Changes to **AS 4100** and **AS/NZS 5131**

Updates for Structural Steel Design, Fabrication and Erection

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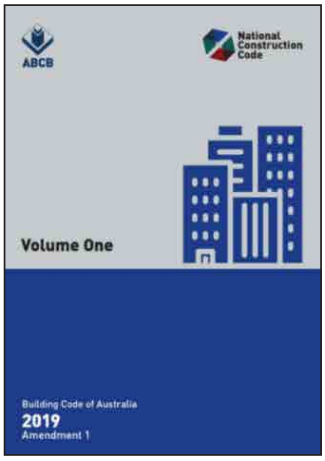
In August 2020 Standards Australia released an amendment to AS/NZS 5131 and a new revision of AS 4100. These two standards work together to provide detailed guidance for the design, fabrication and erection of steel structures in Australia. Understanding the changes that have been made to these standards and the implication for all members of the structural steel supply chain is important in ensuring that positive outcomes for all involved are realised.

Context of Regulation

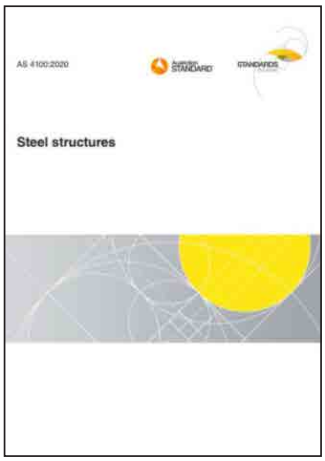
Australia's steel structure design standard; AS 4100 was last updated in 1998, over 20 years ago. This standard covered all aspects of steel design, fabrication and erection, with the latter two areas covered by only two sections. This was considered insufficient when compared to the USA, Canada, EU and the UK which each have detailed, stand-alone, standards covering fabrication and erection. In 2016 Standards Australia released AS/NZS 5131 Structural steelwork – Fabrication and Erection, to keep Australian standards and engineering practice in-line with internationally recognised best practice and regulation.

Until now AS/NZS 5131 was not directly referenced by AS 4100 leading to some industry stakeholders not considering this standard legal under the provisions of the National Construction Code (NCC). This is the principal reason for revising AS 4100 so that AS/NZS 5131 is directly referenced and therefore a secondary reference under the NCC. Since AS/NZS 5131 is directly referenced by AS 4100, its use for fabrication and erection (particularly for bolting installation) is now considered compulsory. The final step in bringing this regulation together will be completed when the NCC is next updated in 2022 with AS 4100:2020 referenced, making AS/NZS 5131 a secondary reference under the NCC.



Nation Construction Code Next Update 2022

AS 5131: 2016 Amd. 1 Secondary Reference



AS 4100: 2020 Primary Reference

Standards Related to Steel Structure Design, Fabrication and Erection

AS 4100: 2020 – Steel Structures

- Provides the minimum design requirements of steel structures
- Primary reference under the NCC
- References AS/NZS 5131 for fabrication and erection
- Includes reference to 'Construction Categories'.

AS/NZS 5100.6: 2017 – Bridge Design Part 6 Steel and Composite Construction

- Provides the minimum design requirements for structural steelwork in bridges
- Primary reference under the NCC
- References AS/NZS 5131 for fabrication and erection
- Includes reference to 'Construction Categories'.

AS/NZS 5131: 2016 Structural Steelwork Fabrication and Erection

- Provides minimum requirements for fabrication and erection of structural steelwork
- Secondary reference under NCC [2022]
- Referenced by AS4100:2020 and AS/NZS5100.6:2017
- Includes reference to 'Construction Categories'.

Revisions to AS 4100: 2020

Fabrication and Erection: Previously covered in sections of AS 4100:1998 now directly references AS/NZS 5131:2016 making its use mandatory.

Construction Categories: Now included in all structural steelwork design and fabrication standards. These categories are a Risk based – Fit for purpose approach for assessing the design requirements and specifications of the structure. Consisting of Four construction categories CC1, CC2, CC3 and CC4 which move from lowest risk category CC1 (Agricultural buildings, gates, handrails) to highest risk category CC4 (Structures with extreme consequences of structural failure).

The construction category is assessed by:

- Importance Level - assessed from NCC or AS/NZS 1170.0.
- Service Category – assessed from AS 4100 Table L1.
- Fabrication Category – assessed from AS 4100 Table L2.

Risk Matrix: The risk matrix was introduced with AS/NZS 5131 and has now been included in AS 4100. This allows those involved to better understand the requirements and their responsibilities.

Architecturally Exposed Structural Steel (AESS): Now referenced with design considerations/criteria and specification requirements.

Lamellar tearing: A type of welding defect that affects rolled plates. A definition and description of lamellar tearing has now been included as well as addressing the probability of occurrence in welded connections.

High Strength Bolts: AS 4100 now aligns with AS/NZS 1252: 2016 and the introduction of EN 14399 Type HR PC8.8 as "alternative assembly types" and PC10.9 as "additional assembly types". Design requirements for 10.9 for all tension categories (S/TF/TB) and minimum tensions for 10.9 have now been included. Bolt tensioning and inspection is now referred to AS/NZS 5131 which gives guidance on the use of specialty fasteners such as Blind-Bolts (HBS Bolts), Swage Bolts and shear-off type tension controlled bolts EN 14399-10 HRC (TCBOLTS).

Geometric Tolerances: Have now been included and aligned with AS/NZ 5131.

Construction Specification: Now identified as the method to transfer information.

Amendments to AS/NZS 5131

Traceability: To better align with international best practice, traceability has been clarified to give more flexibility and responsiveness to stakeholders dependent upon the construction category level. A baseline of lot traceability has been set for CC2, CC3 and CC4, there is no specified traceability requirements for CC1. The new amendment provides the specifier more control over the traceability requirements with a choice to specify increased requirements for the required design category.

AS/NZS ISO 3834: Quality requirements for fusion welding of metallic materials, reference to this standard has changed from an informative reference to a normative reference making it necessary for the application of the standard.

ABCB Alignment: Normative referencing of third party material such as manufacturers specifications and installation instructions are not supported by the Australian Building Codes Board. This is to avoid including proprietary documentation in regulation that the ABCB has no control over. Most of these changes simply replace the normative "shall" with the informative "should" statements.

Risk Matrix: Amended so that simple structures of importance level 3 under the NCC may be classified as either CC2 or CC3 rather only CC3. This change allows more discretion from the designer and will allow CC2 fabricators a greater range of structures that they are able to work on.

Implications for Structural Bolting

Although many of these changes were made in the 2016 revisions of AS/NZS 1252 and AS/NZS 5131 the direct reference in AS 4100 validates their use. It is expected that we will see an increase in the specification and use of 10.9 structural and specialty fasteners such as K2 and shear off type TCBOLTS which are used widely in the US and European markets.

Alternative Assembly Type – EN 14399-3 8.8 HR

AS/NZS 1252 nominates products manufactured to EN 14399 8.8 HR as an alternative assembly and may be used where AS/NZS 1252 is specified. It is important to note that 'System HR' type assemblies are the only alternative and 'System HV' assemblies made to EN 14399-4 are not to be used as alternatives to AS/NZS 1252 assemblies.

'System HV' assemblies may be available in the Australian market and all stakeholders should be wary if they come across them specified or supplied.

Additional Assembly Type – EN 14399-3 10.9 HR

AS/NZS 1252 does not have specification for 10.9 products, instead

it nominates EN 14399-3 10.9 HR as an *additional* assembly type to be used where AS/NZS 1252 10.9 assemblies are specified. AS 4100 refers to all 10.9 assemblies as required to conform to AS 1252, as 10.9 is not covered by AS/NZS 1252 the Euronorm standard will then be relied upon for compliance.

Bolting Category 10.9/S (Snug Tight Condition)

AS 4100 allows the use of AS/NZS 1110 bolts for bolting categories 4.6/S and 8.8/S which are bolts only tightened to the snug tight condition. AS 4100 now states that bolting category 10.9/S must use the AS/NZS 1252 (EN 14399) standard products for snug tightening. In the past many fabricators have supplied/used the AS/NZS 1110 product to be used for 10.9 assemblies in the snug tight or even fully tensioned condition, this will no longer be acceptable under the requirements of the standard.

AS/NZS 1252.1 and Reference to EN 14399

AS 4100 does not directly reference EN 14399 for PC 10.9 bolting assemblies. With the current edition of AS/NZS 1252 any PC 10.9 bolting assemblies will be made to the EN 14399 standard and supplied in packaging labelled accordingly. This may be confusing for end users who are unfamiliar with these standards and the alternative and additional assembly types. Standards Australia has kept the reference to AS/NZS 1252 in preparation for PC 10.9 bolting assemblies to be directly included in future updates of AS/NZS 1252.

Reduction Factors for 10.9 Bolts in Shear

AS 4100 has added a reduction factor, k_{rd}, to account for the reduced ductility for PC 10.9 bolts where the threads intercept the shear plane.

k_{rd} = 1.0 for PC 4.6 and 8.8 bolts

= 1.0 for PC 10.9 bolts where threads do not intercept the shear plane

= **0.83 for PC 10.9 bolts where threads intercept the shear plane**

This reduction factor means that PC 10.9 in shear where threads intercept the shear plane have only a marginal increase in capacity over PC 8.8. This is an important consideration for designers when specifying PC 10.9 bolts.

Table 1. Bolts and bolting category extract from AS 4100:2020

Bolting category	Bolt Standard	Bolt Property Class	Method of tensioning	Minimum tensile strength (f_{uf}) (see Note 2), MPa
4.6/S	AS 1111 (series), AS 1110 (series)	4.6	Snug tight	400
8.8/S	AS/NZS 1252.1, AS 1110 (series)	8.8	Snug tight	830
8.8/TB	AS/NZS 1252.1	8.8	Full tensioning	830
8.8/TF (see Note 1)	AS/NZS 1252.1	8.8	Full tensioning	830
10.9/S (see Note 4)	AS/NZS 1252.1	10.9	Snug tight	1040
10.9/TB (see Note 4)	AS/NZS 1252.1	10.9	Full tensioning	1040
10.9/TF (see Notes 1 and 4)	AS/NZS 1252.1	10.9	Full tensioning	1040

NOTE 1 Special category used in connections where slip at the serviceability limit state is to be restricted (see Clauses 3.5.5 and 9.1.6)
NOTE 2 f_{uf} is the minimum tensile strength of the bolt as specified in AS 4291.1:2015 except for PC 8.8 bolts less than 16 mm diameter where the minimum tensile strength is 800 MPa.
NOTE 3 Bolts to AS 1110 (series) and AS 1111 (series) are not suitable for full tensioning.
NOTE 4 Post-manufacture treatment of high strength bolts may adversely affect material properties.

Equivalent High Strength Fastener

The use of other high strength fasteners having special features in lieu of bolts to AS/NZS 1252 shall be permitted provided that evidence of their equivalence is available. This allows the use of EN 14399-3 HR K2 and EN 14399-10 HRC assemblies to be used with AS 4100. Equivalent fasteners shall meet the following requirements:

a. The chemical composition and mechanical properties of equivalent fasteners shall be in accordance with AS/NZS 1252

b. The body diameter, head or nut bearing areas shall not be less than those provided by a bolt and nut in accordance with AS/NZS 1252

c. The method of tensioning and the inspection procedure for equivalent fasteners may be different from methods specified in AS 4100 so long as the minimum tension is met and that the tensioning procedure is able to be checked.

Weathering Steel Assemblies

With the inclusion of weathering steel in AS 4100 appropriate bolting assemblies should be specified in accordance with AS/NZS 5131. Weathering steel assemblies shall be made of steel with improved atmospheric corrosion resistance, the chemical composition of which shall be as specified in AS/NZS 3678 or AS/NZS 1594. It is not recommended to use HDG fasteners with weathering steel as the contact area between the uncoated steel and the zinc coating will cause galvanic corrosion.

References:

Australian Steel Institute. AS/NZS 5131 & AS 4100 2020 Update: Summary of changes and implications, 2020. https://www.steel.org.au/ASI/media/Australian-Steel-Institute/PDFs/5131-4100-2020-Update-Final.pdf