Mat-5 Steel

POINTS AVAILABLE 2

AIM OF CREDIT

To encourage environmentally responsible production, design and fabrication methods that result in efficient use of steel as a building material.

CREDIT CRITERIA

Up to two points are awarded where at least 95% of all steel used in the building's structure complies with the criteria set out below, and is sourced from a responsible steel maker. Points are awarded as follows:

- Where structural steel comprises 60% or more of the total steel used in the structure, one point is awarded for each of the two initiatives met below:
  - At least 95% of all Category A products and at least 25% of Category B products (see Table 1) meet or exceed the nominated steel strength grades and are permanently marked with their strength grade;
  - At least 60% of the fabricated structural steelwork is supplied by a steel fabricator / steel contractor accredited to the Environmental Sustainability Charter of the Australian Steel Institute.
- Where reinforcing steel comprises 60% or more of the total steel used in the structure of the building, one point is awarded for each of the two initiatives met below:
  - At least 95% of all reinforcing bar and mesh meets or exceeds 500MPa strength grade, and at least 60% of all reinforcing steel is produced using energy-reducing processes in its manufacture (measured by average mass by steel maker annually);
  - At least 95% of all reinforcing steel meets or exceeds 500MPa strength grade, and at least 15% (by mass) of all reinforcing steel is assembled using off site optimal fabrication techniques detailed in Table 2.

Where neither structural steel nor reinforcing steel comprises more than 60% of the total steel used in the structure, a combination of any of these criteria as set out above can be used to achieve the credit for a maximum of two points. See Additional Guidance for more information.

If the material cost of structural and reinforcing steels represents less than 1% of the project's total contract value, or there are no new structural or reinforcing steels used in the project, this credit is 'Not Applicable' and is excluded from the points available used to calculate the Materials Category Score.

COMPLIANCE REQUIREMENTS

All benchmark calculations are based on the mass of steel in the building.

Responsible sourcing

For a steel manufacturer or a steel maker to be considered a responsible source of steel for purposes of this credit, they must show that they comply with both of the following initiatives:

- The steel making facilities where the steel for the project is being sourced have a currently valid ISO 14001 Environmental Management System (EMS) in place. Valid ISO 14001 Environmental Management System (EMS) certificates must be provided from the steel making facilities where the structural and/or reinforcing steels in the project were produced; and

- The steel maker supplying the steel is a member of the World Steel Association's (WSA) Climate Action Programme (CAP). A current CAP certificate from the WSA, confirming that the steel maker is a member of the CAP, must be provided. Certificates are valid for a period of two years and must be current at the time that the Green Star documentation is submitted to achieve points for this credit.

Structural Steel

Structural steel products addressed by the credit are limited to those listed in table 1. Products such as roofing, walling, girts, purlins, decking etc. are generally measured in either square metres or linear metres. As this credit requires that all calculations be made based on mass, please refer to a steel weight calculator (such as the calculator found at www.steelselect.com) for conversions or justify another conversion method.

Category A Products	Minimum Strength Grades
Roof sheeting	550MPa
Wall sheeting	550MPa
Profiled-steel decking	550MPa
Purlins	450MPa
Girts	450MPa
Light-steel framing systems*	450MPa
Category B Products	
Hot-rolled structural steels (including plate) (e.g. universal beam and column sections, parallel flange channels, angles)	350MPa
Cold-formed sections (including hollow sections) (e.g. square and rectangular hollow sections, circular hollow sections, cold-formed channels and angles)	450MPa
Welded sections (e.g. welded beams and columns made from plate)	400MPa

Table 1: Minimum Strength Grades for Structural Steel Products

* Light-steel framing systems refers to building framing systems made of lightweight cold-rolled galvanised steel sections.

Permanent Marking of High Strength Steel Grade

The strength grade shall be permanently marked on Category B products by the manufacturer or fabricator. The permanent mark shall:

- Indicate grade of steel with the units of measure (e.g. 350 MPa); and
- For hot rolled structural steels and welded sections the size of characters should be at least 12mm in height and 0.5mm in depth (into the steel product).

Reinforcing Steel

Reinforcing steel includes reinforcing bar and mesh used in concrete reinforcement in the building structure. This includes steel in situ, stressed, and pre-cast concrete applications.

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Energy-Reducing Processes in Steel Production

To comply with this requirement, the reinforcing steel used in the project must be sourced from a steel maker using an energy-reducing process in manufacturing. It must be shown that 60% of reinforcing products, measured as a percentage of annual mass of reinforcing steel produced by the steel maker, are manufactured with this technology.

Energy reduction arising from energy-reducing processes must equate to at least 40 MJ/tonne.

To determine compliance with this benchmark, a lifecycle assessment must be made in accordance with Protocol for Demonstrating Equivalency in Energy Reduction provided in Additional Guidance.

Currently, reinforcing steel products sourced from a steel maker using a Polymer Injection Technology (PIT, as developed by the University of NSW) in manufacturing 60% of their reinforcing products is an acceptable method of demonstrating compliance with this criterion.

Off site Optimal Fabrication of Reinforcing Steel

Off site optimal fabrication of reinforcing steel used in the building structure includes any combination of the design-driven fabrication techniques in Table 2 which optimise laps in mesh and spacing between bars, thereby reducing material and wastage associated with reinforcing steel fabrication and use.

Optimisation Technique	Description
Engineered Reinforcing Bar Carpet	Reinforcing bars fabricated off site for rolling out on site
Engineered / Customised Mesh	Run-to-length meshes, tailored meshes, high ductility meshes, special size meshes, engineered meshes, variable diameter and spacing meshes
Prefabricated Reinforcing Cages	Prefabricated reinforcing cages for concrete elements such as slabs, walls, cores, columns and piles

Table 2: Off Site Optimal Fabrication Techniques for Reinforcing Steels

Off site cutting and bending of bars to be hand-laid on site is not considered an optimal fabrication technique for the purpose of this credit.

DOCUMENTATION GUIDELINES - DESIGN

Submit all the evidence and ensure it readily confirms compliance.

- ☐ Short report
- ☐ Confirmation from the Quantity Surveyor
- ☐ Extract(s) from the specification(s)

Where the cost of steel is less than 1% of the project's total value:

- ☐ Confirmation from the Quantity Surveyor
- ☐ Extract(s) from the contract

Where no new structural or reinforcing steel is specified in the building:

- ☐ Confirmation from the Quantity Surveyor

Short report prepared by a suitably qualified professional providing uses and quantities of structural and reinforcing steel and a summary of the Credit Criteria options that are being claimed. The document must include references to supporting documentation and a description of how each one of the Credit Criteria has been achieved, using calculations and summary tables wherever appropriate. The short report must include the following, based on the Credit Criteria being claimed:

- A list of the quantities (by mass) and strength grades of each of the structural steel products specified in

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accordance with the products listed in Table 1 of the Compliance Requirements.

- A description of the off-site optimal fabrication techniques used in the building's structure; and
- The total quantity (by mass) of reinforcing and/or structural steel specified for the project.

Note: The relevant sections of the As Built Steel Schedule found in Additional Guidance may be used as a guide.

Extract(s) from the specification(s) requiring that at least 95% (by mass) of steel specified for use in the building be sourced from responsible steel makers or steel manufacturers, addressing the substitution clauses, and, where relevant based on the Credit Criteria claimed:

- Specifying the relevant structural or reinforcing steel strength grades, and where relevant, the permanent steel marking requirements.
- Requiring that, as a minimum, the relevant percentage of structural steel be supplied by an ASI accredited steel fabricator or contractor.
- Requiring that, as a minimum, the relevant percentage of reinforcing steel be supplied by a steel manufacturer that uses energy-reducing processes. The benchmark for energy reducing processes must be included in the specification.
- Detailing the optimal off-site fabrication techniques used for all reinforcing steel in concrete and percentage (by mass) of reinforcing steel specified for use in the Project that will be supplied from off-site optimal fabrication.

Confirmation from the Quantity Surveyor providing the quantities (by mass) of structural and reinforcing steel as percentages of the total steel specified in the building structure. (e.g. to demonstrate that either structural steel, or reinforcing bar and reinforcing mesh, comprises 60% (by mass) or more of the total steel specified in the building structure.

Where the credit is claimed as 'Not Applicable'

- Comparing the total cost of the new structural and reinforcing steel products specified in the project against the project's total contract value including extract(s) from the contract that includes the project's total value; or
- Where no new steel products are present, confirming that this is the case. Where this occurs, the confirmation can come from a structural engineer or the architect.

DOCUMENTATION GUIDELINES - AS BUILT

Submit all the evidence and ensure it readily confirms compliance.

☐ Short report

☐ Steel manufacturer ISO 14001 certificate

☐ Evidence of membership to WSA's Climate Action Programme

☐ Confirmation from the Supplier(s)

☐ Confirmation from the Quantity Surveyor

To demonstrate compliance with ASI accreditation, the following is also required:

☐ ASI Certificate of Achievement

To demonstrate compliance with optimal fabrication techniques:

☐ Confirmation from the steel fabricator

Where the cost of Steel is less than 1% of the project's total value:

☐ Extract(s) from the contract

☐ Confirmation from the Quantity Surveyor

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Where no new structural or reinforcing steel is specified in the building:

☐ Confirmation from the Architect or Head Contractor

Short report describing how the Credit Criteria have been met by providing an as-installed steel schedule prepared by a quantity surveyor, cost manager, cost planner, cost estimator, or architect summarising the uses and quantities (by mass) of structural and reinforcing steel by documenting (see examples in Additional Guidance):

- Product and supplier names;
- The Credit Criteria that are being claimed;
- Indication of compliance with the nominated Credit Criteria;
- Quantities (by mass) of installed products; and
- Describing how the Credit Criteria have been achieved and referencing supporting documentation.
- Where optimal steel manufacturing techniques are claimed, the optimal off site fabrication techniques in Table 2 used in the building; and the quantities (by mass) of steel used in each optimal off site fabrication.

Steel manufacturer ISO 14001 certificate from the Steel Making facilities where the structural or reinforcing steel was produced

Evidence of membership to WSA's Climate Action Programme from the Steel Making facilities where the structural or reinforcing steel was produced (See Compliance Requirements.

Confirmation from the Quantity Surveyor providing the quantities (by mass) of structural and reinforcing steel as percentages of the total steel products installed in the building (structural steel and reinforcing steel only).

Confirmation from the Supplier stating, where relevant based on the credit criteria claimed:

- That they are a responsible steel maker, and listing their compliance documentation.
- The total quantities (by mass) of structural and/or reinforcing steel supplied to the building.
- That the high strength structural steel products listed in the steel schedule have been supplied to the buildings and permanently marked as required.

ASI Certificate of Achievement for every steel fabricator or steel contractor demonstrating that each is accredited to the ASI Environmental Sustainability Charter.

Energy-Reducing Processes report from every reinforcing steel maker, explaining the energy-reducing processes used in their steel making process and confirming that it is used in the production of at least 60% of the reinforcement products they produce on an annual basis. (See Polymer Injection Technology and Equivalency Protocol explanations in Additional Guidance). The report must contain a summary of the life cycle assessment result for this technology in accordance with the Equivalency Protocol (see additional guidance).

Confirmation from the Steel Fabricator stating the optimal off site fabrication techniques used, and the quantities (by mass) of steel supplied.

Confirmation from the Quantity Surveyor providing the quantities (by mass) of structural and reinforcing steel as percentages of the total steel specified in the building structure. (e.g. to demonstrate that either structural steel, or reinforcing bar and reinforcing mesh, comprises 60% (by mass) or more of the total steel specified in the building structure).

Where the credit is claimed as 'Not Applicable'

Comparing the total cost of the new structural and reinforcing steel products specified in the project against the project's total contract value including extract(s) from the contract that includes the project's total value.

Or where no new steel products are present, confirming that this is the case. Where this occurs, the confirmation can come from a structural engineer or the architect.

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ADDITIONAL GUIDANCE

Steel Maker

Steel makers are defined as companies that manufacture steel products from raw materials using a steel making process (e.g. Basic Oxygen Furnace or Electric Arc Furnace).

Steel Making Facility

Steel making facilities are production facilities that manufacture steel products from raw materials (e.g. iron ore or scrap metal) or manufacture steel products from slab or billet by reheating and rolling.

Steel Fabricator / Steel Contractor

Fabrication of structural steelwork refers to a process in which a steel member is prepared for assembly and erection. A fabricator will build the product, control production, manage the project, and often deliver and erect. The tasks involved in this process are referred to as Fabrication.

Steel contractors have full contractual responsibility for the structural steel component of the building, including coordination of all trades involved with steel fabrication, erection and detailing. Also included in this definition are any sub-contractors employed by the above performing similar functions.

World Steel Association (WSA) Climate Action Programme (CAP)

The World Steel Climate Action recognition programme is a scheme which recognises that a steel producer has fulfilled its commitment to take part in the world steel CO_2 data collection program.

The data collection program is at the core of the steel industry's global steel sectoral approach to climate change. Based on a common methodology, definitions and agreed boundaries, the data collection programme enables individual steel plants to compare themselves against both average and best performance and identify its scope for improvement.

Australian Steel Institute (ASI) Environmental Sustainability Charter (ESC)

The ASI has created the ESC as part of an overarching program of steel stewardship, seeking to engage the whole steel supply chain in adopting more environmentally sustainable behaviour. This Charter is directed at the downstream manufacturing, fabricating and supply companies who are an integral part of the entire supply chain.

Polymer Injection Technology (PIT)

Polymer injection involves the use of polymers (e.g. rubber from used car tyres) as a partial substitute for coke and as an alternate carbon injectant to produce foaming slag in Electric Arc Furnace (EAF) steel making.

This technology holds environmental benefits in the form of:

- Reduced energy consumption;
- Lower greenhouse gas emissions;
- Reduced quantities of injectants; and
- Reduced emission levels for NOX CO and SO_2.

Protocol for Demonstrating Equivalency in Energy Reduction (Equivalency Protocol)

The Equivalency Protocol is based on the same LCA methodology used in the Polymer Injection Technology (PIT) study by PE-Australasia and the University of New South Wales (PE and UNSW 2010) used to inform this credit. The energy reduction equivalency benchmark relates to the energy reduction outcomes from using PIT in an Electric Arc Furnace (EAF) steel manufacturing plant compared with standard Coke Injection Technology (CIT).

The methodology can be summarised as follows:

- Lifecycle Assessment generated in accordance with internationally applicable LCA techniques specified in ISO 14040:2006 (Environmental management - Life cycle assessment - Principles and framework) and ISO 14044:2006 (Environmental management - Life cycle assessment - Requirements and guidelines);
- The function considered is the production of steel billet. Other functions relating to the generation of co-products from steel production to be allocated on the basis of procedures recommended in ISO 14044:2006;
- The functional unit is 1 tonne of steel billet;
- The standard measure for Energy in MJ;
- Boundary conditions are 'cradle to gate', meaning all production stages from raw materials mined (cradle) to finished steel billet ready to be converted to products (gate);
- Carbon Footprint calculated and reported in terms of scope 1, 2 and 3 emissions, as defined according to World Business Council for Sustainable Development / World Resources Institute Greenhouse Gas Protocol, Corporate Accounting and Reporting Standard (WBSCD/ WRI, 2004); and
- A single independent peer review conducted on the LCA according to ISO 14044:2006.

As Built Steel Schedule Templates

For Green Star - As Built submissions, the quantities and percentages of product both compliant and non-compliant to the credit criteria must be demonstrated using the following Steel schedule template:

Criteria 1 – High Strength steel:

Category A Products:

Category A Products	Standard Grade (tonnes)	High Strength (tonnes)
Roof Sheeting	0	50
Roof Sheeting	0	5
Wall Sheeting	0	25
Profiled Steel Decking	0	100
Prurlins	0	5
Girts	0	5
Light-steel framing	2	0
Other Miscellaneous	1	0
Total	**3**	**190**
Percentages	**2%**	**98%**

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Category B Products:

Category B Products	Standard Grade (tonnes)	High Strength (tonnes)
Hot rolled structural	375	125
Hot rolled structural	20	0
Welded Sections	10	10
Square Hollow Sections	0	30
Circular Hollow sections	5	0
Total	**410**	**165**
Percentages	**71%**	**29%**

More than 95% of Category A products meet the minimum strength criteria and More than 25% of Category B product meets the minimum grade requirement therefore credit criterion 1 is claimed.

Criteria 2 – Fabricator/Contractor accreditation to the ASI ECS:

Product	Non ASI - ESC Fabrication (tonnes)	ASI - ESC Fabrication (tonnes)
Fabricator 1	100	-
Fabricator 2	-	250
Total	**100**	**250**
Percentages	**29%**	**71%**

More than 60% of fabricated steel comes from a fabricator with the Australian Steel Institute's Environmentally Sustainable Charter. Therefore credit criterion 2 is claimed.

Criteria 3 – Use of energy reducing technologies in steel manufacture:

Reinforcing steels grades:

Product	Grade	
	<500 Mpa (tonnes)	≥ 500MPa (tonnes)
Reinforcing Bar	0	205
Mesh	0	50
Total	**0**	**255**
Percentages	**0%**	**100%**

Strength Grade requirement met for more than 95% of steel in concrete products therefore credit criterion 3 is claimed.

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Product	Reinforcing Steel(tonnes)	Manufacturers' annual average production using Energy Reducing Technologies (ERT) (%)	Average mass of ERT Steel
Reinforcing Bar – Supplier 1	205	73	150
Mesh – Supplier 1	40	73	28
Mesh Supplier 2	10	0	0
Total	**255**		**178**
Percentages = 178/255 =			**69%**

Steel in concrete products produced from using energy reducing processes is greater than 60% therefore credit criterion 3 is claimed.

Criteria 4 – Optimised off-site fabrication of reinforcement steel:

Reinforcing steels grades:

Product	Grade	
	<500 Mpa (tonnes)	≥ 500MPa (tonnes)
Reinforcing Bar	0	205
Mesh	0	50
Total	**0**	**255**
Percentages	**0%**	**100%**

Strength Grade requirement met for more than 95% of steel in concrete products.

Description	Product Name	Tonnes
Reinforcing Carpet	Carpet Mesh	20
Custom meshes	-	20
Prefab Cages	-	20
Total		**60**
Percentages = 60/255 =		**24%**

More than 15% of reinforcing steels is prefabricated off site, therefore credit criteria 4 is claimed.

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BACKGROUND

The production of steel is an energy-intensive process. Strezov and Herbertson (2006) reported a net process energy consumption ranging from 12 to 43GJ/tonne (figures are based on a worldwide steel production figures for various steel product). In addition, the extraction of raw materials requires a substantial amount of energy.

There are many other environmental impacts, in addition to greenhouse gas emissions (GHG), that are associated with the steel manufacturing process and which can be mitigated through the application of the credit criteria. Other environmental impacts associated with steel manufacturing include, but are not limited to:

- Emissions (other than GHG, such as sulphur oxides (SOX) and nitrogen oxides (NOX) from mining, production and transport;
- Destruction and fragmentation of habitat, with subsequent effects upon biodiversity, through mining activity;
- Depletion of raw materials;
- Local air pollution from, for example, dust and small particles.

Use of recycled steel is the most significant opportunity for reducing many of these impacts (Norgate, 2004, Gaballah and Kanari, 2001, Strezov and Herbertson, 2006, NSW Department of Environment and Conservation, 2005). The Australian steel industry recognises this, and is recycling approximately 90% of available construction, demolition and industrial (CD&I) scrap steel per annum (Hyder, 2009). The credit therefore is concerned with other opportunities for reducing the environmental impacts arising from the use of structural and reinforcing steel.

Reducing the total amount of material used for a given purpose will help to reduce a project's overall impact. This credit aims to reward such dematerialisation through the use of high strength steel, and by encouraging off site fabrication of reinforcement steel.

Energy-reducing technologies are encouraged in the credit as these represent a readily available opportunity for steel manufacturers wishing to reduce the energy demand of their products. The use of independent lifecycle assessment, in establishing energy reductions arising from the application of a particular technology, ensures transparency and accountability in assessing such technologies for compliance to the credit criteria.

Measurement and benchmarking of greenhouse gases is a crucial pathway towards encouraging, developing and enacting company-specific and industry-wide initiatives for reducing CO2 emissions in the steel industry (WSA, 2010). The credit aims to facilitate such information dissemination through encouragement of suppliers that are certified to the World Steel Association Climate Action Program.

A permanent mark on a higher strength steel member will identify it as such when the structure is disassembled. This will allow the member to be readily reused to its full potential at its higher strength capacity rather than as a standard strength member.

The credit is not based on full lifecycle assessment (LCA) comparisons of steel products. There is merit in assessing the relative environmental impacts of products and materials by conducting full LCAs of products in various categories. Currently there are barriers to the implementation of such an approach and use of LCA in establishing specific benchmarks (e.g. kgCO2 per tonne in various steel product categories). The credit therefore rewards relative reductions rather than absolute reductions. Future work by the GBCA may involve the application of Life Cycle Analysis to compare the absolute impacts of steel.

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