CPD 5 | SUSTAINABLE STEELWORK SPECIFICATION

This Steel for Life sponsored CPD introduces the first edition of a new Sustainability Specification for structural steelwork and sets out requirements and practices for achieving environmentally sustainable steelwork building construction, including maximal efficiency and minimal waste

Sustainable construction should take into account safety during fabrication, transportation, handling and erection as well as temporary stability of the structural steel frame during construction – and of course the structural adequacy of the design of the structure in the completed project

Introduction

The British Constructional Steelwork Association (BCSA) has published the first edition of the Sustainability Specification for structural steelwork for building construction, which is now freely available at www.steelconstruction.info.

Due to come into force on 1 June, this document will constitute a new Annex J to the National Structural Steelwork Specification for Building Construction (NSSS) when revised in its 8th edition.

Given the current demands to promote more sustainable construction, and particularly in the context of the climate emergency, this document specifies general requirements and practices for achieving environmentally sustainable steel building construction.

This CPD will outline the scope of Annex J, cover the principles of sustainable steelwork building construction, outline guidance for sustainable design of structural steelwork, and look at specification for sustainable fabrication of structural steelwork.

Scope and principles

Annex J supplements the requirements of Clauses 1 to 11 of the NSSS and sets out the basic principles to be followed for sustainable steelwork building construction.

The aim of structural design is to provide a structure capable of fulfilling its intended function and sustaining the specified loads for its intended life, with due regard to sustainability, robustness, economy, and health and safety.

Environmental considerations for sustainable construction should take into account structural adequacy of the design of the structure in the completed project; safety during fabrication, transportation, handling and erection; and temporary stability of the structural steel frame.

All parties in the supply chain for structural steelwork should take practical steps to reduce the greenhouse gas emissions of the processes over which they have control, to contribute to meeting UK commitments to reach net zero carbon by 2050.

Structural steelwork should be designed, procured, detailed and fabricated to minimise material use and to reduce waste, to the extent that this is reasonably practicable.

Steelmaking makes full use of available scrap material, and decisions regarding the choice of steel product to be used – such as plate, section, sheet or reinforcement – should take into consideration that on a global basis this scrap material is a highly constrained resource.

Structural steelwork should be designed and detailed to facilitate its recovery for reuse at its end-of-life stage as part of the circular economy, where this is reasonably practicable.

Requirements for the supply chain

Where possible, implementation of the following practices to minimise the environmental impacts of steelwork construction should be considered.

Project specification may include requirements for the employer to appoint key contractors – for example steelwork, cladding, mechanical and electrical and glazing contractors – as early as possible to ensure packages are fully co-ordinated and to avoid unnecessary reworking.

Early engagement with the steelwork contractor to increase lead-in periods is highly desirable. This enables more efficient planning and co-ordination of site operations and material supply as well as collaboration with the design team.

Similarly, early engagement with the coating system manufacturer and supplier should be a priority to ensure that the coating system used is adequate and its durability is maximised, along »

» with appropriate maintenance to minimise whole-life environmental impacts.

For hot-dip galvanizing, early consultation with the galvanizer is recommended to ensure suitability of the design for galvanizing, such that all work is efficiently processed.

It is also important to maximise structural zones to facilitate lean, efficient designs.

Construction considerations

The project specification may include requirements for the main contractor to ensure early engagement with the supply chain and subcontractors, as well as providing adequate set-down areas to enable transport of fully loaded lorries to site, where possible.

Main contractors also need to ensure the site infrastructure can accommodate energy-efficient plant, and appoint subcontractors with systems that encourage sustainable procurement.

Design considerations

If reclaimed materials are to be considered or specified, then flexibility in the design should be provided to allow for design iterations to reflect the availability of reclaimed materials.

The project specification may include requirements for the engineer to design for material efficiency, with due regard to the practicality and cost of fabrication, and for longevity so that the upfront embodied carbon associated with the structure leads to extended building lifetimes.

Design should also facilitate building flexibility and adaptability and ensure that where complex connections are being considered to reduce material usage, the full fabrication and installation implications have been considered, and any additional waste is considered in material usage and environmental impact assessments.

Similarly, design should consider any temporary works requirements. The use of temporary works, particularly bespoke items that are unlikely to be reused, will increase carbon emissions and should be considered in environmental impact assessments.

Where hot-dip galvanizing has been specified, the possible favourable effect of the galvanized coating on fire resistance should be checked to avoid over-specification.

The carbon emissions associated with temporary works should be considered in environmental impact assessments

Early engagement with the steelwork contractor to increase lead-in periods is highly desirable

Carbon reduction plan

The steelwork contractor may be required to publish a company carbon reduction plan, along the lines of a BCSA template.

A carbon reduction plan can require the steelwork contractor to transport steelwork using low carbon emission vehicles while maximising steelwork loads, taking account of the capacity of the vehicles used.

A plan would also consider any construction site storage or programme constraints, optimise haulage – for example by avoiding empty return trips – and switch from diesel-powered to low carbon emission mobile machinery.

It might also require responsibly sourcing structural materials, engaging with the engineer to explore options for increasing material efficiency, and reducing waste generated during fabrication by re-evaluating internal processes, equipment types, and the sourcing of stock materials.

Guidance for sustainable design of structural steelwork

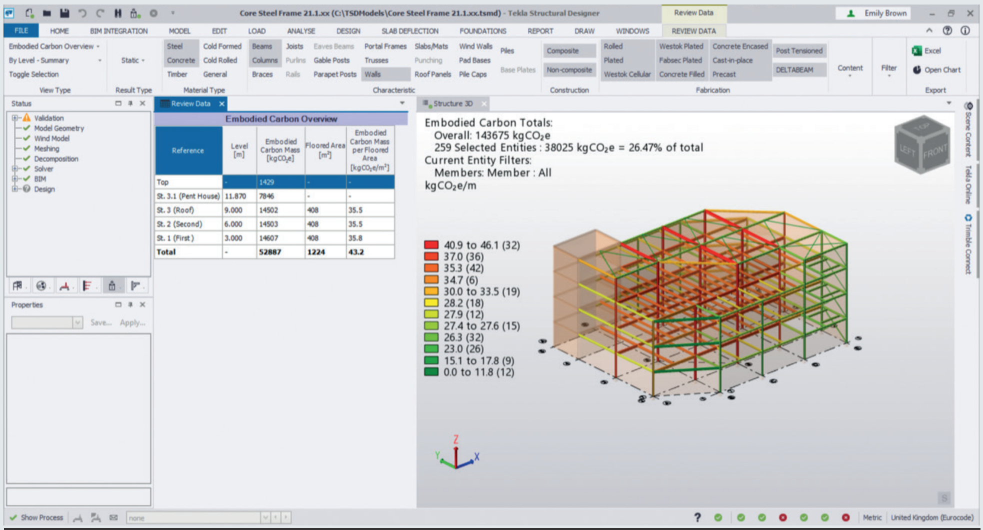
The environmental impacts associated with steelwork building construction may be greatly reduced by taking appropriate decisions during the design process regarding reduction of material in the structure and minimising fabrication, and avoidance of maintenance during service life.

There are many environmental impacts associated with structural steelwork. Of these, greenhouse gas (GHG) or carbon emissions are currently the priority. GHG emissions occur throughout the supply chain, so action is required by all parts of the supply chain for the sector to decarbonise in line with national targets.

This includes supply-side measures, in particular decarbonising steelmaking, and also demand-side measures, including more efficient design and design for longevity, deconstruction and reuse.

Lifecycle assessment

A whole-building lifecycle assessment should be integrated into the design process, rather than focusing on just upfront or cradle-to-gate impacts. The calculation methods for assessing the environmental performance of a building



Calculating embodied carbon correctly is an important part of sustainability considerations

should be based on BS EN 15978.

The assessment should include whole-life (cradle-to-grave and Module D) impacts, which measure all lifecycle phases, including the building's deconstruction and disposal of the materials as waste or through recycling and reuse. Modules – or lifecycle stages – A, B1-B5, C and D should be calculated and reported separately, and assumed scenarios for estimating future impacts should be reported.

When making comparative assessments between materials, products, systems, or design options, the comparison should be done in the context of the whole building, and including all lifecycle stages with functional equivalence defined and justified.

A UK consumption average emissions factor for steel (published by the BCSA) accounts for the varying impacts of steel from different suppliers and is appropriate for embodied carbon assessments during the early design stage where the steel supplier is not known.

Minimising material quantities

Where practicable, the engineer should review design options with the steelwork contractor in an effort to minimise material quantities.

Structural deflection and vibration criteria, co-ordination zones and member depths should be appropriate and allow for efficient structural solutions that avoid excessive material use.

Design for utilisations should be aimed as close to 1.0 (i.e. 100% structural efficiency) as practically possible, with due regard given to permanent and temporary conditions. The use of higher-strength steel grades in members or part of members not governed by serviceability criteria should be considered.

The over-rationalisation of steel member sizes should be avoided to ensure efficient use of material, with due consideration of minimum economic quantities for procurement, and section sizes should be reviewed to minimise weight while complying with safe methods of erection and fire protection requirements.

Design for adaptability and deconstruction

Where practicable, the engineer should review with the steelwork contractor the design options that may contribute to the future flexibility, adaptability, deconstruction and reuse of the building structure.

Such considerations might include how the building design and information records covering the materials and members can facilitate future deconstruction and recovery for reuse and recycling, and ensuring accessibility to members and connections to allow for deconstruction and for ease of strengthening in the future.

Another measure might be greater standardisation of steelwork section sizes, lengths and connections, since this is likely to help ensure the future reuse of structural steelwork. However, a balanced solution, addressing both material efficiency and design for deconstruction and reuse strategies, is required.

Sustainable specification using new steel material – responsible sourcing

All structural steel should be procured based on the principles of responsible sourcing as defined in BES 6001 or equivalent, with the supplier required to have an environmental management system that follows the principles of BS EN ISO 14001 or equivalent.

Where possible, structural steel should be sourced from steel producers that have defined and are implementing a strategy to reduce greenhouse gas emissions and have made a public commitment to decarbonise in line with national and/or international carbon reduction targets.

This includes – but is not limited to – an emissions reduction pathway compatible with the goals of the Paris Agreement, a validated science-based target – for example a target approved by the Science Based Target Initiative – and ResponsibleSteel-certified steel, or steel meeting an equivalent international standard.

Traceability, labelling and marking

The records of the as-erected structure should contain all relevant information to allow the origin and properties of the completed components to be identified to facilitate their reuse in the future.

Aspects of this include geometrical properties for all components, inspection certificates of all steel products, and EPDs for all steel products and any protective treatment systems used.

Other factors to consider should include information on protective treatment, a schedule of proprietary items, and an erection method statement and any information relevant to the

Specification for sustainable fabrication of structural steelwork

Information required by the steelwork contractor:	Information provided by the steelwork contractor:
Any part of the steelwork that is to incorporate reclaimed steel products	All relevant environmental product declarations (EPDs) for the steel and other products
Any part of the steelwork that is to be left untreated	The embodied carbon of the fabricated steelwork
Any details of the fire design, namely the design utilisation per section size in the fire condition	Digital records of the as-erected structure, which should include all environmental, material quality and quantity data, including batch traceability for main structural members, to facilitate future reuse (to be included in the operation and maintenance manual)
Any workshop waste targets	Evidence of having in place an environmental management system
A lifecycle assessment of the whole building	
Any specific material sourcing requirements, for example, products to be sourced from within 500 miles of the project site	

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» disassembly and reclamation of members for reuse – for example, an Industry Foundation Class (IFC) copy of the fabrication detail model and any components that may be unsuitable for reuse, such as fatigue-critical members.

Fabrication waste management

Where possible, the steelwork contractor should consider ordering directly from mills to minimise offcuts. Alternatively, if stock lengths are ordered, these should be used efficiently in order to minimise waste. Splice locations in steel members, where possible, should be co-ordinated to fall within standard stock length sizes.

All steel fabrication waste – offcuts, swarf and the like – should be either reused or recycled.

The steelwork contractor should consider if offcuts of material can be used elsewhere, such as temporary works, connection fittings, shims and packs, rather than simply scrapping for recycling. Reuse should always be prioritised over recycling.

Where possible, the steelwork contractor should consider the use of machines that facilitate common-line cutting of fittings.

The steelwork contractor should have procedures in place to reuse timber load bearers; good practice is to reuse timber bearers between three and five times. Alternatively, steel bearers may be used, along with anti-slip materials, which could also form part of an integrated lifting system for loading and offloading.

Efficient automated fabrication to minimise energy use and waste

To minimise coating waste and coating packaging waste, intermediate bulk containers should be used. Overspray of coatings should be minimised by ensuring operatives are properly trained and that the appropriate and properly maintained equipment is used.

Quality management

Annex J states that the steelwork contractor "shall demonstrate that the management of its operations address sustainability issues relevant to structural steelwork". This can be demonstrated by membership of the BCSA Steel Construction Sustainability Charter.

The BCSA recommends that the steelwork contractor should report the carbon footprint related to its direct operations to the BCSA on an annual basis for statistical purposes.

Implementation

Prepared under the guidance of a steering committee comprised of structural steel suppliers, steelwork contractors, designers and individual sustainability experts from the BCSA, the Steel Construction Institute and the Institution of Structural Engineers, the Sustainability Specification can be incorporated in the contract documentation separately to the NSSS by specifying the following:

- Fabrication in accordance with (i) National Structural Steelwork Specification for Building Construction (NSSS), 7th edition and (ii) NSSS – Annex J – Sustainability Specification.

QUESTIONS

1. The UK has committed to becoming a carbon net zero economy by which year?
a. 2025
b. 2030
c. 2040
d. 2045
e. 2050

2. The calculation methods for assessing the environmental performance of a building should be based on which standard?
a. BS EN 15978
b. BS EN 15979
c. BS EN 15980
d. BS EN 15981
e. BS EN 15982

3. Design should consider any temporary works requirements. The use of temporary works should be considered carefully because they:
a. Can take an exponentially greater time to set up and take down than permanent works
b. Can involve bespoke items that are unlikely to be reused, thereby increasing carbon emissions
c. Have to adhere to stricter building regulations than may be necessary for the finished building
d. Can prove more expensive to erect and dismantle than permanent works
e. Run a greater risk of being rejected at the planning stage than permanent works

4. Structural steel suppliers are required to have an environmental management system that follows the principles of which standard (or equivalent)?
a. BS EN ISO 13998
b. BS EN ISO 13999
c. BS EN ISO 14000
d. BS EN ISO 14001
e. BS EN ISO 14002

5. Why is early engagement with the steelwork contractor to increase lead-in periods desirable?
a. It reduces on-site cost overruns which could result from subsequent design changes
b. It challenges designers to come up with better solutions
c. It enables better planning and co-ordination of site operations, material supply and collaboration with the design team
d. It empowers local government planning departments who can better judge if a scheme should get the go-ahead
e. It gives the end customer of a development more time to consider the design outcome

To complete this CPD, read the module and then answer the questions online at www.building.co.uk/cpd
Closing date: 3 June 2022
CPD credits: 60 minutes