ASCERTAINING COMPLIANCE OF STRUCTURAL STEEL

Synopsis

This Technical Note provides a risk-based fit-for-purpose actionable approach to ascertaining the compliance of structural steel to meet the performance intent mandated by the NCC and Australian Standards. The developed 'steel verification protocol' allows stakeholders to make an informed judgement on the most appropriate conformity assessment pathway.

This Technical Note has been reviewed by a panel of industry stakeholders, as detailed in Appendix A. Their support is gratefully acknowledged.

OUTLINE

1. INTRODUCTION

1.1 Context

The procurement, fabrication and erection of structural steelwork for buildings, infrastructure and resources projects involves a supply chain that is as varied as it is long. Contractual relationships and commercial and political pressures all influence the ultimate procurement scenario, which can also change markedly over the period of project delivery. The Regulatory environment is also continually recalibrating, influenced by tensions that exist between our obligations under World Trade Organisation (WTO) requirements for free trade, performance solutions enabling innovation and the most fundamental requirements to ensure our community can expect risk-minimised safe solutions for their workplaces and habitation.

The steel utilised in a project typically passes through a number of stakeholders in its journey along the supply chain from the manufacturer to inclusion in the steel structure on site. The quality and traceability of the steel utilised in a project is therefore ultimately dependent on a number of parties in the supply chain. If any link in this chain is broken, traceability of the product is lost and the ability to ascertain compliance compromised. Where steel is sourced internationally the same principles apply but overlaid with the additional requirement to ensure the steel meets the performance requirements of the NCC and Australian Standards.

Given the complexity and fluidity of supply chains in today's procurement environment, meeting duty of care for stakeholders can be challenging. There is a need to establish a common understanding of the requirements and clearly articulate responsibilities for all parties in the supply chain. The '*Steel Verification Protocol*' outlined in this Technical Note establishes a methodology to ascertain compliance and works in concert with the '*Steel Procurement Framework*' outlined in Section 9, the latter establishing stakeholder responsibilities.

As with the majority of construction products, structural steel product intended for the Australian marketplace must meet the performance intent of:

a. The National Construction Code (NCC) (Ref. 1) for project types covered under the NCC.
b. The Australian Standards called up in either the contractual documentation (usually the specification) and/or the NCC as applicable to the project type.

This includes both the permanent steelwork and the temporary steelwork required to construct the permanent structure.

Regardless of the type of project, the compliance pathways specified within the NCC provide a robust performance-based approach that should be applied to all project types.

Separate and overarching, the Workplace Health and Safety Act (Ref. 2), Regulations and Codes of Practice provide a basis for ascertaining responsibilities and duty of care for all stakeholders.

The recommendations on ascertaining compliance in this Technical Note are based on three significant principles:

1. The performance framework established by the NCC.

2. The basic principles of duty of care established under Workplace Health and Safety legislation, and
3. The quality benchmark established by the relevant Australian Standards.

The primary focus of this Technical Note is on ascertaining the compliance of structural steel, not fabricated steelwork. However, limited aspects of steelwork fabrication are discussed, primarily to set the downstream context for the supply of compliant structural steel.

1.2 Abbreviations

ABCB	-	Australian Building Codes Board
ACRS	-	Australasian Certification Authority for Reinforcing and Structural Steels
APCC	-	Australasian Procurement and Construction Council Inc
ASI	-	Australian Steel Institute
CAB	-	Conformity Assessment Body
CompMP	-	Compliance Management Plan
CoP	-	Code of Practice
DoC	-	Declaration of Conformity
DTS	-	Deemed-to-satisfy
FPC	-	Factory Production Control
ILAC	-	International Laboratories Accreditation Co-operation
ITT	-	Initial Type Testing
JAS-ANZ	-	Joint Accreditation System of Australia and New Zealand
LTQ	-	Long Term Quality
MRA	-	Mutual Recognition Arrangement (in connection with ILAC)
NCC	-	National Construction Code
QMS	-	Quality Management System
SCA	-	Steelwork Compliance Australia
SDoC	-	Supplier Declaration of Conformity
WHS	-	Workplace Health and Safety

1.3 Definitions

Appropriate authority: means the relevant authority with the statutory responsibility to determine the particular matter (definition from the NCC)

Batch (of structural steel): A group of structural steel product consisting of finished steel of the same yield stress gradation and product form, treated in the same manner and from the same heat (generalised from Refs 6, 7, 8, 9)

Conformity assessment: demonstration that specified requirements relating to a product, process, system, person or body are fulfilled. The concept of conformity assessment is concerned with the fulfilment of specified requirements, not with the wider concept of conformity. (From AS ISO/IEC 17000 (Ref. 4))

First-party conformity assessment: conformity assessment activity that is performed by the person or organisation that provides the object. (From AS ISO/IEC 17000)

Second-party conformity assessment: conformity assessment that is performed by a person or organisation that has user interest in the object. (From AS ISO/IEC 17000)

Third-party conformity assessment: conformity assessment activity that is performed by a person or body that is independent of the person or organisation that provides the object, and of the user interests in the object. (from AS ISO/IEC 17000)

Conformity assessment body: body that performs conformity assessment services. (From AS ISO/IEC 17000)

Conformity assessment system: rules, procedures and management for carrying out conformity assessment. (From AS ISO/IEC 17000)

Conformity assessment scheme: the collection of all conformity assessment activities that are repeatedly applied to a specified group of products, processes, services, systems, persons or bodies

Declaration of Conformity (DoC): the document that is a first-party attestation that the object of conformity (product, process or service) fulfills specified requirements

Heat (of steel): A product of a ladle of steel melted in one vessel and processed under the same conditions (from Refs 6, 7, 8, 9)

Manufacturer: The business operating the hot-rolling process producing the finished steel product

Procurer/purchaser: Organisation or person who is a recipient from a supplier of a product manufactured to a Standard

Structural steel: steel manufactured to a recognised steel product Standard and intended for use in fabricated steel load-carrying structures

Structural steelwork: structural steel that has been fabricated into members, assemblies and components as part of a load-carrying structure

Supplier: An organisation or person that provides steel products manufactured to a Standard

Trusted relationship: a relationship between two or more parties that has developed based on a series of interactions whose performance has been judged as successful. The level of trust may be informal or based on metrics to ensure performance is measured and maintained.

1.4 Outline

This document establishes an actionable pragmatic protocol to ascertain the compliance of structural steel, framed within the context of the requirements of the National Construction Code and Australian Standards.

In order to achieve this aim, the document is divided into the following sections:

- Section 2 provides a summary of the requirements of the National Construction Code and outlines the distinction between a Performance Solution and a Deemed-to-satisfy Solution before establishing that steel that has not been manufactured to Australian Standards must be considered a Performance Solution and treated accordingly.
- Section 3 examines the relationship between product conformity and the design Standards in order to clearly enunciate the requirements for a steel to be considered as conforming to the referenced Standard.
- Section 4 documents the recommended ‘Steel Verification Protocol’, consistent with the requirements of the NCC and recognising that there are a number of stakeholders with a duty of care in the journey steel takes from the manufacturer to the finished structure. Detail to support the technical basis for the protocol is presented in subsequent sections.
- Section 5 considers the important aspect of product testing in supporting the verification of steel to meet the performance requirements of the NCC.

- Section 6 outlines the selection of the appropriate conformity assessment pathway to operationalise the ‘Steel Verification Protocol’. The selection of the conformity assessment pathway is risk-based and fit-for-purpose.
- Section 7 considers what ‘responsible steel procurement’ and duty of care looks like for each member of the supply chain, particularly as regards the requirements of WHS legislation.
- Section 8 clarifies stakeholder responsibilities under the WHS Act and Regulations and Codes of Practice.
- Section 9 brings together the critical elements of the previous sections to define an actionable responsible steel procurement framework, including importantly, the need for a ‘Compliance Management Plan’.

Note:

The primary focus of this Technical Note is on ascertaining the compliance of structural steel, not fabricated steelwork. However, limited aspects of steelwork fabrication are discussed, primarily to set the downstream context for the supply of compliant structural steel.

ASI is intending to develop a separate Technical Note on ascertaining the compliance of structural steelwork in due course.

2. THE NATIONAL CONSTRUCTION CODE

The National Construction Code (NCC) (Ref. 1) is a performance-based code and specifies means to achieve compliance to a range of *Performance Requirements*. The performance requirements outline the minimum necessary standards different buildings or building elements must attain. References to the NCC cited in this Technical Note are specifically to Volume 1, applicable to Class 2 to 9 buildings.

Performance Requirements are satisfied by either:

1. A *Performance Solution*
2. A *Deemed-to-Satisfy Solution (DTS)*
3. A combination of 1 and 2

Performance Requirements must be verified using one or a combination of the following *Assessment Methods*:

- Evidence of suitability in accordance with Part A5 of the NCC
- *Verification Method,* as outlined in Clause A2.2(2)(b) of the NCC
- *Expert judgement,* as defined in the NCC
- Comparison with the deemed-to-satisfy provisions of the NCC

The relevant evidence of suitability is defined in Clause A5.2 of the NCC and may be one or a combination of:

- A current CodeMark Australia or CodeMark *Certificate of Conformity*
- A current *Certificate of Accreditation*
- A current certificate issued by a *certification body* stating the properties and performance of a material, product, form of construction or design fulfil specific requirements of the NCC
- A report issued by an *Accredited Testing Laboratory*
- A certificate or report from a professional engineer or other appropriately qualified person as defined in the NCC
- Another form of documentary evidence, such as but not limited to a Product Technical Statement that:
    a) demonstrates that a material, product, form of construction or design fulfils specific requirements of the NCC, and
    b) sets out the basis on which it is given and the extent to which relevant standards, specifications, rules, codes of practice or other publications have been relied upon to demonstrate it fulfils specific requirements of the NCC.

The *Verification Methods* may include:

- A calculation
- A test, using a technical procedure
- An inspection (and inspection report)
- Any other acceptable form of certification (acceptable to the appropriate authority)

The verification methods may be those provided in the NCC or such other verification methods that are acceptable to the *appropriate authority*. This Technical Note provides a verification methodology that may be acceptable to the appropriate authority.

The overall NCC verification hierarchy is outlined in Figure 1.

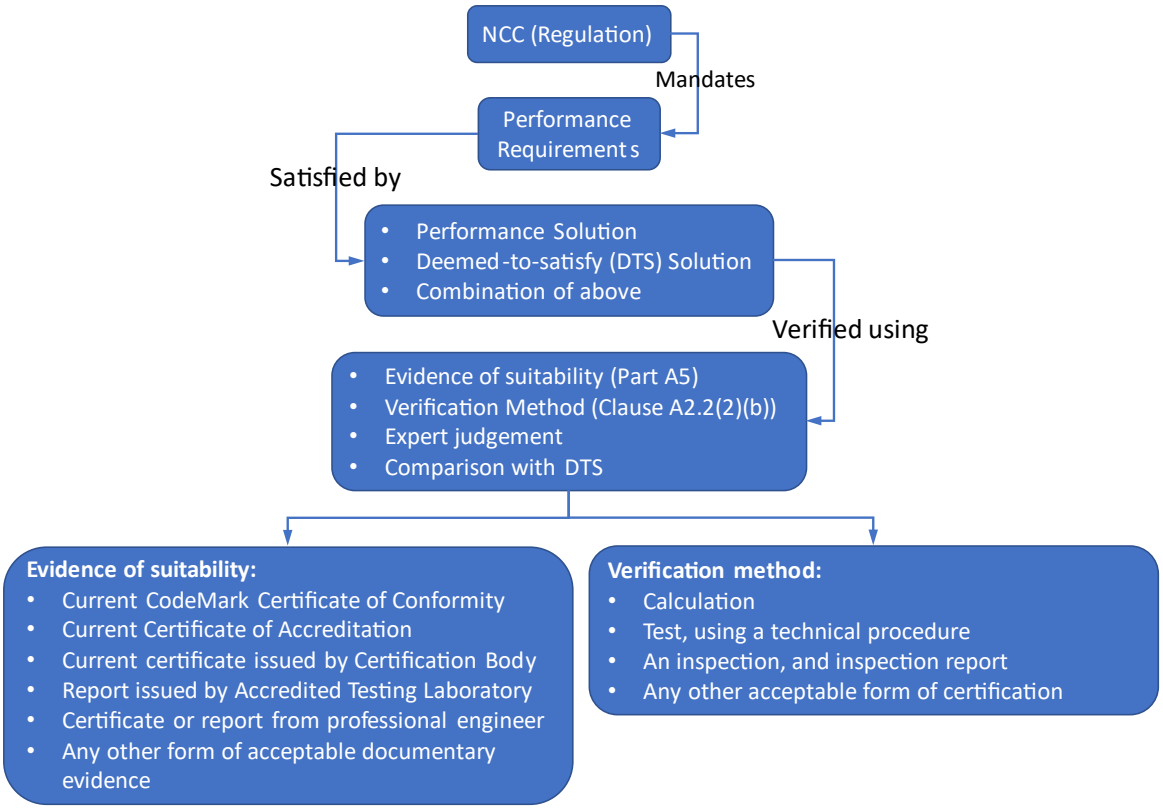

Figure 1 - NCC Verification Hierarchy

In respect of structural provisions (including structural steelwork), the Performance Requirements are defined in Part B1 and include:

1. Clause BP1.1: Structural reliability
2. Clause BP1.2: Structural resistance

The *Deemed-to-Satisfy Solution* for these Performance Requirements is outlined in Clause B1.0, which references Clause B1.4 in respect of determination of the structural resistance of materials and forms of construction.

For steel construction, Clause B1.4 states the structural resistance of materials and forms of construction must be determined in accordance with, as appropriate:

- Steel structures: AS 4100 (Ref. 3)
- Cold-formed steel structures: AS/NZS 4600 (Ref. 4)
- Residential and low-rise steel framing: NASH Standard – Residential and Low-Rise Steel Framing Part 1 or Part 2 (Ref. 5)

If a Deemed-to-Satisfy solution is being adopted, the structural steelwork must meet the requirements of AS 4100, which, in respect of steel materials, calls up the Australian Product Standards (Refs 6, 7, 8, 9) and the structural steelwork fabrication and erection Standard (Ref. 14).

The *Performance Solution* for the aforementioned *Performance Requirements* is referenced from Clause B1.0 to Clauses A2.2(3) and A2.4(3). The *Performance Solution* must be at least equivalent to the *Deemed-to-Satisfy Provisions* (Clause A2.2(1)(b)) or demonstrated to comply with all relevant *Performance Requirements* through an *Assessment Method* (Clause A2.2(1)(a)).

Structural steel that cannot be demonstrated to have been manufactured to the requirements of the Australian Standards called up in AS 4100 cannot be a deemed-to-satisfy solution but must be treated as a *Performance Solution* and must be demonstrated to comply to all relevant *Performance Requirements* through an *Assessment Method.*

Assessing a performance solution is not a trivial task, and in most cases requires information to be assessed early in the process, rather than after a building or structure has been procured. The design, as typically defined in the design drawings and specifications, prescribes the required product compliance, usually by reference to (Australian) Standards. If a product that does not comply with the design requirements is proposed to be procured, authorisation for the change must be obtained from the designer prior to procurement. The designer may need to undertake verification according to the requirements of the NCC (and this Technical Note) for a performance solution.

This Technical Note provides a protocol for verification of structural steel where a performance solution is required.

Key takeaways:

- The National Construction Code (NCC) is performance based
- Utilising Australian design and material Standards is the deemed-to-satisfy approach
- Structural steel that has not been manufactured to Australian Standards **must** be treated as a performance solution
- A specific verification protocol is required under the NCC for any performance solution
- If a product that does not comply with the design requirements is proposed to be procured, authorisation for the change **must** be obtained from the designer prior to procurement

3. PRODUCT CONFORMITY, CONFORMITY ASSESSMENT AND AUSTRALIAN DESIGN STANDARDS

3.1 Context

The Australian Standard AS 4100 'Steel structures' (Ref. 3), like most contemporary design standards around the world, is limit state format. For a structure subjected to actions, the structural steel elements and connections are designed to ensure the structure is within the limit states for strength, stability, serviceability, brittle fracture, fatigue, fire, ductility and durability. Put simply, the design action (S*) must be less than or equal to the design resistance (ϕR_u).

Uncertainties relating to both the actions and the actual capacity of the resisting members are resolved by using a probabilistic approach in design. The actions (loads) are considered as having a probability distribution as shown in Figure 2. The design action is represented by S* on the curve, while the upper and lower limit represents the uncertainty which arises due to the lack of control over or incomplete knowledge of the actions.

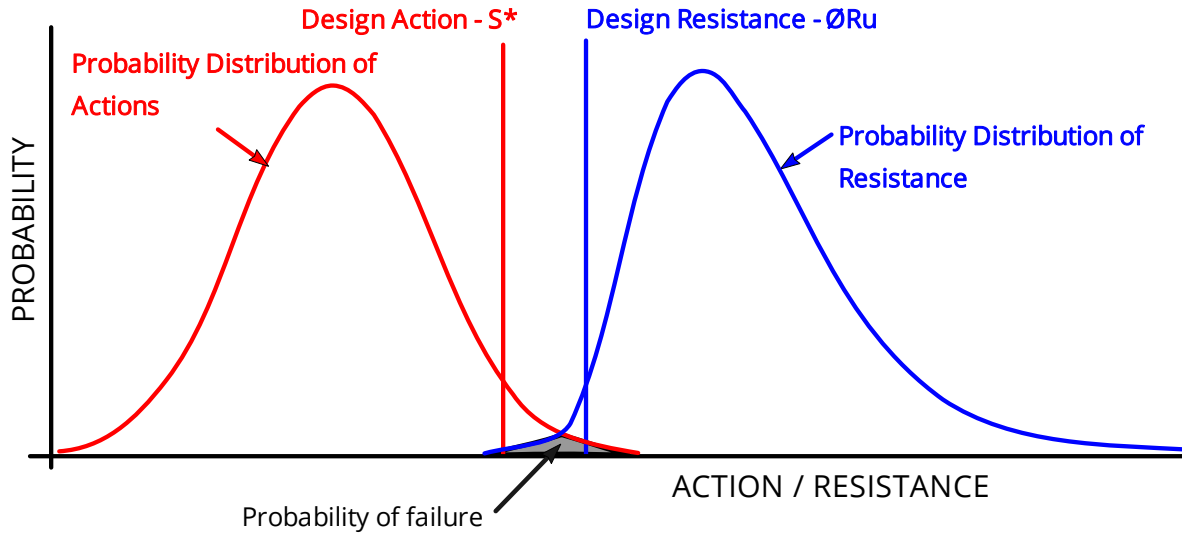

Figure 2 Probability distribution of actions and resistance superimposed

Both the actions and resistance are also subject to variabilities and uncertainties which include:

1. Variations in material properties;
2. Eccentricities due to product and building tolerances;
3. The actual degree of ductility and stability of a member;
4. Differences in behaviour of isolated members compared with members in a structure;
5. Simplifications and inaccuracies in design models.

The resistance is considered to have a log-normal distribution (Ref. 10)) as shown in Figure 2, with the design resistance represented by ϕR_u on the curve and the uncertainty represented by the upper and lower limits.

The probability of the actions exceeding the resistance (the probability of failure) is represented by the shaded area where the two curves overlap.

3.2 Basis for Design Values

The design equations in limit state standards such as AS 4100 'Steel structures' are calibrated to ensure an acceptably low probability of failure. This calibration exercise considers, amongst other things, members being understrength due to variation in material strength and section properties.

To ensure the design assumptions in the calibration exercise remain valid, the structural steels produced by manufacturers must meet long-term minimum, or in some cases maximum values, also known as long-term quality (LTQ) levels. To achieve these long-term quality levels, the manufacturer will target a mean value of material property higher than the minimum target value to allow for production variability. Figure 3 indicates a typical distribution of actual yield stress from Australian manufacturer testing for a 300 Grade steel. Notice the majority of tests are significantly higher than 300 MPa, with an average of around 350-355 MPa.

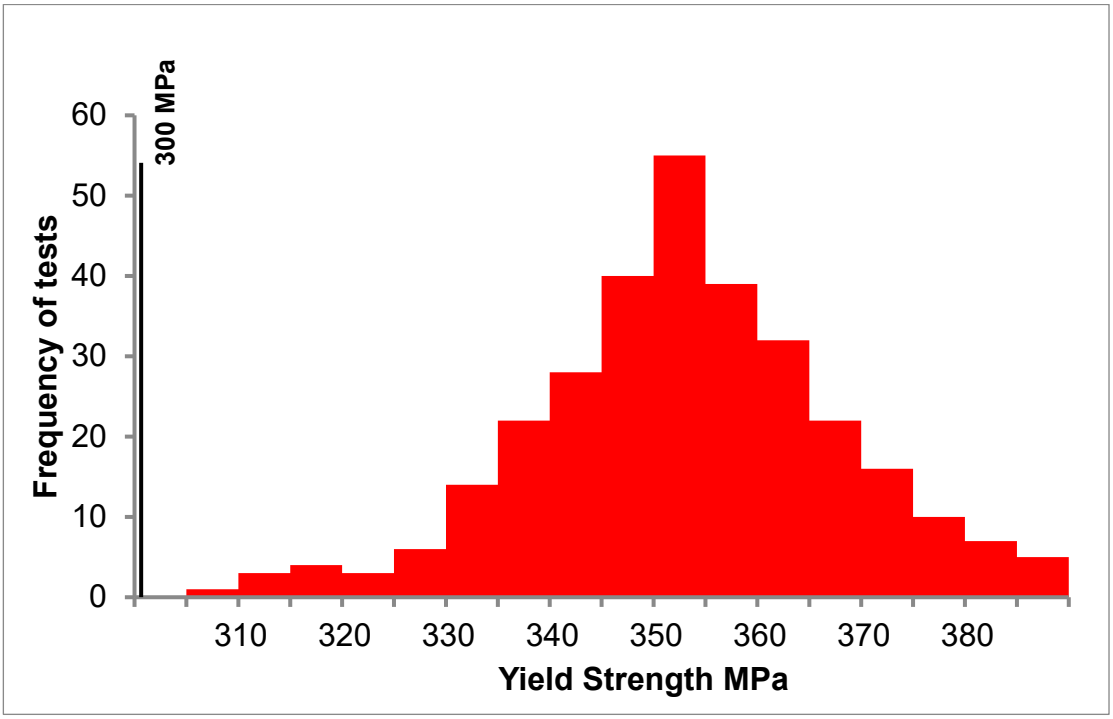

Figure 3 – Yield strength histogram based on manufacturer production testing – 300 Grade steel
(Image courtesy Infrabuild)

Specifically, as noted in the ABCB Handbook: Structural Reliability Verification Method (Ref. 11), our structural design Standards for steel, concrete and timber, adopt the five percentile characteristic material properties according to the NCC Volume 1 (Ref. 1) BP1.2, which states in part “The structural resistance of materials and forms of construction must be determined using five percentile characteristic material properties…”. This is consistent with recommendations in ISO 2394 (Ref. 12) (or the equivalent AS 5104 (Ref. 13)) on which our suite of structural steel related Standards are based.

As an example, the distribution of actual yield strength test results illustrated in Fig. 3 meets the requirement that at least 95% of the results exceed the design grade of 300 MPa. The manufacturer must target the long-term quality results to meet this target.

It is important to understand that a single batch test only affords a snap-shot of the manufacturer’s production at a point in time. A batch test does not give any indication of long-term quality levels. A statistical approach utilising test data collected over a period of time is required to determine this.

It also follows from this that test data on test certificates taken from a single batch of steel cannot be used directly as the basis for design or for (re)grading of the product, as this data does not represent the five percentile (95% passing) material properties to which AS 4100 design basis has been calibrated and the NCC requires. The Commentary to AS 4100 (Ref. 40) makes this clear.

The practice of substituting a higher grade of steel where there is limited test data is also not defendable because, regardless of the steel grade, there are not sufficient tests to determine the

five percentile characteristic strength. The designer must have a sound basis for calculating the five percentile characteristic strength.

> If it is necessary to calculate the characteristic or design values, sufficient test results from the batch must be taken in order to perform the statistical analysis discussed subsequently.

The statistical approaches to verification (batch) testing discussed in subsequent sections of this Technical Note provide a means to estimate the five percentile design value consistent with the requirements of our Standards based on a defined but limited number of tests from a single batch.

3.3 Product Conformity

Structural steel supply standards will typically include product conformity requirements and conformity assessment requirements. Product conformity requirements include specification of the characteristics of the product, e.g. minimum yield stress, and the inspection and test requirements for checking conformity of the product to the requirements of the standard.

The product conformity requirements in the latest AS/NZS structural steel material supply standards (Refs 6, 7, 8, 9) have taken guidance from those found in EN product standards. Specifically, manufacturers of steel products to these standards are required to meet the following requirements:

- Initial Type Testing (ITT): The complete set of tests described in a standard to determine the characteristics of samples of product representative of the product type. The ITT provides the manufacturer with the characteristics of the product using their manufacturing, measuring and quality management system (QMS).
- Factory Production Control (FPC): Operational techniques and all measures necessary to maintain and regulate the conformity of the product to the requirements of the relevant standards, which ensures that performance declared by the manufacturer (through ITT) continue to be valid for all subsequent products. This includes personnel, equipment, procedures and inspection and testing.

3.4 Conformity Assessment

Conformity assessment involves the series of processes necessary to show a product meets the requirements of the standard. The main stages in conformity assessment are inspection/testing (determination), review of the evidence of determination and attestation (statement of conformity). Conformity assessment also interacts with other fields such as quality management. It is essential that a steel manufacturer operates a quality management system in conjunction with its conformity assessment activities, to ensure it consistently meets the requirements of the relevant supply Standard.

3.5 Welding of Steel Structures

Consideration of the welding of steel structures, in particular where steel to other than Australian Standards is utilised, is beyond the scope of this Technical Note. However, AS/NZS 5131 (Ref. 14) references the AS/NZS 1554 (Ref. 37) Standard series for welding, which sets out the processes required for qualification of materials, welding procedures, welds and personnel.
A broad range of parent materials can be welded to AS/NZS 1554.1 (Section 2) and similarly AS/NZS 5131 (Clause 5.3), however there are limitations primarily because the materials of construction listed link into the preheat determination methods given within Section 5 of AS/NZS 1554.1. For steels non-compliant with Section 2 of AS/NZS 1554.1, or any steel with a boron content ≥0.0008%, preheat and other requirements are applicable as defined within the Australian Technical Specification SA TS 103 Structural steel welding—Limits on boron in parent materials (Ref. 38) and WTIA Technical Note 1 The Weldability of Steels (Ref. 39). Briefly, these requirements include:

(a) Verification of preheat requirements
(b) Ensuring that the brittle fracture and Charpy impact properties of the steel are compliant with Appendix B of AS/NZS 1554.1
(c) Ensuring that the steels are matched with the appropriate welding consumables (Clause 4.6 of AS/NZS 1554.1)
(d) Ensuring that the steel is assessed to confirm the performance with AS/NZS 1554.1 prequalified weld procedures, where prequalified weld procedures are to be adopted by the fabricator(1)

Notes:
(1) There will be a significant amount of work required to be undertaken by fabricators to re-qualify their welding procedures if steel is used that does not comply with the performance of the steel product used in their existing welding procedure pre-qualifications.

Key takeaways:

- The limit state design basis for our steel design Standard AS 4100 is predicated on and calibrated against five percentile characteristic material properties, as required under the NCC
- Our steel product Standards define characteristic strength based on the five percentile (95% passing), which is assessed from long term quality testing data
- A single test result provided on a manufacturer test certificate, or a single testing outcome, cannot be used to establish the five percentile characteristic strength
- Steel manufacturers complying with our steel product Standards must have ITT and FPC in place to ensure consistent long term quality levels meeting the requirements of the product Standards
- Particular attention must be paid to the welding of steel structures, in particular where the steel procured is not compliant to Australian Standards
- The fabricator will need to re-qualify their existing weld procedures if using steel that is not the same as that used for their existing weld procedure qualifications

4. STEEL VERIFICATION PROTOCOL

4.1 General

It is clear from Section 2 that the NCC requires steel to be properly identified and its performance verified, regardless of whether the steel is manufactured to Australian Standards (the deemed-to-satisfy solution) or manufactured to a different international Standard and claimed to conform to the NCC and Australian Standards (a performance solution). Section 3 outlines particular sampling and testing processes that need to be implemented consistent with the performance basis of Australian design and product Standards in order to establish compliance with the NCC and Australian Standards. Faced with these requirements, manufacturers, distributors and suppliers, engineers, fabricators, procurers and constructors all have a duty of care to properly ensure the compliance of the steel at all stages of the supply chain.

The ‘Steel Verification Protocol’ outlined in this section establishes a methodology to ascertain compliance and works in concert with the ‘Steel Procurement Framework’ outlined in Section 9, the latter establishing stakeholder responsibilities.

4.2 Context

A robust steel verification protocol must:

1. Establish the veracity of the product at multiple points in the journey from manufacturer to intended use on a project.
2. Maintain verifiable traceability, that is, the ability to link the credentials (documentation provided by the manufacturer) of the steel to the product in hand
3. Be able to be applied to both locally manufactured and imported product.
4. Maintain a similar ‘quality bar’ (the quality defined by the Australian Standards), regardless of point of manufacture.
5. Be cost effective and commercially viable and, ideally, reward good procurement practice with more cost-effective outcomes.
6. Be able to respond in a timely manner to supply of necessary documentation and when product non-compliance is identified.

Accordingly, within the context of the current Australian procurement environment, the recommended steel verification protocol must:

1. Establish the acceptable quality credentials of the steel manufacturer
2. Establish the acceptable quality credentials of the steel
3. Establish traceability of the product from manufacturer to use on the project
4. Where steel is not manufactured to an Australian Standard, establish the acceptable performance requirements of the steel defined in the applicable Australian Standard for the steel product concerned, as referenced in the NCC.
5. Assign appropriate responsibility to the applicable stakeholders in the supply chain.

4.3 Steel Verification Protocol Structure

To fulfil the requirements noted above, the steel verification protocol comprises the following separate but related steps, as indicated in Figure 4:

1. **Steel manufacturer verification (mandatory)**: establishes the quality of the manufacturer’s processes and the product produced. The product may not necessarily be produced to Australian Standards.
2. **Supply chain verification (optional)**: an assessment of the capability of the supply chain to provide compliant product with the necessary documentation.

3. **Traceability verification (mandatory)**: establishes the link between the manufacturer's product and the product used on the specific project.
4. **Product performance verification (mandatory)**: establishes the credentials of the steel product to meet the performance requirements of the NCC and relevant Australian Standards.

Each of these steps is detailed in the following sections. Steps 1, 3 and 4 are mandatory to establish product compliance. Step 2 is optional but, if enacted by the supply chain, provides a measure of process efficiency that should result in more cost-effective outcomes for the complete steel supply chain in Australia.

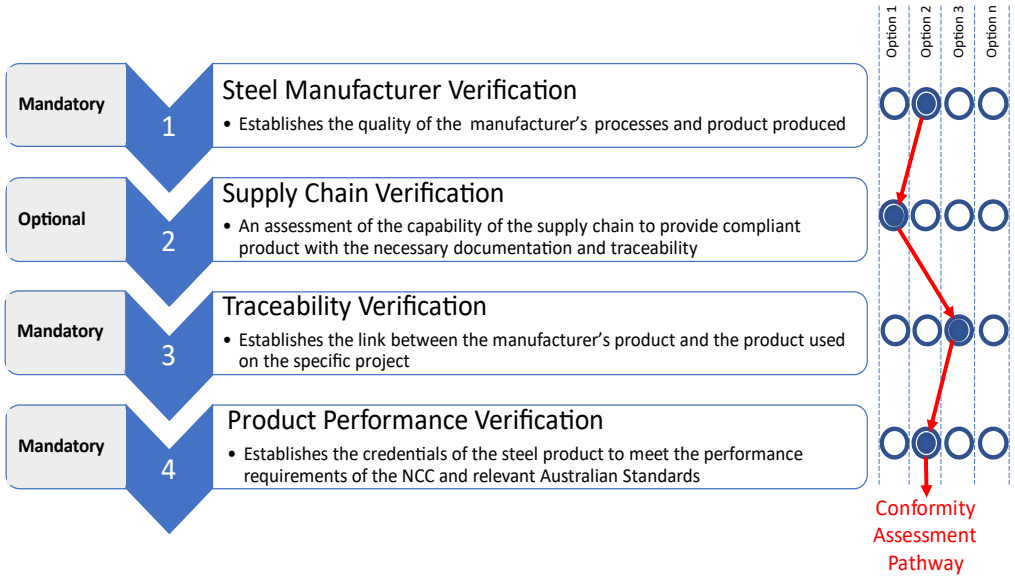

Figure 4 – Steel verification protocol structure using a specific conformity assessment pathway

Within each step of the protocol, a number of options exist. The choice within each step and the combination of the exact options adopted within each step of the protocol is termed the 'conformity assessment pathway', as indicated in Figure 4. The final conformity assessment pathway may vary between projects based on project-specific procurement scenarios and contractual structures.

A risk-based approach to selecting the final conformity assessment pathway based on project type and circumstances is presented in Section 6. The risk-based approach recognises the realities of project procurement processes in today's construction environment and represents a pragmatic solution balancing risk and commercial reality.

4.4 Steel Manufacturer Verification (Mandatory)

4.4.1 Context

Verification of the steel manufacturer is the first step in the steel verification protocol. The process is straightforward, as defined in Figure 5 and is used to establish the extent to which the manufacturer has been independently verified for the requirements set by Australian Standards (refer Section 4.4.2).

Figure 5 – Steel manufacturer verification process

The steps in verifying the steel manufacturer are:

1. **Identify manufacturer**: the steel manufacturer (steel mill) must be able to be identified from the documentation (test certificates or mill certificates). The documentation should also indicate any certifications the manufacturer may have, which will feed into step 2. Certifications must be current.
2. **Select 'Manufacturer Verification Level' (MVL)**: the manufacturer verification level is a function of the scope and extent of third-party certification the manufacturer may have. Refer Section 4.4.3.
3. **Establish evidence**: the evidence required to establish the veracity of the claims made by the manufacturer and used to establish the MVL must be verified. Refer Section 4.4.4.

4.4.2 Standards Context

The Australian structural steel product Standards (Refs. 6, 7, 8, 9) require that manufacturers of steel products to these standards have in place both Initial Type Testing (ITT) and Factory Production Control (FPC). Refer Section 3.3 for further detail.

The combination of ITT and FPC essentially establishes the product characteristics and ensure that the manufacturer maintains those characteristics throughout production runs of the same product type. Without such control of consistency in the manufacturing process, assessment of product characteristics (refer Section 4.7)) becomes much more challenging.

In addition, the product from the steel mill must meet the range of performance requirements for mechanical and chemical properties outlined in the relevant Australian steel product Standards (Refs. 6, 7, 8, 9).

4.4.3 Manufacturer Verification Levels

A number of levels of verification that the steel mill meets the FPC and product requirements are presented. These 'Manufacturer Verification Levels' (MVL) are shown in Table 1 in approximate order of veracity from most (MVL1) to least (MVL5) verified.

The verification level must be demonstrated by appropriate 'evidence of suitability' (adopting terminology from the NCC), as described in Section 4.4.4.

Table 1 - Manufacturer Verification Level (MVL)

Level	Detail
MVL1	**Accredited third-party product certification (for product to Australian Standards)**: undertaken by an independent Conformity Assessment Body (CAB) that itself has been independently accredited. The accreditation body must be a member of the International Accreditation Forum (www.iaf.nu). The ACRS Scheme (ACRS | Home - Australian Certification Authority for Reinforcing Steel (steelcertification.com), accredited by JAS ANZ, is an example of a CAB certifying steel mills manufacturing structural steel products to the Australian Standards.
MVL2	**Accredited third-party product certification (for product to non-Australian Standards)**: undertaken by an independent Conformity Assessment Body (CAB) that itself has been independently accredited. The accreditation body should be a member of the International Accreditation Forum (www.iaf.nu). Where the mill has been certified for production of material to other than Australian Standards, additional verification of the product performance will be required (refer Section 4.7 Product Performance Verification).
MVL3	**Non-accredited third-party product certification (for product to Australian Standards)**: in this case the CAB has not been independently accredited for the specific product. The procurer is relying on the name and reputation of the CAB in respect of the quality (scope and thoroughness) of the certification itself.
MVL4	**Third party FPC certification**: in this case the factory production control (FPC) of the manufacturer has been certified but not the specific product. The Conformity Assessment Body (CAB) may be accredited or not accredited. Additional verification of the product will be required (refer Section 4.7 Product Performance Verification).
MVL5	**Non-verified manufacturer**: claims by a steel manufacturer that they certify product to a Standard amount to first-party certification. The veracity of these claims is entirely dependent on the quality of the processes the manufacturer has in place, which have not been independently verified. The procurer must undertake or organise to have undertaken independent review and auditing and may choose to rely on a 'trusted relationship' built up from previous procurement from the same manufacturer.

4.4.4 Evidence of Suitability

The appropriate evidence of suitability for each Manufacturer Verification Level (MVL) is provided in Table 2.

Table 2 - Evidence of Suitability for Manufacturer Verification Level (MVL)

Level	Appropriate evidence of suitability
MVL1	Accredited third-party product certification (for product to Australian Standards)
	• Copy of valid certificate of approval from accredited certification body[(a)] • Independent confirmation from certification body that manufacturer certification is current[(b)]
MVL2	Accredited third-party product certification (for product to non-Australian Standards)
	• Copy of valid certificate of approval from accredited certification body[(a)(c)] • Independent confirmation from certification body that manufacturer certification is current[(b)] • Documented verification testing, as outlined in Section 4.7
MVL3	Non-accredited third-party product certification (for product to Australian Standards)
	• Copy of valid certificate of approval from certification body[(a)(d)] • Scheme Manual[(g)] or similar providing detailed scope of the certification and methodology for conformity assessment[(d)] • Outcomes from auditing of Scheme Manual and process documentation[(h)]
MVL4	Third party FPC certification
	• Copy of valid certificate of approval from certification body • Scheme Manual[(g)] or similar providing detailed scope of the certification and methodology for conformity assessment[(d)] • Verification testing of product[(e)]
MVL5	Non-verified manufacturer
	• Non-verified manufacturers are supported under this guidance but not recommended[(f)]

NOTES:

a) The steel manufacturer must be able to produce a valid and current certificate of approval demonstrating certification. The certificate of approval must state the scope of products to which the manufacturer is certified. This must cover the type of material being procured.

b) The authenticity and currency of the certification should be independently checked. Most certification bodies maintain website lists of current certifications or can provide confirmation on request. The certification must also display the independent accreditation credentials, which should also be checked with reference to the accreditation authority website.

c) Product to non-Australian Standards is treated as a *Performance Solution* and requires additional verification testing, as outlined in Section 4.7.

d) Where the certification body is not independently accredited, the procurer is relying on the good name of the certification body to be assured of the veracity of the conformity assessment undertaken. It is a reality that any party can claim that they can certify to a Standard. The procurer must have the Scheme Manual reviewed and selected process documentation audited by an appropriately qualified auditor.

e) FPC certification does not cover the specific product. Additional verification testing, as outlined in Section 5, must be undertaken.

f) A non-verified manufacturer has not been independently assessed as having suitable processes in place to deliver consistent product quality. The procurer is relying on the good name of the manufacturer. If the procurer accepts the risk of sourcing from a non-verified manufacturer, a robust verification testing regime must be put in place. Refer Section 5.

g) A product certification scheme will have a 'Scheme Manual' or similar outlining the basis and operation of the Scheme and including the basis for conformity assessment to the relevant Standard.

h) The Scheme Manual must be reviewed and selected documentation from a representative Scheme audit also audited.

4.5 Traceability Verification (Mandatory)

4.5.1 Context

Traceability is the ability to maintain the connection between the test and inspection certificates and the specific steel product to which they apply throughout the process from steel manufacture through distribution to the procurer and on through fabrication and erection of the structure, as shown in Figure 6. In respect of traceability, this Technical Note is concerned primarily with the stage from steel manufacture up to and including procurement of the steel for fabrication. AS/NZS 5131 (Ref. 14) specifies requirements for the type and extent of traceability during fabrication and erection.

It can be challenging to establish the traceability of product Instances of fraud (e.g. altered copies of certificates) and deliberate misleading information (e.g. certificates not applicable to the steel purchased) have been reported. In this environment the procurer must request documentation prior to the purchase of the product. The documentation must be audited rigorously.

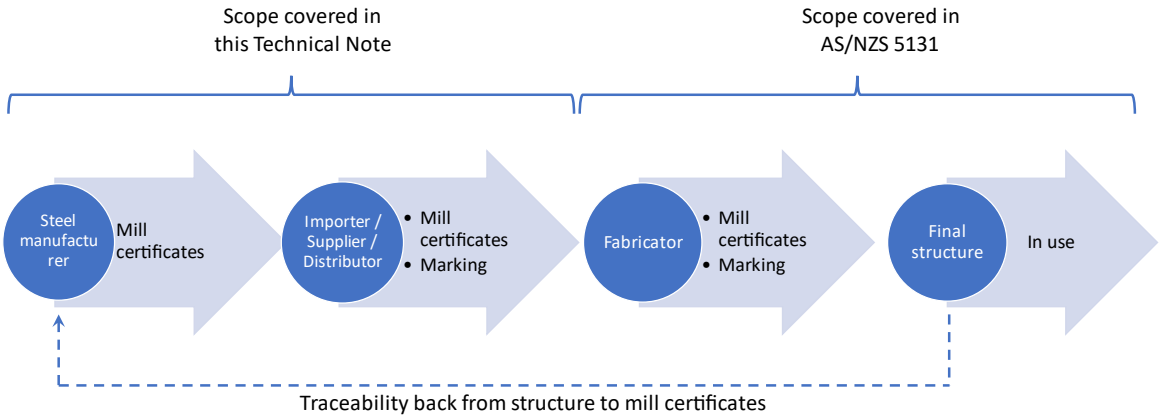

Figure 6 – Traceability connecting manufacture to the finished structure

4.5.2 AS/NZS 5131 Context

AS/NZS 5131 requires, as a starting point prior to fabrication, that the steel product meets the performance requirements of the steel product Standards (Refs. 6, 7, 8, 9). It then prescribes different levels of traceability for product through the fabrication process depending on the 'Construction Category'. The levels are defined as 'batch', 'piece-mark' and 'piece' traceability and may be applied to different structural components depending on the construction category. Reference 15 provides an explanation of AS/NZS 5131 and construction categories.

It is important to understand that the traceability described in AS/NZS 5131 is contingent on proper traceability having been maintained up to and including the point of steel procurement for fabrication. It is also important to understand that, regardless of the construction category (and hence type of traceability implemented during fabrication) defined in AS/NZS 5131, the procured steel must all be traceable back to the corresponding valid test and inspection certificates.

4.5.3 Verification

Verification constitutes the ability to establish a positive link between the valid test and inspection certificates provided and the actual procured product for each batch of product, regardless of whether the product is manufactured locally, sourced internationally or incorporated into fabricated steelwork overseas.

Each of these scenarios has challenges that need to be addressed based on project-specific requirements. However, regardless of the project scenario, the following principles must be followed:

1. Ensure the steel manufacturer is **verified** – refer Section 4.4. A verified manufacturer will have traceable documentation and proper marking of product.
2. Ensure proper **identification** of the material to the relevant Standard (see Appendix B).
3. Ensure the relevant **Documentation** is available. The Australian product Standards prescribe the type and contents of the documentation that is required to be transmitted with the steel product and available to the procurer (see Appendix C).
4. If there is any doubt as to traceability, it is recommended that robust sample collection and testing processes are put in place involving trusted third parties for both sample collection and material testing. There have been documented examples of fraudulent behaviour, with steel material supplied for testing that was not applicable to the batch of product supplied. Testing of samples from each batch must be undertaken utilising an International Laboratory Accreditation Co-operation's (ILAC's) Mutual Recognition Arrangement (MRA) accredited testing facilities (see Section 5.3), whether locally or internationally based. The testing and sampling plan should be selected as indicated in Section 5.4.

5. If there are concerns about the veracity of the sample collection and material testing process, then it is recommended the steel is treated as unidentified steel in accordance with the requirements of AS 4100, which requires the design steel yield strength to be treated as 170 MPa. A sampling and testing plan must also be implemented to establish that the steel ductility, chemical composition and weldability meet the performance requirements of the steel product Standards, AS/NZS 5131 and AS 4100. Alternatively, that sampling and test plan can also include testing of steel strength (see Section 5.3) to provide a statistically appropriate basis for assessing the material strength.
6. As an alternative to adopting a design yield strength of 170 MPa as noted in point 5, and given the lack of any form of traceability, testing a steel sample from every member could be used to check the properties of every member and establish a statistical basis for the design value to be utilised. This approach is obviously expensive and time consuming and would be a last resort, perhaps in combination with identifying and excluding those members where the 170 MPa design yield strength was acceptable and therefore excluded. If there is sufficient documentation to link certain members to an individual batch of steel, then the statistically based verification testing outlined in Section 5.3 may be adopted by taking sufficient samples from each identified batch, rather than a sample from each member.
7. If the steel arrives in a fabricated structure and there are concerns about the veracity of the traceability, then it is recommended the steel is treated as unidentified steel in accordance with the requirements of AS 4100, which requires the design steel yield strength to be treated as 170 MPa. A sampling and testing plan must also be implemented involving cutting of samples from the fabricated steelwork under the direction of a suitably qualified trusted third party. The sampling and testing plan must establish that the steel ductility, chemical composition and weldability meet the performance requirements of the steel product Standards, AS/NZS 5131 and AS 4100. Alternatively, that sampling and test plan can also include testing of steel strength (see Section 5.3) to provide a statistically appropriate basis for assessing the material strength.
8. It must be noted that if steel in a fabricated structure does not have demonstrable traceability, it is likely not known which steel members come from the same batch of steel (or even the same mill) and therefore every piece of steel must be verified if the responsible party is to certify the structural adequacy of the structure to the requirements of the NCC. This is generally a commercially unrealistic scenario and therefore it is very important that the protocols for verifiable traceability are established early in a project in order to avoid a situation where it is impossible for the responsible party to certify the structure.
9. The designer is the responsible party for the original design of the structure and must be provided sufficient information (as outlined in this Technical Note) if requested to certify the structural adequacy of the constructed structure. The designer must approve changes to the design, including use of alternative materials. Where unauthorised changes are made, for example due to procurement practices, then design responsibility is transferred to the party making those changes.

4.5.4 Evidence of Suitability

For each of the functional requirements listed in Section 4.5.3, the recommended evidence of suitability is indicated in Table 3.

Table 3 – Evidence of Suitability for Traceability

Item	Recommended evidence of suitability
1	Manufacturer Verification
	• Refer Section 4.4
2	Identification
	• Marking of material as required by relevant Standard[(a)] • Identification tags on bundled product[(a)] • Photos of marking and ID tags[(b)]
3	Documentation
	• Test and inspection certificates in English[(c)] • Supplier Declaration of Conformity (SDoC)[(d)]
4	Traceability
	• Documentation providing a verifiable link between the material purchased and test and inspection certificates for each batch of material[(e)(f)]

NOTES:

a) Section 11.1 of each of the Australian product Standards (Refs. 6, 7, 8, 9) specifies the requirements for identification and marking of product (refer Appendix B). Material not identified and marked in this manner must be treated as non-compliant with the requirements of the relevant Standard.

b) Where requested by the procurer, the supplier/distributor must provide photos of the member marking and tags for the batch of material supplied.

c) Section 11.2 of each of the Australian product Standards (Refs 6, 7, 8, 9) specifies the requirements for test and inspection certificates (refer to Appendix C) and that they must be available to the purchaser. The Standards specifically state “A test and inspection certificate shall be available to the purchaser for all products manufactured to this Standard for each batch produced” (or “for each section produced” in the case of AS/NZS 3679.2). It is recommended that test and inspection certificates are requested for all steel procured.

d) Section 11.2 of the product Standards requires the manufacturer to provide as part of the test and inspection certificates a declaration that the products supplied comply to the requirements of the Standard (refer to Appendix C). AS/NZS 5131 recommends a Supplier Declaration of Conformity is provided for purchased components. An SDoC must be provided by the importer/supplier/distributor where material is sourced internationally. The SDoC must include reference to the verification test report or reports used to support a claim of conformity. Refer to Appendix D for a typical example of the form of the SDoC.

e) The test and inspection certificate would usually be relied on to provide the documented link connecting test and inspection outcomes to the marking and identification on the product purchased.

f) It can be challenging to establish the traceability of product. Instances of fraud (e.g. altered copies of certificates) and deliberate misleading information (e.g. certificates not applicable to the steel purchased) have been reported. The procurer must check documentation rigorously and may need to implement a robust verification testing process as described in Section 5.3 where anomalies in documentation exist.

4.6 Supply Chain Verification (Optional)

4.6.1 Context

The ease with which product can be sourced from either local or international suppliers and the ensuing competition drives cost as the primary consideration. A focus on cost alone has ameliorated the practice of identifying and utilising 'trusted suppliers' that was the cornerstone of previous supply chain verification and helped ensure cost-effective compliant solutions.

Within the context of the steel supply chain, the most significant supplier between the steel manufacturer and the completed project is usually the steel distributor who, regardless of whether they source material locally or internationally or whether they also perform limited fabrication (steel processing), must ensure the necessary identification, documentation and traceability of the steel required by the Standards and the NCC is maintained and provided to the procurer.

Strictly speaking, supply chain verification is not required if the other mandatory protocols described in this Technical Note are enacted. For this reason, for the current market, supply chain verification is noted as optional. However, ASI strongly encourages supply chain verification as necessary to provide a practical and cost-effective approach to ensuring compliance of structural steel for the Australian market.

4.6.2 Supply Chain Requirements

The primary functional requirements of the steel supplier or distributor as regards steel compliance is to ensure the requirements of the Standards and the NCC are supported, specifically in relation to:

1. **Identification**: of the steel products according to the relevant Standard.
2. **Documentation**: the Australian product Standards prescribe the type and form of documentation that is required to be transmitted with the steel product and available to the procurer.
3. **Traceability**: steel product with identification from the manufacturer must have that identification recorded and maintained, regardless of how the product may be bundled, unbundled, processed and managed within the distribution centre and supply chain.
4. **Product performance verification**: refer to Section 4.7.

In addition, the steel supplier/distributor must:

5. be an **Australian legal entity**: If product is imported directly, then the importer of the product is considered to be the supplier/distributor for the purposes of these requirements.
6. operate a **Quality Management System**: typically AS/NZS ISO 9001. The QMS is the foundation for the delivery of quality, but may need to be extended to support requirements from specific procurers.

4.6.3 Evidence of Suitability

The recommended evidence of suitability for each of the functional requirements listed in Section 4.6.2 is shown in Table 4.

Table 4 – Evidence of Suitability for Importer, Supplier and Distributor

Item	Recommended evidence of suitability
1	Identification
	• Marking of material as required by relevant Standard[(a)] • Identification tags on bundled product[(a)] • Identification transferred where product unbundled[(b)] • Photos of marking and ID tags[(c)]
2	Documentation
	• Test and inspection certificates in English[(d)] • Supplier Declaration of Conformity (SDoC)[(e)]
3	Traceability
	• Documentation providing verifiable link between material purchased and test and inspection certificates for each batch of material[(f)(g)]
4	Product performance verification[(h)]
	• Refer Section 4.7[(i)]
5	Australian legal entity
	• Name and address of importer/supplier/distributor
	• ABN for importer/supplier/distributor
6	Quality Management System
	• Certification for Quality Management System[(j)]
	• Documentation from auditor stating that the QMS covers the elements detailed in this Technical Note[(k)]

NOTES:

a) Section 11.1 of each of the Australian product Standards (Refs. 6, 7, 8, 9) specifies the requirements for identification and marking of product (refer Appendix B). Material not identified and marked in this manner must be treated as non-compliant with the requirements of the relevant Standard.

b) Section 11.1 of each of the Australian product Standards (Refs. 6, 7, 8, 9) requires that where identification is removed (e.g. by unbundling of product), the identification is transferred to each remaining portion of the product.

c) Where requested by the procurer, the supplier/distributor must provide photos of the typical member marking and tags for the batch of material supplied.

d) Section 11.2 of each of the Australian product Standards (Refs 6, 7, 8, 9) specifies the requirements for test and inspection certificates (refer Appendix C) and that they must be available to the purchaser. The Standards specifically state “A test and inspection certificate shall be available to the purchaser for all products manufactured to this Standard for each batch produced” (or “for each section produced” in the case of AS/NZS 3679.2). It is recommended that test and inspection certificates are requested for all steel procured.

e) Section 11.2 of the product Standards requires the manufacturer to provide as part of the test and inspection certificates a declaration that the products supplied comply to the requirements of the Standard (refer Appendix C). AS/NZS 5131 recommends a Supplier Declaration of Conformity is provided for purchased components. An SDoC must be provided by the importer/supplier/distributor where material is sourced internationally. The SDoC must include reference to the verification test report or reports used to support any claim of conformity. Refer Appendix D for a typical example of the form of the SDoC.

f) The test and inspection certificate would usually be relied on to provide the documented link connecting test and inspection outcomes to the marking and identification on the product purchased.

g) It can be challenging to establish the traceability of product. Instances of fraud (e.g. altered copies of certificates) and deliberate misleading information (e.g. certificates not applicable to the steel purchased) have been reported. The procurer must check documentation rigorously. The use of verified importers/suppliers/distributors (refer Section 4.6.4) is recommended.

h) Refer Section 4.7 for detailed explanation of product performance verification.

i) The evidence of suitability required depends on the type of product and compliance pathway selected. Refer Section 4.7 for details. The scope and extent of verification testing shall be the same as for the ‘trusted supplier’ (refer Section 4.6.5).

j) Certification of the Quality Management System must be undertaken by an auditor who is accredited by a signatory to the International Accreditation Forum’s Multilateral Recognition Agreement (eg. JAS ANZ).

k) The audit of the importer/supplier/distributor must include the elements detailed in this Technical Note, specifically the elements of the performance monitoring protocol outlined in Section 4.6.5. The auditor may either document this within the audit report or as a separate audit outcome.

4.6.4 Verified Supplier Status

The concept of a ‘verified supplier’ has the potential to introduce efficiencies for the supply chain, differentiate suppliers and distributors in a crowded market and reimagine the mechanism of ‘trusted suppliers’ noted previously.

A verified supplier is a supplier or distributor who:

1. Has been third-party certified as meeting the processes necessary to support the provision of the evidence of suitability detailed in Table 4, or;

2. Has been third-party certified for their QMS, with specific addition to the audit report of the elements detailed in Table 4.

Note: ASI are planning the implementation of distributor certification under the 'National Structural Steelwork Compliance Scheme' (Ref. 42).

4.6.5 Trusted Supplier Status

Trusted Supplier status is a relationship between a supplier or distributor and a particular procurer. Trusted Supplier status is 'awarded' by the procurer to the supplier/distributor based on an established procurement relationship built up over a period of time and continually tested.

The assessment of the supplier/distributor will depend on the commercial and contractual relationships in play. However, as a minimum, the following requirements shall be assessed:

1. The supplier or distributor has in place a QMS, preferably certified, that also addresses the elements detailed in Table 4.
2. The supplier or distributor has in place a performance monitoring protocol for their steel source when that steel source is other than MVL1 (refer to Section 4.4.2).
3. For supply from an MVL2 steel manufacturer, the performance monitoring protocol shall require batch verification testing to Level 2 (refer to Section 5.3.5) for the first two similar batches of product from a new steel source and thereafter no specific verification testing unless the processes of the steel manufacturer change. A similar batch is a batch that is considered similar to another batch by having the same product form (e.g. UB, UC, PFC, SHS, RHS, CHS, plate), yield stress designation and impact toughness requirements from the same steel manufacturer.
4. For supply from MVL3 and MVL4 steel manufacturers, the performance monitoring protocol shall require batch verification testing to Level 2 (refer Section 5.3.5) for the first two similar batches of product from a new steel source and thereafter Level 1 verification testing for a minimum of every third similar batch.
5. For MVL5 steel manufacturer, the performance monitoring protocol shall require batch verification testing to Level 2 (refer Section 5.3.5) for the first two similar batches of product from a new steel source and thereafter Level 1 verification for a minimum of every similar batch. Where the mechanical properties (yield strength, ultimate tensile strength, % elongation) vary more than one standard deviation from the mean value established by the Level 2 verification testing, the batch shall be tested to Level 2.
6. Records of performance monitoring are available from the supplier on request by the procurer.
7. The supplier/distributor provides to the procurer a 'Supplier Declaration of Conformity' (refer Appendix D) for the product purchased and has available on request the test certificates and assessment report providing the basis for the stated design properties of the steel.

4.7 Product Performance Verification (mandatory)

The particular requirements of the NCC (refer to Section 2) may be interpreted as applying to structural steel product performance verification as outlined in Table 5 and the accompanying notes, based on three distinct scenarios:

1. Product manufactured to Australian product Standard ('Australian Standard Product'), whether the manufacturer is located in Australia or elsewhere
2. Product claiming equivalence to Australian product Standard ('Equivalent Product')
3. Product manufactured to an alternative product Standard ('Alternative Standard Product')

Table 5 Protocol for Product Performance Verification

(aligned with NCC)

	Product Type		
	Australian Standard Product	Equivalent Product	Alternative Standard Product
Product manufacturer	Verified, preferably[a] (to MVL 1,3,4,5)	Verified, preferably[a] (to MVL 2,3,4,5)	Verified, preferably[a] (to MVL 2,3,4,5)
Traceability	Verified[b]	Verified[b]	Verified[b]
Solution type[c]	*Deemed-to-Satisfy*	*Performance*	*Performance*
Assessment method	*Expert Judgement*	*Expert Judgement* *Verification Method* Comparison with *DTS*	*Expert Judgement* *Verification Method* Comparison with *DTS*
Evidence of suitability[d]	*Certificate of Accreditation* Certificate from *Certification Body*[e] *Accredited Testing Laboratory* report[f] Report/certificate from professional engineer[g] (required for MVL 3, 4, 5 only) Other documentary evidence	*Certificate of Accreditation* Certificate from *Certification Body*[e] *Accredited Testing Laboratory* report[f] Report/certificate from professional engineer[g] Other documentary evidence	*Certificate of Accreditation* Certificate from *Certification Body*[e] *Accredited Testing Laboratory* report[f] Report/certificate from professional engineer[g] Other documentary evidence
Verification Method	Not applicable	Test, using a technical procedure[h] Certification from professional engineer[i]	Test, using a technical procedure[h] Certification from professional engineer[i]

NOTES:

a) Regardless of the type of product (Australian, Equivalent, Alternative), the product performance verification outlined in this Table assumes the steel manufacturer has been verified as described in Section 4.4 to MVL 1, 2, 3 or 4. A reliable assessment of product performance cannot easily be undertaken on a product of unknown and/or variable quality. Hence, whilst MVL5 is supported, MVL5 is not recommended under this protocol.

b) Product whose traceability has not been verified according to the guidance in Section 4.5 must not be used, as there is no established link between what is used on the project and product quality that can be suitably demonstrated with the evidence of suitability required by the NCC.

c) As defined by the NCC.

d) Detail of the appropriate evidence of suitability is provided in Table 2 for the steel manufacturer (steel quality), Table 3 for traceability verification and Table 4 for the supplier/distributor.

e) Refer Section 4.4.2 for details of suitable third-party certification.

f) Refer Section 5.3.2 for a discussion on suitable testing laboratories.

g) The NCC Guide to BCA Volume 1 (Ref. 16) states categorically in Clause B1.4 “For designers seeking structural compliance via Performance Solutions, a major principle in determining structural resistance is that the reliability level of the structure or its components must be at least equal to that already achieved in the Deemed-to-Satisfy Provisions”. Refer to Section 3 for guidance on assessment of reliability in respect of steel product performance.

h) Refer to Section 5.3.3 for guidance on scope of verification testing required.

i) The professional engineer should be registered for practice in Australia based on the registration requirements for the particular state concerned and the regulatory requirements in the NCC.

The verification of product performance for ‘Equivalent product’ and ‘Alternative Standard product’ is potentially a time consuming and costly path depending on the particular conformity assessment pathway selected (see Section 6).

4.8 Construction Risk

4.8.1 AS/NZS 5131 Context

In respect of structural steel, the publication of AS/NZS 5131 ‘Structural steel – Fabrication and erection’ (Ref. 14) has introduced a risk-based approach to fabrication and erection of structural steel, for both the permanent structure and also temporary works. Project risk, including the consequences of failure and the complexity of the construction works, is recognised through categorisation into one of four ‘construction categories’, as defined in Table 6. The assessment of the construction category is provided in AS 4100 (Ref. 3) and AS/NZS 5131 (Ref. 14) and discussed in Ref. 15.

Table 6 AS/NZS 5131 Construction categories

Construction Category	Example structure types[(1)]
CC1	• Farm sheds; greenhouses; fences; gates; small signs
CC2	• Low- to medium-rise buildings (industrial buildings, residential buildings, offices, residential apartments and retail) • Single and two level school buildings and structures
CC3	• Large structures (e.g. high-rise buildings) • Large stadia • Road and rail bridges • Post-disaster buildings (e.g. hospitals)
CC4	• Structures with extreme consequences of structural failure

Notes:

The structure types shown are indicative only. The assessment of the construction category is the responsibility of the engineer based on the guidance provided in AS 4100 and AS/NZS 5131. The ‘Building importance level’ from the NCC is one factor in the assessment of the construction category.

A fundamental principle influencing the selection of the appropriate conformity assessment pathway (refer Section 6) is that for high-risk projects (CC3) where project-specific verification testing is required, non-statistical evaluation of conformity (refer section 5.3.4) is limited to steels produced by manufacturers with some form of accredited independent assessment of capability or product quality (FPC or Product Certification).

4.8.2 Component-specific risk

For certain components or assemblies, there may be a heightened risk profile or criticality due to the type or magnitude of stress on the component or assembly. These scenarios need to be addressed on a case-by-case basis, but common examples include:

1. **Complete penetration butt welds on highly loaded connections**: an increased rate of non-destructive testing (NDT) may be adopted
2. **Lamellar tearing on highly constrained connections**: the 2020 revision of AS 4100 introduced new guidance on the selection of materials for the avoidance of lamellar tearing. Thicker plates in connections where welding induces high through-thickness stresses may require special consideration. Where the plate has been manufactured and ordered for improved through-thickness ductility (for example, for the avoidance of lamellar tearing), a statistical approach to verification testing (Level 2 sampling and test plan) for through-thickness ductility is recommended (refer Section 5.3 and Appendix E). Project-specific ultrasonic testing, as outlined in AS 4100, may also be required at specific locations of particular connections.

Key takeaways:

- Manufacturers (steel mills) must be verified with appropriate evidence of suitability
- Establishing the traceability of steel is paramount. Without traceability between the steel procured and the documentation (mill certificates etc), the compliance of every piece of steel is unknown
- Distributors and suppliers must take responsibility for maintaining traceability with correct documentation for each batch of steel
- Performance verification of the steel product must be undertaken to meet the requirements of the NCC
- The extent of product performance verification undertaken should be reflective of the project risk level, as defined by the Construction Category from AS 4100 and AS/NZS 5131

5 PRODUCT TESTING

5.1 General

Product testing of some form is a necessary feature of any of the conformity assessment pathways discussed in this Technical Note. The scope and extent is dependent on the point at which the testing is undertaken and the risk profile exposed by the particular conformity assessment pathway.

There are two forms of product testing relevant to structural steel:

1. Manufacturer testing: undertaken as part of the manufacturing process in order to verify initial product conformity (ITT) and maintain ongoing product conformity (FPC) through production testing. Refer Section 5.2.
2. Verification testing: independent assessment of selected mechanical, chemical and physical properties, utilising an agreed sampling and testing plan. Within the context of this current document, verification testing is undertaken either on a project-specific basis to verify the properties of a batch of structural steel product or by a supplier or distributor as part of their performance monitoring protocol. Refer to Section 5.3.

5.2 Manufacturer Testing

5.2.1 Testing to demonstrate product conformity

The requirements for testing of product as part of the manufacturing process are defined in the Australian steel product Standards (Refs 6, 7, 8, 9) and have been harmonised across the four Standards. In each of these Standards normative Appendix B 'Product Conformity' defines the requirements for ITT and FPC in respect of type of tests, sampling frequency and conformity requirements in order for the manufacturer or supplier to demonstrate product conformity to these Standards.

The Long Term Quality (LTQ) data derived from production testing helps to ensure products conform with the Standard and are consistent with the limit state design philosophy in our design Standards (refer Section 3).

5.2.2 Mill certificates

Clause 2.2.2 of AS 4100:2020 states "Test reports or test certificates that conform to the minimum requirements of the appropriate Standard listed in Clause 2.2.1 shall constitute sufficient evidence of conformance of the steel to the Standards listed in Clause 2.2.1." The requirements for the test reports or test certificates are contained in Clause 11.2 of the Australian steel product Standards, which outlines the range of information that must be shown on the certificate. The Standards require a valid certificate to be available for each batch of steel produced.

ASI regularly receives feedback from stakeholders, in particular engineers attempting to provide certification for structures, that mill certificates provided with imported steel often do not contain the information required by the product Standards or the attributes are not within the range specified to be compliant with the product Standards. In some cases the mill certificates are not in English, which makes assessment difficult. ASI has prepared Technical Notes TN-005 (Ref. 35) and TN-007 (Ref. 36) to provide guidance on AS 4100 requirements for steel, including what information is required on a mill certificate.

5.3 Verification (Batch) Testing

5.3.1 General

Verification testing is independent assessment of selected mechanical, chemical and physical properties utilising an agreed sampling and testing plan to verify the properties of a batch of steel material intended to be utilised on a building or infrastructure project.

The key considerations in developing a project-specific approach to verification testing include:

- The appropriateness of the testing laboratory (refer Section 5.3.2)
- The scope of testing required (refer Section 5.3.3)
- The sampling methodology to be undertaken (refer Section 5.3.4)

The scope and sampling methodology then feed into the adopted sampling and test plan (refer Section 5.3.5).

It is important to note that the verification testing outlined is designed to be applied to a batch of material. Where verification testing is required and the material comes from different batches, each batch will need to have verification testing applied.

It is also important to note that verification testing as described in this Technical Note is only required for certain procurement scenarios. As described in Section 6 and Appendix G, the selection of the appropriate 'conformity assessment pathway' is the basis for the type and extent of verification testing necessary.

5.3.2 Testing Laboratories

Testing must be undertaken by testing laboratories accredited by signatories to the International Laboratory Accreditation Co-operation's (ILAC's) Mutual Recognition Arrangement (MRA), as required for the qualification of test and inspection certificates in the Australian product Standards. The scope of accreditation must include the specific tests required in the relevant Australian product standard. In Australia, the national accrediting body is the National Association of Testing Authorities (NATA). To check the scope of the particular test facility accreditation, reference can be made to the NATA website (https://nata.com.au/accredited-facility).
It should be noted that evidence has been reported of test certificates documenting compromised results due to the testing methodologies adopted. It is therefore important that the veracity of test results is checked. The most expedient way of undertaking this is through checking that the scope of accreditation of the test facility covers the range of tests documented.

5.3.3 Scope of Testing

The scope of testing defines the range of different tests required to verify the product conforms to the material characteristics defined in the Australian product Standard. The recommended scope of testing is aligned closely with the normative requirements of Appendix B 'Product Conformity' of the Australian product Standards. Table 7 provides the scope of testing and the primary functional imperative for the selected tests. The functional imperative highlights the structural engineering basis for undertaking the particular tests.

Table 7 Recommended Scope of Verification Testing

Characteristic	Requirement	Functional Imperative
Mechanical properties	Yield strength, tensile strength, elongation, through-thickness ductility	Section and member structural capacity; required ductility for stress redistribution
	Impact toughness	Resistance to brittle fracture
Chemical composition	Product analysis	Weldability; durability; coating performance
Tolerances	Cross-section dimensions, out-of-straightness	Section and member capacity; detailing
Weld quality	Cold flattening or flange-web tension test (only required for hollow sections and welded sections)	Weld strength and penetration

5.3.4 Sampling Methodology

The sampling methodology adopted is a function of the quality control objectives and a cost-benefit analysis of the expected outcomes. Two fundamental approaches are possible for sampling of a batch of steel:

1. Statistical: Statistical methods for quality control of building materials and components are defined in ISO 12491 (Ref. 19)
2. Non-statistical: limits the extent of testing compared to a statistical approach and is therefore usually more cost-effective

The background and basis for the recommended sampling methodology and sampling and test plans provided in Section 5.3.5 is given in Appendix E.

5.3.5 Sampling and Testing Plans

Two sampling and test plans are provided:

1. Level 1: Documented in Table E1, the Level 1 sampling and test plan is entirely non-statistical, covering the scope of testing outlined in Section 5.3.3.
2. Level 2: Documented in Tables E2(a) and E2(b), the Level 2 sampling and test plan is a mixture of non-statistical (Table E2(a)) and statistical (Table E2(b)) approaches. The mechanical properties (yield strength, tensile strength, elongation and through-thickness ductility (when required)) critical to the structural performance of the product are verified using a statistical approach.

The basis for selection of either the Level 1 or Level 2 sampling and test plan is discussed in Section 5.4.

5.4 Selection of the Appropriate Sampling and Test Plan

The selection of an appropriate sampling and test plan (Level 1 or Level 2) and the frequency of testing is a function of:

1. The manufacturer verification level (MVL) (refer Section 4.4)
2. The verification of traceability (refer Section 4.5)
3. Supply chain verification (refer Section 4.6)
4. The product type (Australian, Equivalent, Alternative) (refer Section 4.7)
5. The risk profile of the project (refer Section 4.8)
6. The risk profile and/or criticality of the component (refer Section 4.8)

These aspects are inter-related and must be considered holistically. The outcome of this consideration is the project-specific ‘conformity assessment pathway’ noted in Figure 3 as part of the steel verification protocol adopted for the project. The type and frequency of verification testing forms one component of the selected conformity assessment pathway, as detailed in Section 6.

Key takeaways:

- Where verification testing is required, the scope and sampling methodology must be consistent with the requirements for demonstrating compliance to the relevant Australian Standards
- ‘Level 1’ and ‘Level 2’ sampling and test plans have been defined, with Level 2 including increased statistically based testing of key structural properties
- Selection of the appropriate sampling and test plan must be based on project risk and the particular conformity assessment pathway assessed as part of the ‘Steel verification protocol’

6 CONFORMITY ASSESSMENT PATHWAY SELECTION

6.1 Context

The conformity assessment pathway operationalises the 'Steel Verification Protocol' illustrated in Figure 4. A fundamental principle influencing the selection of the appropriate conformity assessment pathway is that the approach must be risk-based, considering both project and supply risk. Project risk includes the consequence of failure and the complexity of the construction works and is quantified utilising the construction category designation from AS 4100 and AS/NZS 5131. The supply risk relates to the reliability of the product and this is based on the manufacturer and the chain of custody of steel products from the mill, to the fabrication workshop, and then to site.

A risk-based approach will ensure that the protocol is both responsive to regulatory requirements and cost-effective, commensurate with the risk involved.

The conformity assessment pathway selection framework is based on the following principles:

a) The conformity assessment options are ranked in order from least to most robust as follows: 1. First-party (manufacturer), 2. Third-party FPC Certification, 3. Third-party Product Certification.

b) The risk of non-compliance is arguably reduced if the steel manufacturer is a regular supplier to the Australian market. Over a period of time there is the opportunity to monitor manufacturer performance (periodic testing) and to clearly communicate supply expectations in terms of quality and documentation.

c) It is vital product traceability is maintained through the whole supply chain. The supply chain, specifically steel distributors and suppliers, must support the requirements for product marking and traceability. There is the opportunity for the supply chain to play a proactive role in managing steel supply to ensure cost-effective solutions.

d) Product traceability becomes more challenging for steel in offshore fabricated structures due to the loss of product markings (bundle or individual products) by the time the fabricated components arrive in Australia. In this situation it is recommended there are robust sample collection and material traceability processes in place involving trusted third parties, preferably residing in-country. Product traceability is required from the steel mill to the steel fabricator's workshop, through the fabrication process to the site. If the construction reviewer or the statutory authority have concerns about the test sample collection or material traceability processes, it is recommended the steel is treated as unidentified steel in accordance with the requirements of AS 4100 (Ref. 3). This will involve cutting samples from fabricated structural steelwork for testing when it arrives in Australia.

e) For high-risk structures where project-specific verification testing is required, non-statistical evaluation of conformity is limited to steels produced by manufacturers with some form of independent assessment of capability or product quality (FPC or Product Certification) that itself has been accredited. Non-accredited 3rd party certification is not recommended for high-risk (CC3 or CC4) projects.

f) Low-risk (CC1) structures will generally not be covered under the NCC. A requirement for verification is not regulated but a basic duty of care remains. Steel supplied from certified manufacturers and/or via verified or trusted suppliers requires no further verification. Steel supplied from non-certified manufacturers and/or via suppliers who are not verified or trusted requires limited verification.

g) Some overseas products may be covered by certification such as CE marking. The validity of the certification must be verified and the product still requires product performance verification.

6.2 Conformity Assessment Pathway Selection

The conformity assessment selection process flowcharts, based on the above principles, are presented in Appendix G for each of CC1, CC2 and CC3 project risk categories.

Key takeaways:

- Separate conformity assessment pathways are presented based on project risk, that is, for each of construction categories CC1, CC2 and CC3
- The conformity assessment pathway and the extent of sampling and testing required is fundamentally predicated on the assessed veracity of the steel manufacturer and traceability. With verified manufacturers and supply chains, no verification testing may be required.
- Procurers should consider carefully the benefits a verified solution brings, in respect of product risk, project schedule risk and reputational risk from the consequences of failure

7 RESPONSIBLE STEEL PROCUREMENT – A SUPPLY CHAIN SOLUTION

7.1 Context

The procurement, fabrication and erection of structural steelwork for buildings, infrastructure and resources projects involves a supply chain that is as varied as it is long. Contractual relationships and commercial and political pressures all influence the ultimate procurement scenario, which can also change markedly over the period of project delivery. It is also clear that the Regulatory environment is continually recalibrating, influenced by tensions that exist between our obligations under World Trade Organisation (WTO) requirements for free trade, performance solutions enabling innovation and the most fundamental requirements to ensure our community can expect risk-minimised safe solutions for their workplaces and habitation.

Regardless of the procurement permutations implemented and the project type, there is an overarching duty of care prescribed by Regulation for all stakeholders. Taken within the context of a supply chain, this may be contextualised as a 'chain of responsibility', linking the duty of care of each stakeholder through overlapping responsibilities designed to ensure a shared responsibility and a consistent and seamless approach to compliant outcomes.

The following sections explore Workplace Health and Safety (WHS), duty of care and the responsibilities for each stakeholder in the supply chain.

7.2 Workplace Health and Safety and Duty of Care

7.2.1 Model Workplace Health and Safety Act

The Model Workplace Health and Safety Act 2011 (Ref. 2) (the WHS Act) provides a framework to protect the health, safety and welfare of all workers at work. It also protects the health and safety of all other people who might be affected by the work. The WHS Act also provides protection for the general public so that their health and safety is not placed at risk by work activities. The general requirements of this Act have been implemented in most, but not all, jurisdictions in Australia.

The WHS Act places the primary health and safety duty on a person conducting a business or undertaking (PCBU). The PCBU must ensure, so far as is *reasonably practicable*, the health and safety of workers at the workplace.

Reasonably practicable is specifically defined, meaning that which is, or was at a particular time, reasonably able to be done to ensure health and safety, taking into account and weighing up all relevant matters, including:

- The likelihood of the hazard or the risk concerned occurring
- The degree of harm that might result from the hazard or the risk
- What the person concerned knows, or ought reasonably to know, about the hazard or risk, and ways or eliminating or minimising the risk
- The availability and suitability of ways to eliminate or minimise the risk
- After assessing the extent of the risk and the available ways of eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk.

There are two elements to what is *reasonably practicable*. A duty-holder must first consider *what can be done*, that is, what is possible in the circumstances for ensuring health and safety. They must then consider whether it *is reasonable, in the circumstances*, to do all that is possible.

In practice, this means that what can be done should be done unless it is reasonable in the circumstances for the duty-holder to do something less.

The question of what is *reasonably practicable* is to be determined objectively, and not by reference to the duty-holder's capacity to pay or other particular circumstances. A duty-holder

cannot expose persons to a lower level of protection simply because it is in a lesser financial position than another duty-holder.

Safe Work Australia have prepared a guide (Ref. 41) on determining what is reasonably practicable to meet a health and safety duty.

7.2.2 Codes of Practice

The Work Health and Safety Act 2011 references a range of 'Codes of Practice' (CoP) that provide implementation guidance. CoP's relevant to the current discussion include:

- 'Managing the risks of plant in the workplace'
- 'Safe design of structures'
- 'Construction work'

The Model Codes of Practice may be freely downloaded from:

https://safeworkaust.govcms.gov.au/resources-publications/model-codes-of-practice.

Specific state implementations of these may be found on the relevant State Regulator (usually WorkSafe or SafeWork) website.

Codes of Practice are admissible in court proceedings under the WHS Act and Regulations. Courts may regard a Code of Practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates.

Whilst there are a number of codes of practice relevant to construction work and the supply chain, the 'Safe design of structures' Code of Practice 2015 (Ref. 21) is of particular relevance.

7.2.3 Stakeholder Scope

The overarching focus of the 'Safe Design of Structures' CoP is on those who provide design services and deliverables (including as specifically stated architects, building designers, engineers, building surveyors, interior designers, landscape architects, town planners, building contractors and all other design practitioners contributing to, or having overall responsibility for, any part of the design). However, it is significant to note that the Act/Regulation and/or CoP also outlines specific duties for:

1. **Clients** (a person conducting a business or undertaking who commissions a design or construction work or a construction project)
2. The **principal contractor**
3. The **manufacturer** (including of a product or a structure). This includes steel manufacturers and also fabricators.
4. The **importer** (including of material or a structure). This includes importers of steel material and also of fabricated steel structures.
5. The **supplier** (including of material or a structure). This includes distributors of steel material and components.
6. The **constructor** (of the steel structure). This includes steelwork erectors and other contractors associated with site installation.

Examples of these duties are referenced in the following sections outlining responsibilities of specific stakeholders. It is important to note that the Act specifically states that duties assigned to a person under the Act cannot be transferred. The duty of care cannot be abrogated through contractual undertakings.

Significantly, the CoP states:

"Where more than one person has a duty for the same matter, each person retains responsibility for their duty and must discharge it to the extent to which the person has the capacity to influence or control the matter or would have had that capacity but for an agreement or arrangement claiming to limit or remove that capacity".

7.2.4 The Safety Report

The WHS Regulation and CoP make specific reference to the '*Safety Report*' as the written report that the designer **must** provide to the client that specifies the hazards relating to the design of the structure that, so far as the designer is reasonably aware:

- Create a risk to persons who are to carry out the construction work, who use the structure as a workplace or during demolition; and
- Are associated only with the particular design and not with other designs of the same type of structure

The *Safety Report* should include information about:

- Any hazardous materials or structural features and the designer's assessment of the risk of injury or illness to construction workers arising from those hazards
- The action the designer has taken to control those risks

The client must provide a copy of the *Safety Report* to the principal contractor.

Working with WHS (Qld), ASI has established a definitive link between non-compliant construction products (in this case steel) and the duties of care under the WHS Regulation (Ref. 22). It is therefore clear that the steps taken to address risks associated with the known issue of potential non-compliance of steel must be included in the Safety Report.

7.3 Chain of Responsibility and the Steel Supply Chain

The overlapping duties of care mandated in the WHS Act and Regulations and contextualised in codes of practice such as the Safe Design of Structures Code of Practice (Ref. 21) create, in effect, a 'chain of responsibility' connecting all parties in the supply chain, to ensure safe carriage of the overarching obligation to provide our community with risk-minimised safe outcomes that are applicable to all project types.

More recently, in response to demonstrable issues with non-conforming construction products across all construction materials, the Qld State Government enacted the "Building and Construction Legislation (Non-conforming Building Products—Chain of Responsibility and Other Matters) Amendment Act 2017" (Ref. 23) that establishes a chain of responsibility, placing duties of building product supply chain participants (including product designers, manufacturers, importers, suppliers and installers) to ensure building products used in Queensland are safe and fit for intended purpose.

Other jurisdictions are in the process of addressing non-conforming building products. The reader is encouraged to actively track the status of implementation in their respective State. The status at the time of writing is provided in Appendix H which also lists websites containing further information on non-conforming building products for each State.

Separate to the above, in some states, the supply chain is also required to comply with chain of responsibility requirements for the transportation of products from yard to site.

7.4 Risk Assessment and Documentation

The Safe Design of Structures Code of Practice (CoP) pays particular attention to assessment of risks and establishing documentation to ensure all relevant parties are informed throughout the lifecycle of the project and structure.

The CoP speaks to the risk management process as a systematic way of making a workplace as safe as reasonably practicable and being used as part of the design process. The following steps are recommended:

- Identify hazards – find out what could cause harm

- Assess risks, if necessary – understand the nature of the harm that could be caused by the hazard, how serious the harm could be and the likelihood of it happening. This step may not be necessary if you are dealing with a known risk with known controls
- Control risks – implement the most effective control measure that is reasonably practicable in the circumstances and ensure it remains effective over time
- Review hazards and control measures to ensure they are working as planned

The 'steel verification protocol' outlined in this Technical Note provides the engineer the tools necessary to dependably address all the points noted above in relation to potential hazards created by non-compliant steel products.

In respect of establishing documentation, the CoP recommends key information about identified hazards and action taken or required to control risks should be recorded and transferred from the design phase to those involved in later stages of the lifecycle. Communicating this information to other duty holders will make them aware of any residual risks and reduce the likelihood of the design being altered by those engaged in subsequent work on or around the building or structure. As regards construction products, this would include procurement decisions, which must be based on full knowledge of the requirements for steel and steelwork compliance.

The CoP suggests a 'Safety Report' (refer Section 7.2.4) as an appropriate vehicle to transfer this information to other stakeholders.

7.5 Emerging supply chain imperatives

A discussion on responsible steel procurement would not be complete without highlighting the emerging imperative of sustainability that is driving the shape of future supply chains.

Sustainability and the broader corporate social responsibility context are driving procurement decisions. Increasingly, sustainability is being defined using ESG Principles which relate to a set of standards for company operations that cover environmental, social and governance best practice:

- **Environment**: The supply chain must demonstrate environmental sustainability credentials aligned with a focus to reduce the carbon footprint, reduce waste and use of resources, increase participation in the circular economy – Reduce | Reuse | Recycle | Remanufacture, and to prevent harm to the environment, community and its ecosystems.
- **Social**: This area considers societal impact of the company, which includes diversity, human rights and the health, safety and welfare of employees. From a lifecycle perspective, procurement of compliant construction products ensures fit-for-purpose outcomes that minimise long term maintenance, rework and the likelihood of early failure of the structure. The Modern Slavery Act came into effect on 1st January 2019. The social issue of modern slavery occurs in sourcing from global supply chains and business has the power and influence to be watchful of, and to address. Modern slavery comprises practices such as human trafficking, slavery, forced labour, child labour, and slavery-like practices. The Act prescribes a reporting regime relating to responsible materials sourcing for larger businesses (annual revenue more than AUD $100M) with voluntary reporting for all others.
- **Governance**: Covers the rights, conduct and responsibilities of management of the company, and includes employee pay and compensation, transparency and responsible processes, stewardship, and ethical business conduct.

A detailed discussion of these aspects is beyond the scope of this Technical Note. However, stakeholders in the steel supply chain would be well advised to educate themselves as to the likely current and emerging influences of these aspects on supply chain operation.

Key takeaways:

- WHS Duty of Care is overarching. WHS Codes of Practice, in particular the 'Safe design of structures code of practice' mandate specific duties for most stakeholders in the supply chain
- Both WHS and legislative changes that have or are being implemented by various States establish a 'chain of responsibility' between all stakeholders in the building product supply chain.
- WHS requires designers to identify potential hazards, which would include that of non-compliant construction products, and for other stakeholders in the supply chain to ensure risks are minimised with respect to potential non-compliant construction products.
- Sustainability and ESG (Environmental – Social – Governance best practice) principals are key influences that will shape the supply chain moving forward.

8 STAKEHOLDER RESPONSIBILITIES AND WHS

8.1 Context

Section 7 outlined the framework for responsible steel procurement established by the WHS Act and Safe Design of Structures Code of Practice (CoP). That framework both mandates and implies a range of responsibilities for the various stakeholders in the supply chain, as further elaborated in this section.

8.2 Responsibilities of Designers

Section 22 of the WHS Act speaks to the responsibilities of “persons conducting businesses or undertakings that **design** plant, substances or structures”. Paraphrasing the significant aspects:

- The designer must ensure, so far as is reasonably practicable, that the plant, substance or structure is designed to be without risks to the health and safety of persons.
- The designer must carry out, or arrange the carrying out of, any calculations, analysis, testing or examination that may be necessary for the performance of the duty imposed.
- The designer must give adequate information to each person who is provided with the design for the purpose of giving effect to it concerning, among other things, any conditions to ensure the structure is without risks to health and safety during construction, use as a workplace and demolition. The development of a work health and safety (WHS) file for a structure could assist the designer meet the duty to provide information to others. It could include copies of all relevant health and safety information the designer prepared and used in the design process, such as the safety report, risk register, safety data sheets, manuals and procedures for safe maintenance, dismantling or eventual demolition.
- The designer, on request, must, so far as is reasonably practicable, give current relevant information on the matters referred to in the item above to a person who carries out, or is to carry out, any of the activities referred to.

The Safe Design of Structures CoP provides clarity on who is considered a designer, paraphrased:

- architects, building designers, engineers, building surveyors, interior designers, landscape architects, town planners and all other design practitioners contributing to, or having overall responsibility for, any part of the design
- building service designers, engineering firms or others designing services that are part of the structure
- contractors carrying out design work as part of their contribution to a project.
- temporary works engineers
- persons who specify how structural alteration, demolition or dismantling work is to be carried out.
- Persons who modify a design without reference to the original designer take on the duties of a designer

The CoP also provides further clarity regarding responsibilities of designers, paraphrased:

- Safe design begins at the concept development phase of a structure when making decisions about: …materials to be used…
- In addition to core design capabilities relevant to the designer’s role, a designer should also have: …knowledge of technical design standards…

- So far as is reasonably practicable, the duty holders involved must consult each other on the hazards and risks associated with the building and work together on appropriate design solutions.

The designer has a responsibility to inform his client fully of the expectations regarding process when the designer is required to certify the structure as fit-for-purpose under the protocols required in the NCC. It is highly recommended that appropriate wording is added to the drawing notes and/or construction specification. Recommended wording would be of the form:

“The design of the steelwork has been based on the requirements set out in the contract specifications and AS 4100, together with the corresponding referenced Australian Standards for supply of steelwork, supply of fasteners and welding consumables and fabrication. The contractor is to provide all documentation in English that the steelwork complies with the construction specification and the Standards. Any deviation to these requirements, unless approved by the design engineer, may render the structural steel and steelwork not fit-for-purpose and not compliant with the requirements of the NCC. The structural steel and/or steelwork will need to be verified and/or re-supplied under these circumstances”.

8.3 Responsibilities of Manufacturers

Section 23 of the WHS Act applies to “a person (the **manufacturer**) who conducts a business or undertaking that manufactures” plant, a substance or a structure. Paraphrasing the significant aspects:

- The manufacturer must ensure, so far as is reasonably practicable, that the plant, substance or structure is manufactured to be without risks to the health and safety of persons.
- The manufacturer must carry out, or arrange the carrying out of, any calculations, analysis, testing or examination that may be necessary for the performance of the duty imposed.
- The manufacturer must give adequate information to each person to whom the manufacturer provides the plant, substance or structure concerning, among other things, the results of any testing and of any conditions necessary to ensure the structure is without risks to health and safety during construction, use as a workplace and demolition.
- The manufacturer, on request, must, so far as is reasonably practicable, give current relevant information on the matters referred to in the item above to a person who carries out, or is to carry out, any of the activities referred to.

8.4 Responsibilities of Importers

Section 24 of the WHS Act applies to “a person (the **importer**) who conducts a business or undertaking that imports” plant, a substance or a structure. Paraphrasing the significant aspects:

- The importer must ensure, so far as is reasonably practicable, that the plant, substance or structure is without risks to the health and safety of persons.
- The importer must: (a) carry out, or arrange the carrying out of, any calculations, analysis, testing or examination that may be necessary for the performance of the duty imposed or (b) ensure that the calculations, analysis, testing or examination have been carried out.
- The importer must give adequate information to each person to whom the importer provides the plant, substance or structure concerning, among other things, the results of any testing and of any conditions necessary to ensure the structure is without risks to health and safety during construction, use as a workplace and demolition.
- The importer, on request, must, so far as is reasonably practicable, give current relevant information on the matters referred to in the item above to a person who carries out, or is to carry out, any of the activities referred to.

8.5 Responsibilities of Distributors and Suppliers

Section 25 of the WHS Act applies to "a person (the **supplier**) who conducts a business or undertaking that supplies" plant, a substance or a structure. Paraphrasing the significant aspects:

- The supplier must ensure, so far as is reasonably practicable, that the plant, substance or structure is without risks to the health and safety of persons.
- The supplier must (a) carry out, or arrange the carrying out of, any calculations, analysis, testing or examination that may be necessary for the performance of the duty imposed or (b) ensure that the calculations, analysis, testing or examination have been carried out.
- The supplier must give adequate information to each person to whom the supplier supplies the plant, substance or structure concerning, among other things, the results of any testing and of any conditions necessary to ensure the structure is without risks to health and safety during construction, use as a workplace and demolition.
- The supplier, on request, must, so far as is reasonably practicable, give current relevant information on the matters referred to in the item above to a person who carries out, or is to carry out, any of the activities referred to.

8.6 Responsibilities of Fabricators

Fabricators are not specifically named in the WHS Act, which is understandable, as fabrication is one of the myriad of functions that cannot all be specifically named. However, Section 23 of the WHS Act is applicable as the fabricator is "a person (the **manufacturer**) who conducts a business or undertaking that manufactures … a structure that is to be used, or could reasonably be expected to be used, as, or at, a workplace". Paraphrasing the significant aspects:

- The manufacturer (fabricator) must ensure, so far as is reasonably practicable, that the plant, substance or structure is manufactured to be without risks to the health and safety of persons.
- The manufacturer (fabricator) must carry out, or arrange the carrying out of, any calculations, analysis, testing or examination that may be necessary for the performance of the duty imposed.
- The manufacturer (fabricator) must give adequate information to each person to whom the manufacturer provides the plant, substance or structure concerning, among other things, the results of any testing and of any conditions necessary to ensure the structure is without risks to health and safety during construction, use as a workplace and demolition.
- The manufacturer (fabricator), on request, must, so far as is reasonably practicable, give current relevant information on the matters referred to in the item above to a person who carries out, or is to carry out, any of the activities referred to.

8.7 Responsibilities of Principal Contractors

Section 26 of the WHS Act applies to "persons conducting businesses or undertakings that install, construct or commission plant or structures". Paraphrasing the significant aspects:

- The person must ensure, so far as is reasonably practicable, that the way in which the plant or structure is installed, constructed or commissioned ensures that the plant or structure is without risks to the health and safety of persons who install or construct the plant or structure, who use the plant or structure, who carry out reasonably foreseeable activities such as decommissioning, dismantling, demolition or disposal or who are in the vicinity and whose health and safety may be affected by the actions noted above.

The CoP provides further clarity regarding responsibilities of principal contractors:

"The principal contractor is a person conducting a business or undertaking that:

- *commissions the construction project (the client), or*

- *is engaged by the client to be the principal contractor and is authorised to have management or control of the workplace.*

The principal contractor has duties to ensure the construction work is planned and managed in a way that eliminates or minimises health and safety risks so far as is reasonably practicable. Further guidance on managing risks for construction projects and principal contractor duties is available in the Code of Practice: Construction Work."

Principal contractors should also note that there will be additional time and costs associated with certification by the engineer where verification of steel and steelwork is required. Refer Section 8.2.

8.8 Responsibilities of Clients

The responsibilities of clients are not specifically referenced in the WHS Act. However, as a stakeholder driving the final procurement outcomes for a project, there is clearly a primary duty of care prescribed under Section 19 of the WHS Act. Paraphrasing the significant aspects:

- A person conducting a business or undertaking must ensure, so far as is reasonably practicable, that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking.
- A person conducting a business or undertaking must ensure, so far as is reasonably practicable: (a) the provision and maintenance of a work environment without risks to health and safety; and (b) the provision and maintenance of safe plant and structures.

The CoP provides further clarity regarding responsibilities of clients:

"A person conducting a business or undertaking that commissions construction work (the client) has specific duties under the WHS Regulations to:

- *consult with the designer, so far as is reasonably practicable, about how to ensure that health and safety risks arising from the design during construction are eliminated or minimised, and*
- *provide the designer with any information that the client has in relation to the hazards and risks at the site where the construction work is to be carried out."*

Clients should also note that there will be additional time and costs associated with certification by the engineer where verification of steel and steelwork is required. Refer Section 8.2.

Key takeaways:

- The WHS Act and codes of practice, in particular the 'Safe design of structures code of practice', impose particular and very significant responsibilities on most members of the supply chain
- These shared responsibilities create, in effect, a 'chain of responsibility' where all stakeholders must work together to ensure risk-minimised outcomes
- There will be additional time and costs for the engineer to certify where verification of steel and steelwork is required.

9 RESPONSIBLE STEEL PROCUREMENT FRAMEWORK

9.1 Context

The responsibilities mandated by the WHS Act unite the supply chain for a building or structure into a 'chain or responsibility' through a shared duty of care to ensure risk-minimised outcomes.

Appendix A of the Safe Design of Structures CoP documents the consultation, cooperation and coordination duties between stakeholders for a range of different contractual project structures.

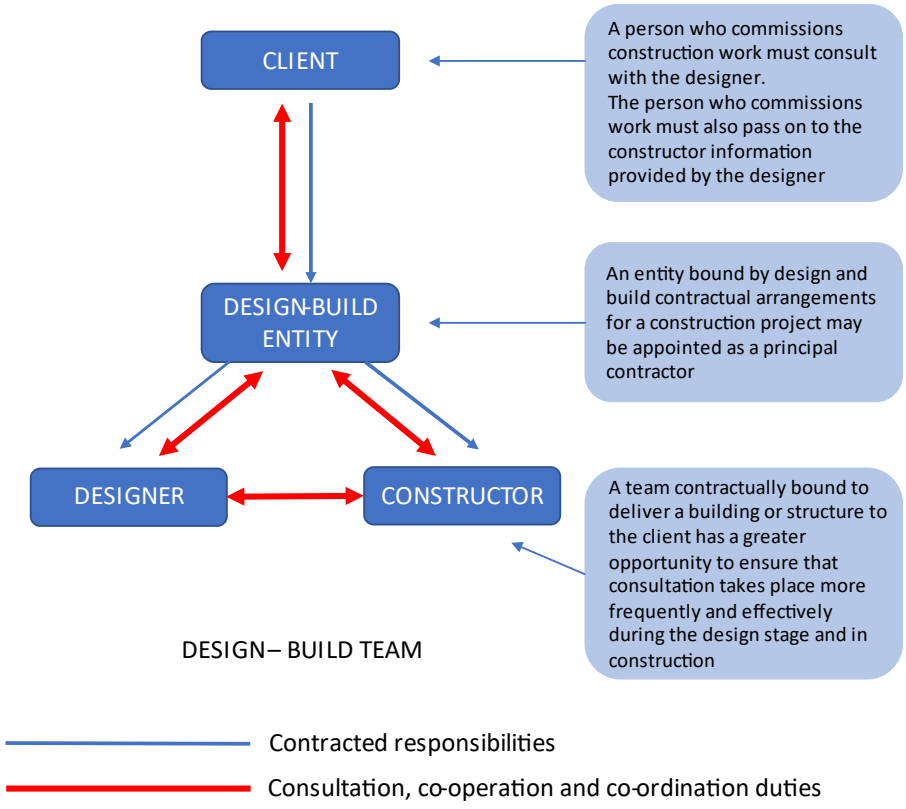

Figure 7 – Responsibilities for consultation, cooperation and coordination
Design-build contractual structure

Figure 7, reproduced from Appendix A of the Safe Design of Structures CoP, illustrates the responsibilities of and interactions between the stakeholders in a project based on a design-build contractual model. Other contractual models are, of course, possible. Notice the responsibility for consultation, cooperation and coordination is required, irrespective of the contractual relationship between the parties.

9.2 Responsibilities for Steel Procurement

Figure 8 presents a flowchart of the steel procurement process based on the recommendations in this Technical Note and highlighting the responsible parties contextualised from the general responsibilities derived from WHS Regulation and noted in Section 8. The intent of the flowchart is valid irrespective of the contractual relationships enacted on a particular project, for example, as illustrated in Fig. 7. It is important to reiterate that the duty of care and responsibilities defined in the WHS Act cannot be abrogated or re-assigned by a particular contractual relationship.

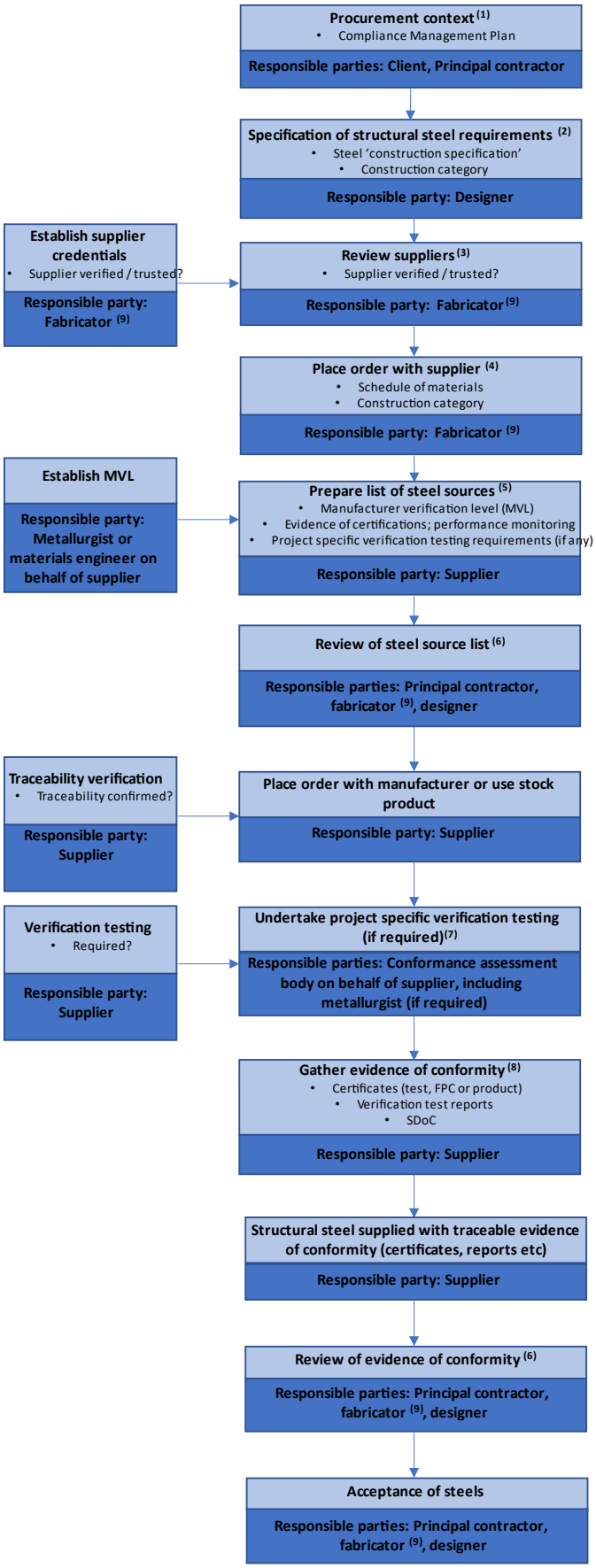

Figure 8 – Responsibilities within steel procurement process

Notes to Fig. 8:

(1) The client must take shared responsibility for understanding the contemporary procurement environment and engaging with the project delivery team to ensure a cost-effective risk-minimised quality solution is the outcome. Along with all other stakeholders, clients do have responsibilities under WHS Regulation. The principal contractor should prepare a Compliance Management Plan (refer Section 9.3) prior to the project procurement commencing as an agreed protocol to address potential non-compliance.

(2) The requirements for the 'construction specification' are defined in AS 4100 (Ref. 3) and AS/NZS 5131 (Ref. 14). The construction specification, including drawings, is prepared by the designer. ASI have developed the 'National Structural Steelwork Specification' (Ref. 24) to support designers in properly implementing AS/NZS 5131 into the project process.

(3) The review of suppliers and the use of verified / trusted suppliers is strongly recommended. Support for verification of the supply chain in this manner provides the best opportunity to introduce cost-effective compliant outcomes.

(4) Orders for steelwork placed with suppliers must clearly transcribe the relevant requirements of the construction specification and state that steel must meet the 'Steel verification protocol' defined in this Technical Note. Purchase orders might conveniently be appended with a summary of the protocol as part of the standard conditions.

(5) The selected supplier(s) must provide details of the steel sources proposed. The credentials of the steel sources, including the assessed MVL, evidence of certifications and results of performance monitoring must be available. Where project specific verification testing is required, this must also be available for review. It would be convenient for the supplier to develop these credentials for the steel sources commonly utilised.

(6) Specific review of the proposed steel source list and evidence of conformity are recommended hold points. A mandated review will help ensure the veracity of the procurement process.

(7) Any requirement for project-specific verification testing is dictated by the particular conformity assessment pathway adopted. Refer to Appendix G. The supplier may need to rationalise stock responsive to the need to supply material for both CC2 and CC3 projects.

(8) The required evidence of conformity is defined in Section 4.

(9) Depending on project type and size, the responsibilities of the fabricator may also be assumed by the structural steel contractor, who subcontracts fabrication to the fabricator.

9.3 Compliance Management Plan

The compliance of construction products on a project cannot be assumed. An internationalised procurement environment, price competition and the complexity of ascertaining compliance make it difficult for stakeholders to adequately respond within project timeframes to situations where the compliance of particular products is in question.

Given this environment, the principal contractor must have in place a plan for managing procurement and compliance of structural steel to ensure cost effective, timely risk minimised outcomes. The procurement, fabrication and erection of structural steelwork should be undertaken under a documented Compliance Management Plan (CompMP).

The CompMP should include:

- the requirements of the Quality Plan in AS/NZS 5131
- Process and documentation checklists for purchasing steel
- Process for identification and traceability of steel and steelwork from purchasing through to completion of the project
- Process for ascertaining compliance of structural steel (as defined in this Technical Note)
- Process and documentation checklists for erection of structural steelwork

- Assigned responsibilities for compliance management, including names and CV's of relevant personnel
- A response to any specific issues documented in the designer's 'Safety Report' (refer Section 7.4) required under WHS

The CompMP should be provided by the principal contractor prior to first procurement of materials for the project.

Key takeaways:

- WHS responsibilities and duty of care cannot be abrogated or re-assigned by a particular contractual relationship
- The procurement process and responsibilities indicated in Figure 8 are considered good practice and consistent with duty of care under WHS
- A 'Compliance Management Plan' prepared by the principal contractor is strongly recommended to proactively minimise project impact caused by potential non-compliant construction products

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APPENDIX A

INDUSTRY STAKEHOLDER REVIEW PANEL

The Technical Note was prepared under the guidance of an ASI steering committee and was peer reviewed by a range of representatives and organisations as listed below. The contribution of these entities for the benefit of the Australian steel community is gratefully acknowledged.

Name	Company	Company type
Anthony Ng	Infrabuild	Manufacturer
Chris Kilmore	Bluescope	Manufacturer
Doug Hawkes	Structural Integrity Engineering	Engineer
Glenn Gibson	IDEC	Fabricator
George Vorobieff	Head to Head International	Consultant
John Merrick	Arcadis	Engineer
Maria Mavrikos	Structural Challenge	Fabricator
Mark Bubicich	Liberty Primary Steel	Manufacturer
Michael Sampson	Southern Steel	Distributor
Pablo Santos	S & L Steel	Fabricator
Patrick Beshara	LendLease	Constructor

APPENDIX B

IDENTIFICATION AND MARKING OF STRUCTURAL STEEL PRODUCT

B.1 Context

The Australian steel product Standards (Refs 6, 7, 8, 9) mandate specific requirements for identification and marking of steel product claiming to comply to the Standards.

Steel manufacturers, suppliers, distributors and fabricators must be familiar with these requirements for identification and marking to ensure product is compliant. They must have access to current copies of the relevant product Standards.

B.2 Marking Requirements

The product Standards require all product lengths to be identified with a mark that indicates the identification requirements noted in Section B.3. In addition, bundles or packs of material are to be marked with the bundle/pack identification information noted in Section B.3.

The marks shall be produced/applied at the time of manufacture, legible and durable to the point of fabrication and/or after fabrication and coating (depending on the type of identification and type of product). Depending on the product the marking shall be applied at defined locations and spacings.

B.3 Identification Requirements

The identification requirements across the four product Standards may be summarised as:

Individual lengths/plates:

(a) A mark with the two characters ‘AS’ to indicate the item is made to the relevant Australian Standard

(b) The manufacturer’s name or mark or both

(c) The grade of the steel

(d) A mark allowing the item to be traced to a test certificate

(e) The nominal size and shape

Bundles/packs:

(f) The manufacturer’s name or mark or both

(g) Reference to the relevant Standard eg AS/NZS 3678

(h) The grade of steel

(i) The identification of the heat of steel from which it was made

(j) The nominal size and shape

APPENDIX C

TEST AND INSPECTION CERTIFICATES

C.1 Context

The Australian steel product Standards (Refs 6, 7, 8, 9) specifically state “A test and inspection certificate shall be available to the purchaser for all products manufactured to this Standard for each batch produced”. They also mandate specific requirements for test and inspection certificates in Clause 11.2 for steel product claiming to comply to the Standards.

Steel manufacturers, suppliers, distributors and fabricators must be familiar with these requirements for test and inspection certificates to ensure product is compliant. They must have access to current copies of the relevant product Standards.

C.2 Minimum Requirements for Test and Inspection Certificates

The minimum requirements for test and inspection certificates across the four product Standards may be summarised as:

(a) Shall be in English alphanumeric characters, issued by the manufacturer and include the following:

(b) Manufacturer’s name

(c) Test certificate number

(d) Date of certification

(e) Product, testing specification and grade e.g. AS/NZS 3678-350L0

(f) Product designation

(g) Product steelmaking process, for example basic oxygen or electric arc

(h) Length, bundle, pack or unique product identifier to which the test certificate applies

(i) Heat number (from steel feed melting and casting)

(j) Chemical analysis type e.g. cast analysis ‘L’ or product ‘P’

(k) For each test, a laboratory identification providing traceability to the laboratory accreditation of the test type.

(l) Chemical composition for all elements listed in the applicable Standard, typically carbon (C), phosphorus (P), manganese (Mn), silicon (Si), sulphur (S), chromium (Cr), molybdenum (Mo), vanadium (V), nickel (Ni), copper (Cu), aluminium (Al), titanium (Ti), niobium (Nb), boron (B), carbon equivalent (CE) and any element intentionally added.

(m) As required in the relevant Standard, mechanical testing information:

I. Tensile tests providing position and orientation, batch or item test and results (yield strength, gauge length and % elongation)

II. Impact tests providing position and orientation, batch or item test, test piece dimensions, tested temperature and results (individual and average energy in joules)

III. Through-thickness tensile tests providing position and orientation, batch or item test and results (% reduction in area)

(n) Any additional heat treatment of the test piece

(o) The manufacturing facilities quality management system’s certifier and certification number

(p) The body assessing the product conformity to the Standard in question. For self-assessment, this is the manufacturer, the default scheme being as described in Appendix B of the Standard in question.

(q) A declaration from the manufacturer that the products supplied comply with the requirements of the Standard in question. This shall be validated by the manufacturer's authorised inspection representative, including their name and position. Where the document has been validated by the purchaser's authorised representative or by an inspector designated by a third party, their name and position shall be on the document.

C.3 Qualifications on Test and Inspection Certificates

The product Standards require that tests documented on a test and inspection certificate are performed by a laboratory accredited by signatories to the International Laboratory Accreditation Corporation (ILAC) through their Mutual Recognition Agreement (MRA) for the specific tests described on the test and inspection certificate. The appropriate logo or further details of the ILAC (MRA) signatory shall be noted on the document.

In Australia, ILAC (MRA) accredited bodies include National Association of Testing Authorities (NATA).

NOTES:

1. It is important that stakeholders check the accreditation of the testing laboratory specifically covers the range of tests documented on the test and inspection certificate. There have been reported instances of both fraudulent and misleading documentation. Check ILAC website at International Laboratory Accreditation Cooperation (ilac.org)
2. Market feedback indicates that in certain regions internationally, there are concerns with the reliability of test results from some accredited test facilities. Where concerns exist, it is recommended that a duplicate set of samples is collected by an independent authority and the duplicate set sent to an accredited testing facility in Australia.

APPENDIX D

SUPPLIER DECLARATION OF CONFORMITY (SDoC)

D.1 Context

AS/NZS 5131 (Ref. 14) recommends a Supplier Declaration of Conformity is provided for purchased components. An SDoC must be provided by the supplier or distributor where material is sourced internationally. The SDoC must include reference to the verification test report or reports used to support any claim of conformity.

D.2 Typical Form of SDoC

Figure D.1 provides an outline of the typical form of an SDoC for structural steel.

Notes to Fig. D.1:

1. Each SDoC must have a unique number for identification purposes
2. Company details must include the company name, registered business address, ABN and contact details. The street address of the location of manufacture (for steel manufacture) must also be included.
3. The ‘Unique product identification’ will usually be the combination of the product name and the mill certificate credentials, the latter comprising the manufacturer name, the mill certificate number and the steel batch number.
4. The Standards to which conformity is declared will be one of the relevant Australian steel product Standards (Refs. 6, 7, 8, 9).
5. The intended use of the product describes the expected application of the product. In most cases for structural steel this might be “Steel structures or composite steel and concrete structures as defined in the scope of AS 4100, AS/NZS 5100.6 and AS/NZS 2327”.
6. The ‘Evidence of Compliance’ will depend on the exact conformity assessment pathway selected (refer Section 6 and Appendix G) up to the point of supply and would include the appropriate combination of the following:
    a. Documentation demonstrating the applicable Manufacturer Verification Level (MVL) (Refer Section 4.4). This might include certification credentials of the steel manufacturer and accreditation credentials of the conformity assessment body (CAB) certifying the steel manufacturer
    b. Mill certificates from the steel manufacturer
    c. Evidence of marking and identification to verify traceability (refer Section 4.5)
    d. Test reports or test certificates where product performance verification (Refer Section 4.7) is required
    e. Assessment report where test reports or test certificates are used with an assessment method to verify product performance
7. The declaration must be signed and dated by a party authorised to make the declaration on behalf of the company.

SUPPLIER DECLARATION OF CONFORMITY

SDoC Number:

1. Company Details:
(including Corporate address and street address where product manufactured, if applicable)

2. Unique product identification:
Name:
Unique identification code:

3. Standard(s) to which conformity declared:

4. Intended use:

5. Evidence of conformity:
Manufacturer verification level:
Mill certificates:
Marking & identification:
Test reports/test certificates:
Assessment reports:

Declaration:
I hereby declare that the product noted at item 2 complies with the Standards noted at item 3 based on the evidence of compliance noted at item 4
Name: Signed: Date:
Position:

Figure D.1 Typical Form of SDoC

APPENDIX E

VERIFICATION BATCH TESTING AND INSPECTION

E.1 Context

Verification testing is the independent assessment of selected mechanical and chemical properties of a test sample. Such testing should be undertaken by a suitably accredited test facility. The sample or samples will be taken from a batch or lot of product intended for use in a building or infrastructure project. The procurer or the project designer needs to specify the material properties to be assessed, the sampling plan and the basis on which decisions about the quality of batches of product will be made (pass/fail or statistical sampling).

Testing must be undertaken by test facilities accredited by signatories to the International Laboratory Accreditation Co-operation's (ILAC's) Mutual Recognition Arrangement (MRA). The scope of accreditation should include the specific tests required in the relevant material supply standard. In Australia, the national accrediting body is the National Association of Testing Authorities (NATA). To check the scope of test facility accreditation, reference can be made to the website of the relevant accrediting body.

Note that in certain regions internationally, test facility accreditation is no guarantee of reliable test results. If there are concerns about the reliability of an offshore test facility utilised for project specific third-party testing, it is recommended a duplicate set of samples is collected. One set of samples is sent to the offshore test facility while the second is sent to Australia. A robust sample collection process and tracking system involving a trusted third party is advisable. A small percentage of the samples sent to Australia can be tested (10-20% suggested). It is recommended a qualified metallurgist review the two sets of test results and advise if additional testing in Australia is warranted.

E.2 Verification Testing Basis

The recommended verification testing focuses primarily on the mechanical and chemical properties of structural steels, as these variables have a significant impact on their structural performance and weldability.

Chemical composition of the finished product should be determined in accordance with the AS/NZS 1050 series Standards or other procedures that achieve the same, or better, degree of accuracy. The product analysis should conform to the limits for chemical elements, including residual elements such as boron that should not be intentionally added to the steel without the agreement of the purchaser as required in the applicable product standard. Typically, the method of choice is spark OES (Optical Emission Spectrometry) as it allows for fast and accurate element analysis of solid metal samples.

The verification testing and inspections should be undertaken to the requirements of the relevant product standard. Any testing and inspection bodies engaged to undertake such activities shall be appropriately accredited.

E.3 Sampling and testing plan

E.3.1 Introduction

Batch testing and inspection is predicated on selection of an appropriate sampling and testing plan. Two sampling and testing plans have been prepared for use in conjunction with the conformity assessment pathway selection approach proposed in this document. These are termed 'Level 1 and 'Level 2'.

The Level 1 plan features a non-statistical acceptance criterion for all material property testing and inspections, see Table E1. The Level 2 plan features a statistical sampling (inspection by variables) batch acceptance approach for material tensile properties (Table E2(b)) and a non-statistical acceptance criterion for the remaining properties (Table E2(a)).

E.3.2 Sampling and Testing Plan – Level 1

The Level 1 sampling and testing plan shown in Table E1 features a non-statistical acceptance criteria for all material property testing and inspections.

Table E1

Sampling and testing plan – Level 1

Structural Steel Product	Characteristic	Requirement	Sample Size	Acceptance No. (Ac)(4)
Structural hollow section	Chemical composition	Product analysis	1	0
	Tolerance	Straightness	1	0
	Mechanical properties	Yield stress, tensile strength, elongation	1(1)	0
		Impact toughness	3(2)	0
	Weld quality	Cold flattening	1(1)	0
Plate	Chemical composition	Product analysis	1	0
	Mechanical properties	Yield stress, tensile strength, elongation	1(3)	0
		Impact toughness	3(2)	0
		Reduction in area for through-thickness properties	1	0
Hot-rolled bars and sections	Chemical composition	Product analysis	1	0
	Tolerance	Out-of-straightness	1	0
	Mechanical properties	Yield stress, tensile strength, elongation	1(1)	0
		Impact toughness	3(2)	0
Welded sections	Chemical composition	Product analysis	1	0
	Tolerance	Straightness	1	0
	Mechanical properties	Yield stress, tensile strength, elongation	1(3)	0
		Impact toughness	3(2)	0
	Weld quality	Web to flange tensile test	1(3)	0

Notes:

(1) One test for each batch not greater than 50 tonnes. Two tests for batches greater than 50 tonnes.

(2) As per product Standard, typically three test samples for impact toughness testing.

(3) One test for each batch not greater than 70 tonnes. Two tests for batches greater than 70 tonnes.

(4) The ‘Acceptance Number’ is the highest number of nonconforming items that can be found in a sample for a lot to still be considered acceptable.

E.3.3 Sampling and Test Plan – Level 2

The Level 2 sampling and testing plan features a statistical sampling (inspection by variables) acceptance criterion for tensile properties of structural steels (Table E2(b)), and a non-statistical acceptance criterion for the remaining properties of interest (Table E2(a)).

Table E2(a)

Sampling and testing plan – Level 2

Batch acceptance criterion: Non-statistical

Structural Steel Product	Characteristic	Requirement	Sample Size	Acceptance No. (Ac)[4]
Structural hollow section	Chemical composition	Product analysis	1	0
	Tolerance	Straightness	1	0
	Mechanical properties	Impact toughness	3[1]	0
	Weld quality	Cold flattening	1[2]	0
Plate	Chemical composition	Product analysis	1	0
	Mechanical properties	Impact toughness	3[1]	0
		Reduction in area for through-thickness properties[5]	1	0
Hot-rolled bars and sections	Chemical composition	Product analysis	1	0
	Tolerance	Straightness	1	0
	Mechanical properties	Impact toughness	3[1]	0
Welded sections	Chemical composition	Product analysis	1	0
	Tolerance	Straightness	1	0
	Mechanical properties	Impact toughness	3[1]	0
	Weld quality	Web to flange tensile test	1[3]	0

Notes:

(1) As per product Standard, typically three test samples for impact toughness testing.

(2) One test for each batch not greater than 50 tonnes. Two tests for batches greater than 50 tonnes.

(3) One test for each batch not greater than 70 tonnes. Two tests for batches greater than 70 tonnes.

(4) The ‘Acceptance Number’ is the highest number of nonconforming items that can be found in a sample for a lot to still be considered acceptable.

(5) Where the plate has been manufactured and ordered for improved through-thickness ductility (for example, for the avoidance of lamellar tearing), a statistical approach to verification testing is recommended (refer Table E2(b))

Table E2(b)

Sampling and testing plan – Level 2

Batch acceptance criterion: Statistical sampling

Structural Steel Product	Characteristic	Requirement	Sample Size	Acceptance No. (Ac)
Structural hollow section	Mechanical properties	Yield stress, tensile strength, elongation	min 3(1)	$\bar{X}_p - K.s \geq L$ (1) where: $\bar{X}_p$ = mean value of tests from batch s = standard deviation K = statistical multiplier (Table F1) L = minimum value of property from product standard
Plate	Mechanical properties	Yield stress, tensile strength, elongation	min 3(1)	
		Reduction in area for through-thickness properties(2)	min 3(1)	
Hot-rolled bars and sections	Mechanical properties	Yield stress, tensile strength, elongation	min 3(1)	
Welded sections	Mechanical properties	Yield stress, tensile strength, elongation	min 3(1)	

Notes:

(1) Refer to Appendix F for details of sampling inspection by variables methodology

(2) Where the plate has been manufactured and ordered for improved through-thickness ductility (for example, for the avoidance of lamellar tearing), a statistical approach to verification testing is recommended

E.4 Non-statistical Evaluation of Conformity

E4.1 Sampling, Testing and Assessment

Sampling, testing and assessment shall be undertaken in the following steps:

a) Select samples at random from the batch of steel.

b) For each characteristic in table E1 or E2, carry out inspection or testing on the number of samples required.

c) Record the number of non-conforming characteristics and accept the batch if the number is less than or equal to the acceptance number (Ac).

d) For any characteristic, if the number of non-conforming test results is greater than the acceptance number (Ac), the batch is rejected.

E4.2 Retesting in Case of Non-Conforming Product

The proposed retesting requirement outlined below is based on that found in BS 4449 (BSI, 2005).

If any test specimen fails to meet the yield stress, tensile strength, yield/ tensile ratio, elongation, impact toughness, flange to web tensile (welded sections), cold flattening (structural hollow sections), or out of straightness requirements, four additional specimens shall be taken from the

same batch to undergo tests. If all the additional four specimens pass the retests, the batch is deemed to conform to the standard. Otherwise the batch is deemed non-conforming.

E.5 Statistical Sampling Batch Acceptance Criterion

Refer to Appendix F for a statistical sampling (inspection by variables) methodology for assessing the conformity of tensile properties of a batch of steel.

E.6 Traceability

The identification number of the batch shall be identified on the verification test report and on individual or bundled product.

E.7 Test Report

A test report shall be prepared containing the following information:

a) The manufacturer's name

b) The section designation

c) The grade of steel

d) The date of testing

e) The heat number

f) Product marking

g) Individual test results

h) Computed minimum values (only applies if statistical sampling (inspection by variables) undertaken)

E.8 Supplier Declaration of Conformity

A Supplier Declaration of Conformity (SDoC) (refer to Appendix D) shall be provided. The SDoC shall include the following:

a) A statement from the supplier that the specific batch of structural steel covered by the SDoC complies with the mechanical and chemical properties, weld quality (only applicable for steel material to AS/NZS 1163 and 3679.2) and out of straightness requirements of the relevant product standard.

b) Reference verification test report or reports used to support the claim of conformity.

APPENDIX F

STATISTICAL SAMPLING AS A MEANS OF DEMONSTRATING CONFORMITY

F.1 Introduction

The international standard ISO 12491 (Ref 19) provides statistical methods for all types of building materials and components to ensure that they meet the quality control requirements given in ISO 2394 (Ref 12))/AS 5104 (Ref 13), which forms the basis for AS/NZS 1170.0 (Ref 20). The previous versions of the AS/NZS steel supply standards required steel mills to use a statistical sampling approach based on the ISO 12491 methods to demonstrate their statistically predicted proportion of non-conforming product is less than 5% at a 90% confidence level.

Sampling and testing plan (Level 2) features a statistical sampling (inspection by variables) approach to assessing the conformity of the tensile properties of batches of steel. This covers the following mechanical properties:

a) Tensile strength (f_u)

b) Yield stress (f_y)

c) Yield to tensile ratio (f_y/f_u)

d) Elongation (A_{gt})

e) Reduction in area for through-thickness properties (where the plate has been manufactured and ordered for improved through-thickness ductility (for example, for the avoidance of lamellar tearing))

The statistical sampling (inspection by variables) methodology presented in this Technical Note is based on ISO 12491 (Ref 19).

Impact toughness, chemical composition, weld quality and out of straightness should be verified using the non-statistical evaluation of conformity approach proposed in Table E2(a).

F.2 Statistical Sampling (Inspection by Variables) Methodology

F.2.1 Extent of Sampling

A minimum of three test specimens shall be taken from each batch of steel. Additional numbers of samples may be taken if the computed minimum or maximum values do not comply with those specified in the product standard.

The preparation of test samples shall be as per the relevant structural steel manufacturing standard. Properties to be tested:

a) Yield stress (f_y)

b) Tensile strength (f_u)

c) Elongation (A_{gt})

F.2.2 Evaluation of Results

The minimum values of yield stress, tensile strength, elongation and the maximum value of f_y/f_u shall be computed as follows:

Step 1: Estimation of the mean and standard deviation of the test population

The mean value and standard deviation of the tests within the batch should be estimated using the following equations for X_p and s, respectively:

$$\overline{X_p} = \sum x_s / n_p$$

$$s = \sqrt{\sum (x_s - \overline{X_p})^2 / (n_p - 1)}$$

where x_s is the individual test value and n_p is the number of test values within the batch.

Step 2: Estimation of the nominal value from tests

The minimum or maximum value of a material property may be estimated from the following equations:

$\overline{X_p} - Ks \geq L$ for minimum nominal values (no individual test result less than the lower value specified in the product standard)

$\overline{X_p} + Ks \leq U$ for maximum nominal values (no individual test result greater than the upper value specified in the product standard)

where K is the statistical multiplying factor from Table F1 and L and U are the minimum and maximum value respectively specified in the appropriate product standard.

Table F1

Statistical multiplication factor *K*

Number of test values n_p	3	4	5	6	8	10	20	30	∞
For f_y (p=0.95 at 75% confidence level	3.15	2.68	2.46	2.34	2.19	2.10	1.93	1.87	1.64
For A_{gt}, f_y/f_u (p=0.90 at 90% confidence level)	4.26	3.19	2.74	2.49	2.22	2.07	1.77	1.66	1.282

Example

Consider five tensile tests with measured upper yield strength values of ReH = 365, 340, 355, 400 and 395 MPa. From the above equations, the mean value $\overline{X_p}$ = 371 MPa and the corresponding standard deviation s = 25.84 MPa. The estimated nominal value is therefore:

$\overline{X_p} - Ks$ = 371 - (2.46 × 25.84) = 307.4 MPa

From AS/NZS 3679.1, the minimum yield stress value for Grade 300 yield stress for the material ReH = 300 MPa, for a thickness of between 11 and 17 mm. As the minimum value criteria is satisfied and no individual test values fall below the grade minimum, it is therefore concluded that the batch of steel complies with the minimum yield stress requirement for Grade 300 steel.

F.3 Verification Test Report

Refer Appendix E.

F.4 Supplier Declaration of Conformity

Refer to Appendix D.

F.5 Personnel Competency

The supplier shall employ a qualified metallurgist or materials engineer to undertake the calculations presented in section F.2.

APPENDIX G

CONFORMITY ASSESSMENT PATHWAY SELECTION

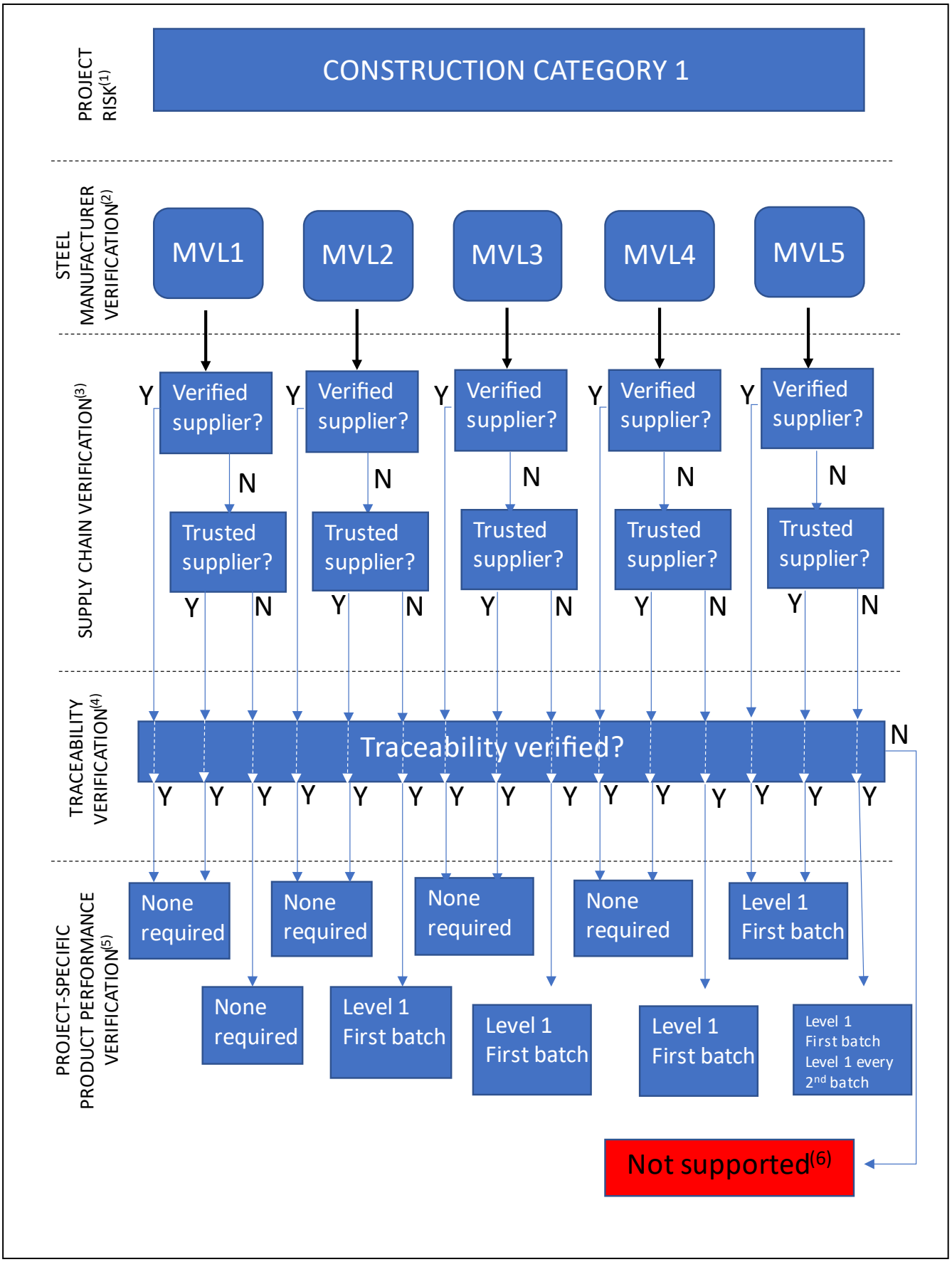
G.1 Context

The conformity assessment pathways detailed in subsequent sections have been configured as a function of the Construction Category (CC) assessed for the project based on AS 4100:2020 and identically in AS/NZS 5131:2020. Construction Categories from CC1 to CC4 are defined, from least to most risk. The designer is required to assess the Construction Category for the structure or part of the structure.

Fabrication and erection requirements for CC1 to CC3 are defined in AS/NZS 5131, including for material identification, traceability and conformity. CC4 represents projects that are of national significance or present very high risk or consequence of failure and whose requirements are greater than CC3 but cannot be pre-defined.

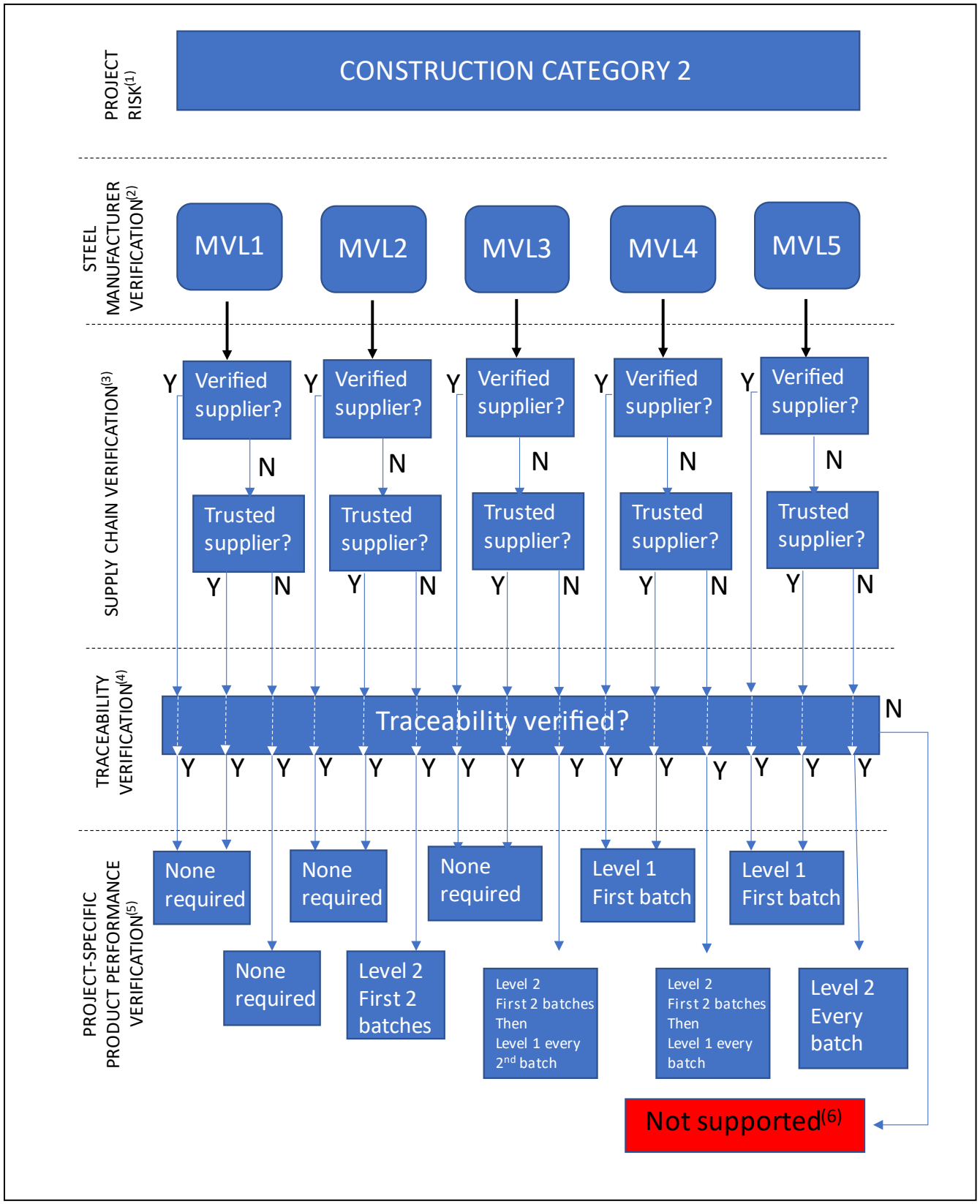
The requirements for CC4 above and beyond CC3 must be defined for the specific project. Consequently, the conformity assessment pathway for CC4 cannot be pre-defined, excepting to note that it should be at least as rigorous as CC3.

G.2 Construction Category 1



For notes, refer to Section G.4.

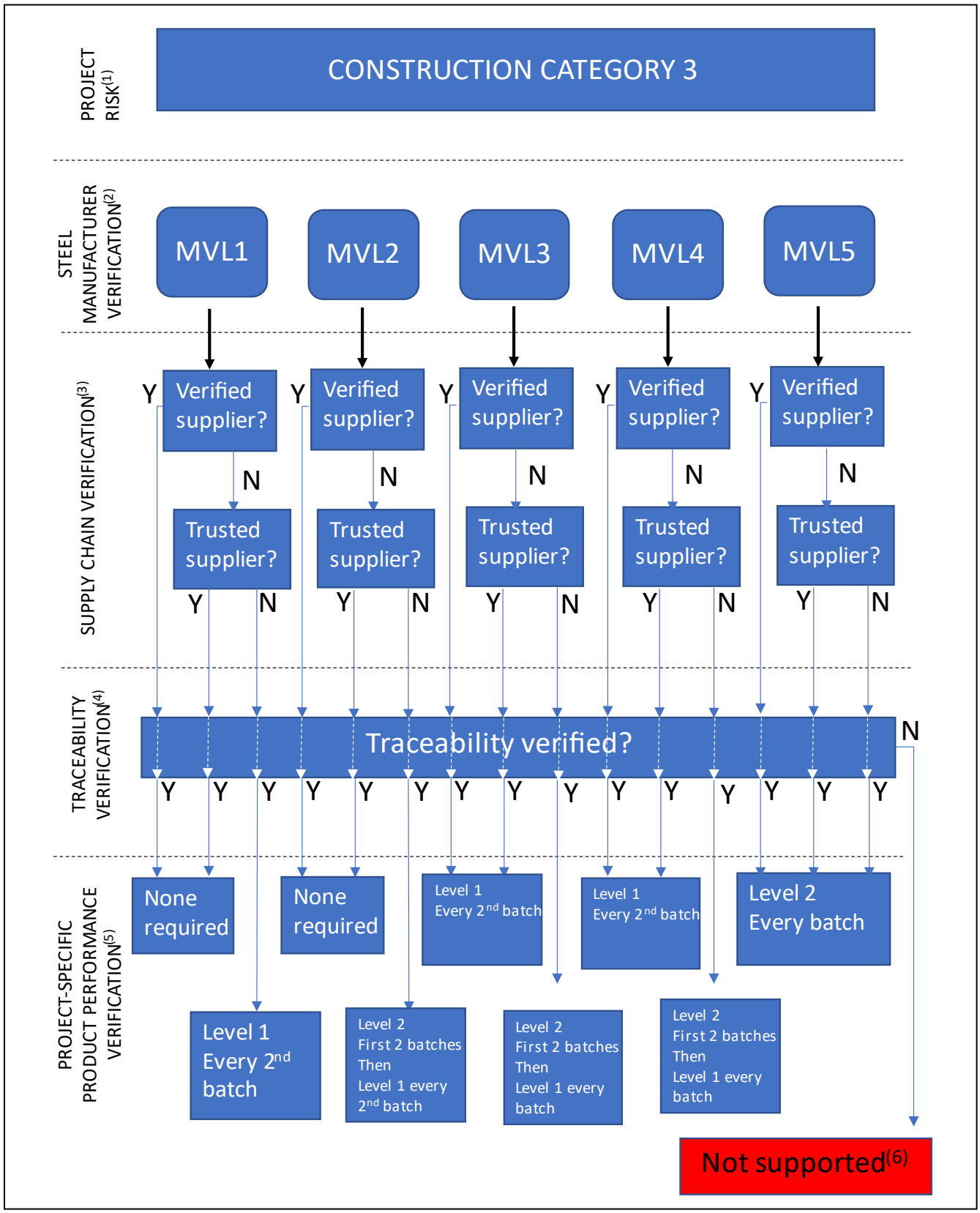
G.3 Construction Category 2



For notes, refer to Section G.4

G.4 Construction Category 3 (and CC4 as Noted)

Note: This may also be applied to Construction Category 4. Refer to Section G.5 for further detail.



For notes, refer to Section G.5.

G.5 Notes

(1) Refer to Section 4.8 for details of assessment of project (construction) risk.
(2) Refer to Section 4.4 and Table 1 for details of Manufacturer Verification Level (MVL)
(3) Refer to Section 4.6 for details of supply chain verification
(4) Refer to Section 4.5 for details of traceability verification. For the case of a verified or trusted supplier or supply chain, traceability verification should be trivial. Where the supplier is (or supply chain if more than one party is involved in the supply chain) not verified or trusted, traceability verification must be completed, otherwise there is no verified link between the material provided and the documentation or manufacturer.
(5) Refer to Section 4.7 for details of product performance verification. The verification of product performance may be undertaken by the verified supplier, the trusted supplier under a performance monitoring protocol established with the procurer or by the procurer on an as-needed basis. There are obvious increasing supply chain efficiencies from the former approaches compared to the latter.
(6) Where there is no verified traceability between the material supplied and the documentation or manufacturer, it is only possible to establish the steel compliance by testing every piece of steel, which is considered commercially not viable. In this case, the only option is to treat the steel as unidentified under Clause 2.2.3 of AS 4100 (Ref. 3).
(7) The conformity assessment pathway selection for CC3 may be applied to CC4 with consideration as to whether any project-specific additional requirements are necessary. CC4 is for special purpose structures where the requirements are at least at the level of CC3 if not greater, but any requirements over and above CC3 are based on the specific project, as defined in the construction specification.

APPENDIX H

STATE-BASED REFERENCES TO NCBP ACTIONS

H.1 Context

Issues with non-compliant building products and the pressure on building regulation to address very public instances of building and structure failure (of various forms) has resulted in a number of state and federal working groups and reports to understand and ultimately address the root causes.

Currently, all states are addressing the recommendations from the recent Shergold Weir Report 'Building Confidence' (Ref. 18), which the Building Ministers Forum commissioned in mid-2017 as an assessment of the effectiveness of the compliance and enforcement systems for the building and construction industries across Australia, a response to a number of significant and publicly documented failures in structures to that date (and subsequently).

Of the 24 recommendations in that report, a number are relevant to the responsibilities of stakeholders outlined in this current discussion:

- **Recommendation 13:** That each jurisdiction requires building approval documentation to be prepared by appropriate categories of registered practitioners, demonstrating that the proposed building complies with the National Construction Code.
- **Recommendation 14:** That each jurisdiction sets out the information which must be included in performance solutions, specifying in occupancy certificates the circumstances in which performance solutions have been used and for what purpose.
- **Recommendation 15:** That each jurisdiction provides a transparent and robust process for the approval of performance solutions for constructed building work.
- **Recommendation 17:** That each jurisdiction requires genuine independent third-party review for specified components of designs and/ or certain types of buildings.
- **Recommendation 21:** That the Building Ministers' Forum agrees its position on the establishment of a compulsory product certification system for high-risk building products.

The list of actions following are predominantly focused on those resulting from the Shergold Weir Report where available.

The Association of Consulting Architects Australia (ACA) provides a summary of implementation plans for Shergold Weir Report recommendations in each state (Ref. 25).

H.2 Construction Risk

Procurement of non-compliant materials and components represents a clear and present risk to the construction phase on any building project and has been unequivocally recognised for many years (Ref. 17). Quantifying that risk for the purposes of putting in place a risk-based approach to cost-effectively minimising risk is a work in progress in Australia, in particular incentivised by the recommendations of the Shergold Weir Report (Ref. 18) into a number of significant building failures. Currently the ABCB and every State regulator has processes in place to operationalise the Shergold Weir recommendations.

At the time of publication of this Technical Note, and in partial response to the Shergold Weir recommendations, the ABCB are developing a classification of buildings by '*building complexity*', which means "those attributes that are complicated or organisational, which increase the likelihood of non-compliance in a situation where the safety and/or health consequences of that non-compliance would be significant". There are six complexity levels from 0 to 5 corresponding to increasing complexity from 0.

The building complexity categorisation is inherently intended to support currently evolving approaches to risk-based inspection schedules and other yet undefined components of ensuring a compliant solution. The building complexity categorisation may well become a future component of the steel verification protocol outlined in this Technical Note.

H.3 References to New South Wales NCBP Actions

The NSW Government has and is addressing the recommendations of the Shergold Weir Report with a number of initiatives, summarised on the NSW Fair Trading website (Ref. 26).

The NSW Government enacted the 'Design and Building Practitioners Act 2020 (NSW)' (Ref. 27) on 11th June 2020. A prominent feature of the Act is the establishment of a new, non-delegable statutory duty of care that will be owed to building owners by builders, designers, product manufacturers, suppliers and supervisors and the prohibition against such duty being contracted out by parties to a construction contract. The Act also imposes a regime requiring design and building practitioners to provide design compliance declarations and building compliance declarations in respect of compliance with requirements of the NCC and other applicable requirements.

H.4 References to Victorian NCBP Actions

The Victorian Government has commissioned a review of Victoria's Building System (Ref. 28).

The Victorian Government has enacted, through the Victorian Building Authority (VBA), a new Code of Conduct for Building Surveyors (Ref. 29) as a direct response to one of the recommendations of the Shergold Weir Report.

H.5 References to Queensland NCBP Actions

The Queensland Government has introduced a number of reforms, including:

- Strengthening the professional indemnity insurance environment for building industry professionals in Queensland - Interim report (Ref. 30) https://www.hpw.qld.gov.au/__data/assets/pdf_file/0021/4917/safebuildingspwcreport.pdf

- The Department of Housing and Public Works Queensland has issued a Building Plan (Ref. 31) with action items to help address recommendations of the Shergold Weir Report.

- 'Building and Construction Legislation (Non-conforming Building Products – Chain of Responsibility and other matters) Amendment Act 2017' (Ref. 23)

H.6 References to South Australian NCBP Actions

The South Australian Government has implemented building reforms under their 'Planning, Development and Infrastructure Act 2016' (Ref. 32). In respect of addressing Shergold Weir Report recommendations, the 'Planning, Development and Infrastructure (Accredited professionals) Regulations 2019 (Ref. 33), which sit under the Act, address the registration and professional development recommendations in Shergold Weir.

H.7 References to Western Australian NCBP Actions

The Western Australian Government is seeking feedback on a range of consultation papers as a first step, including for registration of stakeholders under WA's '*Building Services (Registration) Act 2011*'. See for example Ref 34.