in a safe, carefully controlled and monitored factory environment. Here, consistently high quality standards can be maintained and assured, with each component manufactured to the exact specifications of each project. This leads to quicker, safer and more predictable on-site operations.

Offsite construction has clear environmental benefits, with on-site waste virtually eliminated and fewer deliveries to site, cutting carbon emissions associated with transport. Steel construction has always been carried out in this way, making it an exemplar for sustainable offsite construction.

Manufactured from the most abundant element on earth, iron, steel can be recycled or reused endlessly without detriment to its properties. Its superior strength-to-weight ratio means a little steel goes a long way, giving architects complete flexibility to achieve their most ambitious designs. Manufactured in a controlled factory environment, pre-engineered steel components are delivered to site ready for rapid assembly, with no waste.

Multicycling

Steel can be reused repeatedly without ever losing its qualities as a building material. This unique characteristic gives all steel a high value at all stages of its life cycle. The recovery infrastructure for steel recycling is highly developed and highly efficient, and has been in place for decades. Current recovery rates from demolition sites in the UK are 99 per cent for structural steelwork and 94 per cent for all steel construction products – figures that far exceed those for any other construction material.

Adaptable

Significant environmental damage can be caused at the end of a building's life when it has to be demolished and its materials scrapped. Steel-framed buildings, however, do not decay, and

are easily adaptable if the configuration of the building needs to change. The ability of steel to bridge long spans means that steel buildings contain large open-plan spaces which are easily reconfigured with partition walls. The steel frame itself can be adapted, with parts added or taken away, and its light weight means that extra floors can often be added without overloading existing foundations.

Reusable

Because steel frames are essentially a kit of parts, they can easily be dismantled and reused. Bolted connections allow components to be removed in prime condition and easily reused either individually or en masse as entire structures. It means that steel components are perpetually reused in a continuous loop, and never sent to landfill.

Demountable

Entire steel structures can be fully dismantled and reconstructed in a different location in a matter of days, without creating any dust and dirt, and very little noise. This demountable capability is inherent in a steel building – it doesn't need to be specially designed in and rarely requires any extra provision

in the construction process. Constructing a building from a demounted structure is one of the most sustainable ways of creating a 'new' building.

Fast

The speed of steel construction has made it the framing material of choice for the UK construction sector. A shorter construction programme reduces disruption and disturbance around the site. Steel is relatively clean and quiet to erect, and requires few site deliveries. Speed of construction delivers an economic benefit too, which is fundamental to sustainable development. The shorter on-site period reduces the cost of preliminaries, reduces the period of financing and delivers a building that is operational faster – providing a quicker return from rent or sale.

Manufactured

All steel components are manufactured in the controlled environment of a fabrication workshop, where consistent structural elements with assured quality can be created to meet the specific requirements of each project. In this environment, steel parts can be easily standardised, tested and certified. Any waste material produced during the

fabrication phase can be recycled and used in the steelmaking process.

Safe

Industry surveys consistently demonstrate that steel is the safest construction material. Components are fabricated offsite in a safe, controlled factory environment. From here they are delivered to site and erected by a small number of skilled personnel. There is minimal requirement for on-site cutting or adjustment, and no need for the time-consuming and potentially hazardous shuttering and handling operations associated with other construction materials.

Zero waste

When you specify steel for a building, you can rest assured that it is unlikely ever to become waste. Steel always has a value and is only ever sent to landfill as a last resort. Waste generation is one of the least sustainable aspects of construction. Choosing a steel-framed building is the simplest and most effective way to reduce waste. Even during steel manufacture and fabrication, any swarf or offcuts are recovered and recycled in the steelmaking process.

Recycled content

Recycled content is specified to encourage recycling of materials which would otherwise be disposed of. However, it is not a suitable driver for metals that are already recovered and recycled close to their maximum. Specifying recycled content for steel does not have any beneficial environmental effect, but can distort the market and result in unnecessary transport costs and emissions. All steel is recyclable and will be multicycled many times without any artificial stimulus.

All new steel manufactured by Corus has a significant recycled content. The modern steelmaking process requires the input of scrap and it is not possible to make steel without it. The average recycled content of structural steel used in the UK is 60 per cent.



Cabot Circus Footbridge, Bristol, in construction (photograph: SH Structures)



Vulcan House, Sheffield: a BREEAM Excellent-rated building

BCSA Sustainability Charter

The BCSA's pioneering Sustainability Charter sets environmental objectives for its members and measures performance against key sustainability criteria

In 2005, the BCSA became the first representative organisation to launch a sustainability charter. The objective of this charter is:

“To develop steel as a sustainable form of construction in terms of economic viability, social progress and environmental responsibility.”

Member commitments

BCSA Member and Associate Member companies that agree to be bound by the charter have to make a formal declaration of their commitment to a set of sustainable principles, and to be assessed and monitored against a range of environmental, social and economic criteria.

Charter Members formally declare that they will adhere to the following aims and objectives:

- Operate their businesses to the highest ethical standards in efficient and financially sustainable ways, in order to undertake contracts that satisfy clients and add value for stakeholders
- Work to assess and minimise the effect of manufacturing and construction activities on the eco-efficiency of steel construction through its life cycle
- Work towards increasing the efficiency of use of resources and energy in steel construction by promoting the recovery, reuse and recycling of steel
- Foster the health and safety of employees and others in the steel construction industry, and operate generally in a healthy, safe and environmentally sound manner
- Demonstrate social responsibility by promoting values and initiatives that show respect for people and communities associated with steel construction and with other organisations in the supply chain.

The Charter has been used to help improve understanding of sustainability among steel construction companies, as well as providing them with a tool to help them manage their businesses in more sustainable ways. Charter Members also agree to provide data which is used to calculate sustainability Key Performance Indicators and benchmark their performance.

Sector commitments

A second objective of the Charter takes the BCSA's sustainability initiative beyond individual companies and requires the sector to engage directly with building specifiers and bridge procurement agencies. The aim is to develop suitable “green” specifications for steel construction that draw on the established capabilities of BCSA Charter Members in the supply chain.

Sustainable procurement

Raw materials are responsibly sourced by Corus, and the company champions environmentally responsible practices throughout its supply chains

Corus gives confidence to all of its supply chains that its materials are responsibly sourced, to provide a route for customers to obtain credits under the BREEAM family of certification schemes.

Upstream influence

Corus is committed to minimising the environmental impact of its upstream operations. As a large customer, Corus is committed to wielding its influence over its global suppliers, encouraging them to adopt responsible practices. To support these efforts, Corus has an online supplier assessment tool which it uses to screen potential suppliers, as well as to promote and monitor the performance of existing suppliers.

Downstream benefits

Corus also takes responsibility for managing the environmental impacts of its products once they leave its manufacturing facilities. Downstream, the properties of its products and the information Corus provides to customers can have a significant impact on the environmental performance of completed buildings and structures throughout their life.

Meeting sustainable procurement expectations

Corus has worked with the Building Research Establishment (BRE), the Eden Project and other organisations to develop its understanding of the construction industry's requirements in relation to sustainable procurement. It supports the principles of BES 6001 and is working to assess its products to the requirements of this standard.

Corporate Responsibility

For Corus, corporate responsibility involves the integration of financial and strategic goals with a commitment to the health, safety and well-being of its employees and communities; a focus on improving environmental performance and providing sustainable products, and conducting all aspects of its business with honesty and integrity. To read the Corporate Responsibility Report, please visit www.corusgroup.com/responsibility



The Kids of Steel programme, where thousands of children across the country participate in a mini triathlon, is one of the many community projects that Corus have initiated

Delivering the triple bottom line

Sustainable construction is about more than delivering environmental benefits – it's about reducing social and economic impacts too



Castleford Footbridge plays a key role in a local social regeneration project

The triple bottom line

There are three elements to sustainability: environmental, social and economic – known as the 'triple bottom line'. The environmental element understandably receives the most attention, but to be truly sustainable a structure must also deliver economic and social benefits.

Economic benefits of steel

Steel construction has numerous economic benefits:

- Steel has a high strength-to-weight ratio, so less of it is needed to make a quality structure, and smaller foundations are required. This means that material costs for a given building will be lower with steel than with any other alternative
- Steel construction is quick. Quicker construction means lower labour costs and fewer time-consuming preliminaries. It also means that a building is finished earlier, speeding up the development process and enabling building owners to achieve a faster return on their investment. That's vital in challenging economic times

- Steel also retains its value. Because it maintains all of its properties and qualities for life, it is endlessly recyclable. At the end of a building's life, the most economic solution for a steel-framed building is either to refurbish it or for its components to be demounted and rebuilt elsewhere.

Social benefits of steel

Underpinning every environmental benefit of steel is a social benefit, as the examples below demonstrate:

- Steel facilitates rapid construction, resulting in less disruption to the local community around the building site. There are fewer vehicle movements to site, very little on-site noise and zero waste

- Steel construction enables structures to be demounted and rebuilt without noisy and dusty demolition. That's beneficial to the local community and leaves behind no environmental legacy

- The steel industry requires skilled, settled workers. There is little need or desire for an itinerant workforce, and as such it provides more stable employment than in some other sectors

- The high strength of steel enables it to achieve long spans, creating bright, airy buildings that are a pleasure to live and work in. Steel structures don't degrade with age either, so they never look tired and outdated.

Material costs for a given building will be lower with steel than with any other alternative



The stunning Cabot Circus roof, Bristol
(photograph: MD & Associates)



Design guidance

Best practice design guidance for steel construction is widely available, supported by online tools and resources for the construction sector

The steel construction sector is committed to developing and disseminating best-practice design guidance. A range of guidelines on implementing codes and standards has been published. This has been further enhanced by extensions to the rules which enable more innovative designs to be achieved.

Steel construction guides

The Steel Construction Institute (SCI) is the leading provider of guidance on the use of steel in construction. It publishes around 15 new reports each year. Recent guides have covered:

- Modular buildings
- Floor vibrations
- Acoustic performance and detailing
- Thermal bridging
- Energy efficient housing using light steel framing.

The SCI has also created the www.steelbiz.org website to give those involved in steel construction direct online access to up-to-date, high-quality technical information on steel construction.

Steel Essentials

The Steel Essentials guide provides helpful advice and useful reference across a number of steel construction topics, including sustainability, health and safety, fire protection, acoustic performance, structural design and corrosion protection. A copy of this pocket guide can be ordered or downloaded from www.steelessentials.info

Leading the transition to Eurocodes

The steel construction sector is taking a leading role in the transition to Eurocodes 3 and 4 in the UK. It has developed a number of tools, including publications, courses and online information, giving architects and designers step-by-step guidance on how to use the Eurocodes.

As part of its commitment to supporting the new standards and in conjunction with its partners in Europe, SCI has developed a fast, free and easy route to the application of the Eurocodes through the multi-lingual www.access-steel.com website.

Target Zero

The steel construction sector is providing practical guidance to underline its full commitment to supporting the Government's drive towards zero carbon buildings

Tackling greenhouse gas emissions

The provisions of the 2007 Climate Change Bill have committed the UK Government to a reduction in national carbon emissions by 80 per cent compared to 1990 levels. Because buildings in operation account for almost half of all greenhouse gas emissions in the UK, the construction sector has a major role to play in helping to achieve this target.

Achieving such a drastic cut in greenhouse gas emissions from construction will require radical changes to the way buildings are constructed and used in this country. Recognising this fact, the Government has set demanding targets for the industry. All new residential buildings must be zero carbon in operation by 2016 and all non-domestic buildings must meet this requirement by 2019.

Target Zero guidance

The steel construction sector is fully committed to supporting the Government's drive towards zero carbon buildings. It recognises that reliable data is needed to help inform vital technical decisions about building construction if the Government's zero carbon objective is to be achieved.

That's why the BCSA and Corus have resolved to provide and disseminate this much-needed information. They have commissioned AECOM to lead a £1m, three-year development project to generate fully detailed and costed solutions for five building types that meet the emissions reduction targets set out by Government. Guidance for each of the building types will be published over a 15-month period, starting in November 2009 with guidance for school buildings. To find out more please visit www.targetzero.info

We recognise that reliable data is needed to help inform vital technical decisions about building construction if the Government's zero-carbon objective is to be achieved.

Mitigating climate change

Steelmakers and steelwork contractors are successfully working together to cut the carbon dioxide emissions associated with steelmaking and steel construction



Lakeside Energy from Waste Plant, Colnbrook



Xstrata Aerial Walkway, Kew Gardens (photograph: Jane Wernick, Jane Wernick Associates)

Today, carbon dioxide (CO₂) emissions from steelmaking are around 50 per cent lower per tonne of steel than they were 40 years ago. Nevertheless, the steel construction sector recognises that it has a significant contribution to make in further reducing global CO₂ emissions.

Carbon reduction achievements

Corus has long been working to improve the efficiency of its processes, to save energy and reduce its environmental impact. The company recently established a Climate Change Taskforce to develop and implement its carbon-reduction strategy, with a target of reducing CO₂ emissions by at least 20 per cent per tonne of steel by 2020, compared to 1990 levels.

Corus is now highly proficient at recovering the gases arising from its blast furnaces, coke ovens and steel plants. The gases are reused for process heating and electricity generation. On-site generation now accounts for 40 per cent of all electricity used by Corus – equivalent to a 700,000 tonne cut in CO₂ emissions from conventional electricity generation.

Embodied energy advice

The steel sector is committed to improving the design advice available on the embodied energy of buildings and other structures. The updated advice will provide information on the embodied energy and carbon in a range of building types with different framing solutions. It will help the industry to move away from a simplistic 'per tonne' calculation towards more accurate and complete ways of calculating embodied energy and carbon.

Corus has made a commitment to ensure that all its calculation methods and data are consistent with the standards set by the World Steel Association and other authoritative bodies.

Developing environmental best practice

Manufacturers of finished steel products are also taking positive steps to reduce their environmental impacts. The BCSA has developed a carbon footprinting tool for its Members, which all of its 'Gold' status Charter Members are required to use. The data from this tool provides Key Performance Indicators for each member and is used by the BCSA to develop best practice guidelines.

ULCOS – consortium for emissions reduction

The ULCOS (ultra-low CO₂ steelmaking) project is a consortium of 48 European companies and organisations from 15 countries, supported by the European Commission. It has an ultimate target of a 50 per cent reduction in emissions per tonne of steel by 2050.

Corus is a major partner in ULCOS. The first phase involves research to evaluate a new generation of steelmaking technologies, while the second phase will operate the most promising of these on a demonstration plant scale. It will focus on four areas:

- A new generation of blast furnaces that recycle top gas and capture CO₂ for storage
- Direct reduction of iron
- Smelting reduction
- Carbon-reducing fuel technologies, such as electrolysis, hydrogen cells and biomass.

The level of investment in this project (around €360M) is testament to the commitment of the European steel industry to change things for the better and to develop innovative technologies that not only benefit us today, but also generations to come.

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Interior of Bridge Academy, Hackney, showing exposed composite flooring

Thermal mass and CO₂: facts and figures



Bridge Academy, Hackney, made excellent use of exposed thermal mass (main photograph: Martine Hamilton Knight)

Carbon dioxide emissions associated with steel manufacture are kept low by effective emissions reduction initiatives and extensive use of steel scrap

The CO₂ content of structural steel

To calculate the environmental impacts of steel manufacturing, the World Steel Association adopts the 'system expansion' method of lifecycle assessment, which is the preferred approach of the ISO 14040 series of environmental standards. This approach considers all new steel to be part of single global system of supply and demand. Credits are given for co-products used in the manufacturing process which save energy or emissions, such as process gases being used to generate electricity.

An example of the calculation method for the carbon dioxide emissions associated with steel production can be viewed at www.corusconstruction.com/sustainability

Carbon and energy impacts of steel products:

	Plate	Sections	Tubes	HDG	Purlins & rails
CO ₂ (tonnes per tonne of steel)	0.919	0.762	0.857	1.35	1.1
Energy (GJ per tonne of steel)	17.37	13.12	15.42	21.63	19.38

It is standard practice to express these figures on a per tonne basis. This may give the impression that steel has higher impacts than other construction products. However, steel has a higher strength-to-weight ratio than most other structural materials meaning that one tonne of steel goes a lot further. As a result, the CO₂ emissions associated with any steel building will be lower.

Cradle to gate values

There are other values in circulation for the carbon content of steel. Some are higher and some are lower than the values in the table opposite. Most other values have been derived by less rigorous methods than system expansion. These other methods generally rely on a cradle to gate analysis and thus ignore the environmentally beneficial effect of recycling, which only becomes apparent during the full cradle to grave life cycle. Inferior cradle to gate methods are used for comparison because other material industries cannot provide robust cradle to grave data to the level of the steel industry.

The thermal mass myth

Research shows that the optimum floor thickness required to achieve an effective thermal mass is readily delivered by steel-framed buildings

There is a common misconception that buildings must be heavyweight to achieve an optimum thermal mass. This myth has probably arisen because buildings such as churches are cool in the summer. However, the main reason that churches stay cool is because they have very few windows, which reduces solar gain.

Steel delivers optimum floor thickness

In modern buildings, the greatest accessible mass is found in the concrete floor slab. Independent research has shown that the optimum thickness of concrete floor slab for providing thermal mass is 75-100mm. This thickness of concrete floor slab is routinely available in almost all steel-framed buildings, which are generally the lightest weight form of construction.

Extra weight unnecessary

The extra weight associated with heavy, bulky concrete frames is not required to improve thermal mass and is surplus to requirements. In fact, the extra mass of heavyweight concrete components may actually increase the energy required to heat and cool the building.



The Slimdek flooring system is a result of extensive research and development work

Innovation in steel

A ceaseless quest for improved performance, efficiency and sustainability drives continuous innovation in structural steel products and processes



The structural A-frame uniting 201, Bishopsgate and the Broadgate Tower, London

Innovation is essential if the construction sector is to meet the UK Government's sustainable development agenda. The steel sector has long embraced innovation, in both product development and process efficiency, to help reduce the carbon footprint of steel construction.

Dedicated research and development

Thorough, long-term and rigorous research and development is at the heart of innovation in the steel construction sector. Dedicated teams at Corus are continuously seeking to improve the environmental and structural performance of steel products and the efficiency of manufacturing, construction and finishing processes.

Recent research and development projects in structural steel include:

- Improving the efficiency of composite floor decks
- Developing improved standard connections
- Improving the thermal performance of building cladding to enable steel-framed industrial buildings to meet the new performance criteria for Part L of the Building Regulations
- Supporting the development of improved fire engineering techniques leading to lower cost fire solutions
- Developing improved methods for corrosion protection
- Developing newer and quicker methods of core construction

- **Photovoltaic metal roof and wall cladding** – Corus is collaborating with Australian company Dyesol – a world leader in dye-sensitised systems – to develop a metal roof and wall cladding product with dye-sensitised solar cell (DSC) functionality. DSC is an emerging photovoltaic technology that mimics photosynthesis in plants.

Innovation and the triple bottom line

While innovation generates an improvement in environmental performance, it also has a positive effect on the economic and social factors of the triple bottom line. For instance, steelwork is increasingly pre-engineered in a way that makes pre-planning of operations easier and more certain; a three

dimensional model of the steel frame can be built in virtual reality, thus facilitating detailed planning of the erection procedure; steel is prefabricated offsite, which increases accuracy and reduces liability to errors that would generate site hazards. All of these things improve health and safety: the number one priority, and a vital socially sustainable factor. Offsite innovation also has a positive economic impact, reducing time required on site, as well as the need for expensive site preliminaries.

Offsite innovations

Offsite product innovations in the steel construction sector include significant developments in the use of light-gauge steel in buildings. Cold-rolled sections have now been widely adopted for

structural elements such as purlins and rails, floor decking, supports for infill walls and demountable partitions and as framing for residential and modular construction.

These developments have increased the use of factory-made precision components in building construction, reducing the need for site-based adjustment and finishing trades.