AS/NZS 5131 - STRUCTURAL STEELWORK FABRICATION AND ERECTION

IMPLEMENTATION GUIDE FOR ENGINEERS, SPECIFIERS AND PROCURERS

1. BACKGROUND AND CONTEXT

1.1 Background

The Australian Industry Group (AiG) (Ref. 1) found that 95 percent of respondents surveyed in the steel product sector reported non-conforming product in their supply chain. The guide authored by a broad cross-section of industry and published by the Australasian Procurement Construction Council (APCC) entitled 'Procurement of construction products – A guide to achieving compliance' (Ref. 2) addresses these concerns by providing both an informed understanding and a set of guiding principles which all stakeholders should reference.

There is a fundamental question that impacts on all stakeholders in the industry and is implicit in ensuring conformance to the Work Health and Safety Act and Regulations and that is: **"How can you warrant the safety of a structure if you cannot confirm that the safety critical construction products utilised in that structure are compliant?"** Addressing that question as far as is reasonably practicable goes to the core of the ASI's efforts to support industry on this journey, in respect of structural steelwork.

1.2 Context

The Australian community requires project costs to be balanced against a basic requirement that steel products be manufactured and installed to performance requirements meeting Australian Standards and to operate safely. To achieve this, all products and fabricated assemblies must meet the performance requirements of the relevant Australian Standards specified, regardless of country of origin.

The current regime of self-inspection and certification demonstrably does not work (Refs 1, 2). Currently compliant Australian fabricators are being penalised through cheaper, but non-compliant, suppliers putting steelwork, a safety critical component of construction, under risk of failure and costly rework.

The **National Structural Steelwork Compliance Scheme** (NSSCS) (Ref. 3) is a purpose-built compliance regime that seeks to provide a balance between quality, safety and cost. The NSSCS is a quality compliance and certification system for supply, fabrication and erection of structural steelwork based on the principles of the European Standard EN 1090 (which exists within a regulatory system including CE Marking) and is compatible with the design Standards AS 4100 (structural steelwork) (Ref. 4), AS 5100 (bridges) (Ref. 5) and supporting Australian Standards including those for welding, bolting and corrosion protection.

The NSSCS is intended to cover the majority of structural steel fabrication in Australia.

The NSSCS is based on four supporting initiatives, as indicated in Figure 1, comprising:

1. **Fabrication Standard**: the new AS/NZS 5131 'Structural Steelwork – Fabrication and erection' (Ref 6) provides the technical foundation for the NSSCS.
2. **Conformity Assessment**: is the determination that a product, process, service or system conforms to specified requirements. In this instance the specified requirements are defined in AS/NZS 5131. The framework that defines conformity assessment to AS/NZS 5131 is used by **Steelwork Compliance Australia** to assess conformity of fabricators.
3. **Steelwork Compliance Australia (SCA)**: SCA has been set up by ASI as an independent certifying authority, with the aim of certifying fabricators to the risk-based 'Construction Category' classification embodied in AS/NZS 5131.
4. **Risk Identification**: AS/NZS 5131 requires the engineer to classify the structure or part thereof into one of four '**Construction Categories**' based on risk to human life of failure and the type of loading and complexity of fabrication involved in fabricated structural steelwork.

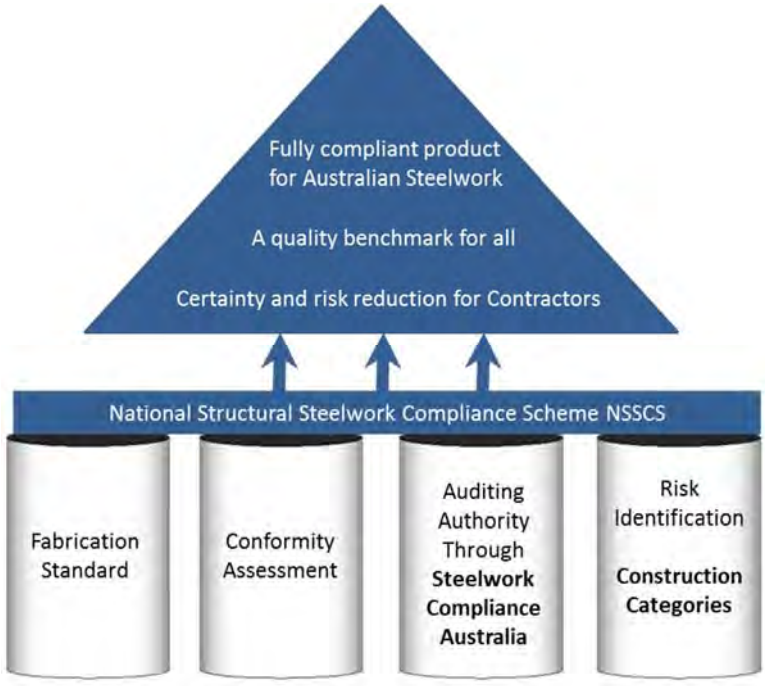

FIGURE 1 NATIONAL STRUCTURAL STEELWORK COMPLIANCE SCHEME (NSSCS) STRUCTURE

1.3 Engineering context and responsibilities under AS/NZS 5131

As the principal technical authority in the project supply chain, the design engineer has certain responsibilities under AS/NZS 5131. These responsibilities are straightforward and likely to be easier to handle and more defendable than any existing compliance process the design engineer may have been involved in. The responsibilities include:

1. Nominating the 'Construction Category' for a particular structure or component therein. In most instances this will be obvious and already established through industry best practice and guidance from the ASI and/or other professional bodies. Guidance on suggested generic classifications is provided in Section 2.5 of this Technical Note.

2. Ensuring that, for the scope of work for which the design engineer is contracted, the construction specification has suitable wording to reference the Standard and the necessary project-specific detail selections. In most cases, the scope already covered in the Standard will allow project specifications to be much simpler and more 'standardised'. To support

implementation of AS/NZS 5131, ASI has developed the 'National Structural Steelwork Specification' (NSSS). See Section 6 for further detail.

3. Where contracted to do so, checking the submittals for materials and fabrication to confirm conformity. If the fabricator is certified, the documentation provided will be available, complete and verifiable.

4. Providing project-specific certification as is currently required.

The following sections of this Technical Note provide the implementation guidance necessary to immediately action these responsibilities as noted below:

Section 2 overviews the fundamental structure of AS/NZS 5131.

Section 3 provides guidance on the determination of the Construction Category. This determination is strongly aligned to the current definition of the building or structure Importance Level, as defined in the National Construction Code (NCC), and should therefore be straightforward for the engineer to assess. For projects for which the NCC is not applicable, the determination of the Construction Category is also straightforward. Refer to Section 3.6.

Section 4 defines **required** and **optional** additional information that must be included as part of the construction documentation for the project. The required additional information should be included in full but may be divided between the drawing notes and the project specification, as appropriate. The optional additional information may be included as part of the construction documentation for the project, either on the drawing notes or in the project specification.

Section 5 discusses the project responsibilities that need to be assigned, typically by the contractual documentation.

Section 6 highlights the requirements in AS/NZS 5131 that are specifically associated with each Construction Category.

Section 7 discusses the new **National Structural Steelwork Specification** (NSSS) as the implementation tool for actioning the AS/NZS 5131 requirements in current practice. Adoption of the NSSS makes implementation of AS/NZS 5131 straightforward for engineers, specifiers and procurers.

1.4 Responsibilities of other stakeholders

Robust compliance requires all stakeholders in the supply chain to meet certain requirements, to ensure the timeliness and veracity of information matches the performance expectations implicit in AS/NZS 5131. It is also important each stakeholder understands what to expect from the rest of the supply chain.

In summary, responsibilities of other stakeholders include:

The Builder:

- Establishes in contracts clear responsibilities for meeting the requirements of the Construction Category nominated by the engineer.
- Employs fabricators that have the demonstrated capability of producing to the required construction category. For improved efficiency and compliance outcomes, utilising a certified fabricator is recommended. Fabricator certification status is easily checked from the SCA website www.scacompliance.com.au.
- Directs that the requisite project-specific compliance documentation is to be assembled, packaged and submitted to regulatory authorities (usually building certifier).
- Manages compliance to the relevant WHS Act, in particular as regards the duty of care for product compliance.

The certified Fabricator:

- Is audited by an accredited Steelwork Compliance Australia (SCA) certifier and obtains certification to the nominated construction category.
- Maintains the certification with annual audits.
- For a specific project, ensures that the processes and documentation are consistent with the requirements of the Standard for the particular Construction Category.
- Provides the Declaration of Compliance (DoC) for the fabricated products covered.

The Steel Distributor:

- Provides test certificates with steel supplied. Where not ACRS Certified and requested by the fabricator, provide 'Declaration of Compliance'.
- Maintains traceability through necessary documentation.
- If a distributor is a 'steel processor', then they are required to undertake some of the requirements of the certified fabricator (to maintain integrity).

1.5 Benefits of the NSSCS

The benefits of the NSSCS are significant, with a known and defendable industry-accepted quality benchmark for project-specific selection and, in effect, a **national technical prequalification system** that packages project compliance for straightforward review and sign-off. The implementation is straightforward and easily actioned through standardised drawing notes and specification clauses, as further detailed in Section 7.

2. THE STRUCTURE OF AS/NZS 5131

The overarching organisational structure of AS/NZS 5131 may best be thought of as comprising three layers:

a) **Good practice:** The significant majority of AS/NZS 5131 is simply good practice, based on what was defined in AS 4100, our other Standards and input from international Standards, in particular those from North America, Canada, Europe and the UK.

b) **Risk-based approach**: The engineer selects the Construction Category as described in Section 3 of this Technical Note.

c) **Project-specific selections**: The Standard defines a number of inputs where the construction specification either must or may provide choices (refer Section 4 of this document for further information). These mandatory and optional choices provide the capacity for the construction specification to tailor AS/NZS 5131 requirements to suit a specific project. The 'National Structural Steelwork Specification' (refer Section 7) highlights these as 'particular requirements' and makes it straightforward for the specifier to action AS/NZS 5131 requirements.

3. GUIDANCE ON THE DETERMINATION OF THE CONSTRUCTION CATEGORY IN AS/NZS 5131

3.1 Background

The selection of a '**Construction Category**' as applicable to a steel structure or components therein is a risk-based approach intended to provide consistency with the reliability-based philosophy and principles on which the fundamental load assessment (AS/NZS 1170 series) and structural design (AS 4100 and AS 5100) are based. The approach translates into a fit-for-purpose assessment that ensures the fabrication and erection of steel structures is based on a rational risk assessment, recognising the importance of the structure, what maintenance and inspection

measures will be in place, the consequences of failure and the complexity of the fabrication and erection.

AS/NZS 1170 series (Ref. 7) is based on the philosophy and principles set out in ISO 2394 entitled 'General principles on reliability for structures' (Ref. 8), which provides a common basis for defining design rules relevant to the construction and use of a wide variety of buildings, bridges and civil engineering works. It includes methods for establishing and calibrating limit states design standards. The required reliability is related to the expected social and economic consequences from a design failure. Significantly, the required reliability may be achieved through suitable combinations of the following measures:

a) Measures related to design, such as choice of values of action variables, reliability of design calculations, accuracy of mechanical models used and the like.

b) Measures relating to quality assurance, to reduce the risk of hazards from gross human errors, design and execution (fabrication and erection).

The Construction Category classification provides a fit-for-purpose level of quality assurance to reduce risks associated with fabrication and erection. It achieves this through reliability differentiation from inspection and supervision levels.

AS/NZS 1170.0 references the 'importance level' for the building or structure as the primary indicator of the relative risk to life in extreme events (consequences of failure), and is based on the philosophy and principles set out in ISO 2394. For Australia, the importance level is defined in the Building Code of Australia (BCA) (Ref 9). For New Zealand, Section 3 of AS/NZS 1170.0 is utilised.

The 'importance level' is one component of the risk assessment that provides the basis for the evaluation of the Construction Category. Other components reflect the type of loading the structure is subjected to and the complexity of the fabrication. Taken together, these components formalise the reliability differentiation that is included in ISO 2394 and is implicit within AS/NZS 1170.0.

3.2 Context

This section provides guidance on the choice of the Construction Category relevant to the building or structure as a whole or to components of the structure where it is appropriate to assign different Construction Categories to different components. The guidance is based on what is contained in Appendix C of AS/NZS 5131.

NOTE: The process outlined for defining a Construction Category is consistent with the philosophy and principles on which AS/NZS 1170.0 is based and intended to provide a level of consistency between the basis for the design assumptions and those for the ensuing fabrication and erection for the building or structure.

The determination of the Construction Category is undertaken in the design phase, based on the known loading for the building, the intended function, what maintenance and inspection measures will be in place, the elements that comprise the structure and the expected complexity of fabrication or erection for the structure. The construction documentation, comprising drawings and specifications, should embody the specifics of these decisions and the mandatory and optional information necessary to fully define the requirements for the chosen Construction Category or categories. The NSSS (refer Section 6) does this.

3.3 Input factors determining the choice of Construction Category

The selection of the Construction Category defined in Section 3.4 is based on three input variables:

- The 'importance level' which reflects the risk to life and consequences of failure (refer Section 3.3.1).
- The 'Service Category', which reflects the actions to which the structure and its parts are likely to be exposed, such as earthquake or fatigue (refer Section 3.3.2).

- The 'Fabrication Category', which reflects the complexity of the fabrication of the structure and its components (refer Section 3.3.3).

3.3.1 Importance level

The Building Code of Australia (for Australia) or Section 3 of AS/NZS 1170.0 (for New Zealand) defines the 'importance levels' for different structure types. Importance levels are designated from 1 (representing the lowest risk to life) up to 4 (representing the highest risk to life and/or post disaster recover functions). An additional importance level of 5 is designated for New Zealand only, representing special structures outside the scope of the Standard.

NOTE: There is no provision in the BCA or in AS/NZS 1170.0 for designating parts of a structure with different importance factors.

3.3.2 Service Category

The selected Service Category reflects the uncertainty in the exposure of the structure to actions that may expose flaws in the structure during use. The Service Category is selected based on Table 3.1.

TABLE 3.1

SUGGESTED CRITERIA FOR SERVICE CATEGORIES

Service Category	Criteria
SC1	• Structures or components designed for predominantly quasi-static actions only. Examples include typical multi-level buildings, warehouses and storage facilities; or, • Structures and components subject to low seismic demand (Categories 3, 4 systems in New Zealand and earthquake design Categories I and II in Australia); or, • Structures and components designed for low level fatigue actions where fatigue assessment is not required (for example, for applications that satisfy AS 4100 Clause 11.4 or cranes classified S1-3 according to AS 1418.1).
SC2	• Structures and components with members and connections subject to fatigue assessment in accordance with AS 4100, AS 5100 or NZS 3404.1. Examples include road and railway bridges, cranes and immediate supporting structure (where supported off the building or structure) and structures susceptible to vibrations produced by wind, crowds or vibrating machinery; or, • Structures and connections subject to medium to high seismic demand (Category 1, 2 systems in New Zealand and earthquake design Category III in Australia).

The structure or part of the structure can contain components or structural details that are categorised under different Service Categories.

NOTE: The Service Category is also used to assess the recommended extent of non-destructive examination (NDE) of welds (see Table 13.6.2.2(A) of AS/NZS 5131) and therefore should be nominated in the Construction Specification or on the project drawings.

3.3.3 Fabrication Category

The selected Fabrication Category reflects the complexity of the fabrication inherent in the structure or parts of the structure. The Fabrication Category is selected based on Table 3.2.

TABLE 3.2

SUGGESTED CRITERIA FOR FABRICATION CATEGORIES

Fabrication Category	Criteria
FC1	• Non-welded components manufactured from any steel grade products; or, • Welded components manufactured from steel grade components less than or equal to Grade 450.
FC2	• Welded components manufactured from steel above Grade 450; or, • Site welded components essential for structural integrity; or, • Components receiving thermic treatment during manufacturing; or, • Components of CHS trusses requiring end profile cuts.

The structure or part of the structure can contain components or structural details that are categorised under different Fabrication Categories.

3.4 Determination of the Construction Category

The Construction Category may be determined by the process outlined in Appendix C of AS/NZS 5131, which in summary is:

1. Selection of the building or structure importance level, from either the Building Code of Australia (for projects in Australia) or Section 3 of AS/NZS 1170.0 (for projects in New Zealand). For buildings or structures not covered by the BCA, use Section 3 of AS/NZS 1170.0.
2. Selection of the Service Category (refer Table 3.1).
3. Selection of the Fabrication Category (refer Table 3.2).
4. Determination of the Construction Category from Table 3.3.

TABLE 3.3

RISK MATRIX FOR DETERMINATION OF THE CONSTRUCTION CATEGORY (FOR AUSTRALIA)

Importance level		**1**		**2**		**3**		**4**	
Service Categories		**SC1**	**SC2**	**SC1**	**SC2**	**SC1**	**SC2**	**SC1**	**SC2**
Fabrication Categories	**FC1**	CC1	CC3	CC2	CC3	CC3	CC3	CC3	CC3
	FC2	CC2	CC3	CC2	CC3	CC3	CC3	CC3	CC4

NOTE: The determination of the Construction Category is the responsibility of the designer, taking national provisions, published guidance from industry associations and the relevant Work, Health and Safety regulations and Codes of Practice into account.

3.5 Generic classification of structure types

In general, each structure or part thereof should be classified into a construction category based on the project-specific aspects and how they affect the three input factors used to calculate the Construction Category, as outlined in Section 3.4.

However, in practice, the range of variation for the input factors for many structure types is quite limited, which then allows some generalisations to be made and 'typical' structures classified into one of the four Construction Categories. In time, these classifications of typical structures will become 'accepted practice' and it is only unusual or exceptional project-specific circumstances that would result in a structure being classified in a different Construction Category.

A generic classification of typical structures is shown in Table 3.4, based on Australian conditions.

It is important to note that the guidance on determination of the Construction Category provided in Appendix C of AS/NZS 5131 is INFORMATIVE. Whilst many structures will naturally fall into one or other of the Construction Categories, and hence we can reasonably suggest the classification of typical structures as provided in Table 3.4, there will always be a need for the engineer, as the professional involved in design of the structure who best understands the functional aspects and design basis, to assess the input parameters and provide a judgement as to the most appropriate Construction Category.

Not all structures can be classified in a straightforward manner for the 'importance factor' based on the BCA and guidance. Special purpose and important structures, such as road and rail bridges, would generally be designed for fatigue and the relevant authorities would require these to be fabricated to Construction Category 3 as a minimum. Similarly, road signage and structures over road and rail lines might be classified as Construction Category 3 by the relevant authorities.

This highlights the important point that for certain structure types, the relevant professional authority, or even the client, may require the structure to be fabricated to a specific Construction Category. Provided the category is not less than what the engineer would rationally judge, the mandating of a specific Construction Category by a professional authority or client is possible. However, in the interests of fit-for-purpose, rational, cost-effective solutions, over-specification via higher Construction Categories than required should not be encouraged.

TABLE 3.4

GENERIC CLASSIFICATION OF STRUCTURE TYPES

Construction Category	Typical structures
1	• Gates, handrails, agricultural buildings (no people congregating), greenhouses
2	• Commercial, residential, educational buildings, not exceeding 15 storeys • Hospitals and healthcare facilities with a capacity less than 50 residents and not having surgery or emergency treatment facilities • Warehouses • Industrial buildings
3	• Bridges • Structures or sub-structures designed for fatigue actions • Commercial, residential, educational buildings of 15 storeys or greater

	• Hospitals with surgery or emergency treatment facilities • Healthcare facilities having a capacity of more than 50 residents • As specifically required in authority construction specifications
4	• Structures with extreme consequences of structural failure • As required by national or project-specific provisions • Special structures (long span bridges, power stations etc.)

3.6 Application to non-NCC structures and the WHS Act

A number of structure types are not covered under the requirements of the National Construction Code (NCC) typically but not exclusively, specialised structures associated with some resource and infrastructure related projects. However, the relevant Workplace Health and Safety (WHS) Act and regulations are applicable and there is the need to demonstrate duty of care for all project types. The ASI has drawn definitive correlation between the WHS Act (Qld) and product compliance, which is available from our website at http://steel.org.au/key-issues/compliance/whs-2011/ (Ref. 10).

In respect of classification of a structure into a Construction Category, the principles and rationale embodied in AS/NZS 5131 apply equally well to non-NCC structures and it is usually straightforward to assess an 'importance level' (from the NCC) and subsequently a Construction Category for these structures.

4. ADDITIONAL REQUIRED AND OPTIONAL INFORMATION

4.1 Context

AS/NZS 5131 represents a foundation of 'good practice' that is considered appropriate across all projects. In order to make that foundation specific to particular projects, AS/NZS 5131 presents a range of 'particular requirements' where the user needs to make choices, some mandatory, some optional, around selections for the specific project.

For convenience of the user, Appendix B of AS/NZS 5131 summarises particular requirements that are in the body of AS/NZS 5131 and relate to choices that the user needs to make for a specific project. In general, the responsibility for defining and documenting those choices is placed on the 'Construction Specification'. This information needs to be specifically addressed either in drawing notes, the project specification, or both. Which items appear in the drawing notes and which in the project specification is left to company policy.

4.2 Required additional information

The **required** additional information is defined in Table B1 of AS/NZS 5131. This **required** additional information must be included in full in the construction specification where the relevant aspect is within the scope of the project.

4.3 Optional additional information

The **optional** additional information is defined in Table B2 of AS/NZS 5131. This **optional** additional information may be included in the construction specification where the relevant aspect is within the scope of the project.

5. RESPONSIBILITIES TO BE ASSIGNED

5.1 Context

As with any project, it is vitally important that responsibilities for actioning requirements on a construction project are clearly defined. Without clear assignment of responsibilities, there is increased potential that actioning or checking of requirements may slip through without being addressed, which may lead to a heightened risk profile.

The drafting rules for Australian Standards (Ref. 13) do not allow responsibilities to be assigned, viewing this as contractual. However, stating what responsibilities exist for the sake of clarity, is allowable.

5.2 Responsibilities to be assigned

Appendix B.3 of AS/NZS 5131 outlines requirements where the responsibility for actioning these on a project basis is not defined and will depend on the contractual arrangements. The table does not represent the only areas of responsibility that need to be addressed, only those where current construction practice may vary between projects.

6. REQUIREMENTS RELATING TO EACH CONSTRUCTION CATEGORY

6.1 Context

AS/NZS 5131 represents a foundation of ‘good practice’ that is considered appropriate across all projects. However, it was not considered appropriate that all projects should be treated with equal risk. The ‘Construction Category’ assignment recognises this and AS/NZS 5131 ties certain requirements to each Construction Category. In effect, a risk-based fit-for-purpose layer sits on top of the body of the Standard representing good practice.

6.2 Requirements relating to each Construction Category

For convenience of the user, Appendix B.4 of AS/NZS 5131 summarises the particular requirements relating to each Construction Category that are detailed in the body of the Standard.

7. NATIONAL STRUCTURAL STEELWORK SPECIFICATION (NSSS)

7.1 Context

AS/NZS 5131 places significant reliance on the ‘Construction Specification’ to define the project- specific variables. The Construction Specification includes technical specifications, the project drawings and associated documentation. ASI has recently published the ‘National Structural Steelwork Specification’ (NSSS) (Ref. 11) to support the pragmatic and effective implementation of AS/NZS 5131.

The intent of the NSSS is to standardise the development of structural steel related project requirements across Australian practice, which will significantly improve efficiencies in project delivery, cost, quality, compliance and long term value. In combination with the ASI ‘National Structural Steelwork Compliance Scheme’ (NSSCS) and contingent certification of fabricators, our community can expect risk-minimised fit-for-purpose value-engineered outcomes for structural steelwork projects in Australia.

7.2 Structure

As detailed in Section 2, AS/NZS 5131 represents a foundation of 'good practice' that is considered appropriate across all projects, and includes a range of additional **required** and **optional** information, the selection of which is based on project-specific requirements.

Consequently, the NSSS is structured in such a way as to minimise reference to redundant requirements that are already called up in AS/NZS 5131. Rather, focus is placed on those requirements where choices are required for project-specific selections. In general, these are classified as 'Particular Requirements' in the NSSS specification.

7.3 Implementation

The documentation for the NSSS is free to download and implement for client specifications, available from the ASI website (Ref. 11). ASI has also worked closely with NATSPEC (Ref. 12) to ensure the corresponding NATSPEC specifications for structural steelwork and the NSSS are aligned.

7.4 Standard drawing notes

Notes utilised on the project drawings should be consistent with the project specification and provide specific detail where necessary. A set of Standard Drawing Notes is available as part of the package of information included under the NSSS.

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