

AS 4100:2020



# Steel structures



AS 4100:2020

This Australian Standard ® was prepared by BD-001, Steel Structures. It was approved on behalf of the Council of Standards Australia on 31 July 2020.

This Standard was published on 21 August 2020.

The following are represented on Committee BD-001:

- Australian Building Codes Board
- Australian Chamber of Commerce and Industry
- Australian Industry Group
- Australian Steel Association
- Australian Steel Institute
- Austrroads
- Bureau of Steel Manufacturers of Australia
- Consult Australia
- Engineers Australia
- Rail Industry Safety and Standards Board
- University of New South Wales
- University of Sydney
- Weld Australia
- Western Sydney University

This Standard was issued in draft form for comment as DR AS 4100:2019.

### **Keeping Standards up-to-date**

Ensure you have the latest versions of our publications and keep up-to-date about Amendments, Rulings, Withdrawals, and new projects by visiting:

[www.standards.org.au](http://www.standards.org.au)

ISBN 978 1 76072 947 9

# Steel structures

Originated in part as SAA INT 351—1956.  
Previous edition AS 4100—1998.  
Third edition 2020.

© Standards Australia Limited 2020

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Cth).

## Preface

This Standard was prepared by the Standards Australia Committee BD-001, Steel Structures, to supersede AS 4100—1998.

The objective of this Standard is to provide designers of steel structures with specifications for steel structural members used for load-carrying purposes in buildings and other structures.

Major changes to the 1998 edition include the following:

- (a) Reference to the “construction specification” (as the document containing the particular design data and details to be provided) as one deliverable from the design process. A definition of the construction specification consistent with that in AS/NZS 5131 has also been provided ([Clauses 1.3.16](#) and [1.6.2](#)).
- (b) Introduction of the definition of “construction category” and an informative appendix providing guidance on selection of the appropriate construction category, both consistent with AS/NZS 5131 ([Clauses 1.3.15](#) and [1.7.2](#), and [Appendix L](#)).
- (c) Definition and description of “architecturally exposed structural steelwork” (AESS) ([Clauses 1.3.3](#) and [1.7.3](#)).
- (d) Definition and treatment of “lamellar tearing” consistent with AS/NZS 1554.1 ([Clauses 1.3.40](#) and [3.8](#), and [Appendix M](#)).
- (e) Alignment with AS/NZS 5100.6:2017 (various clauses).
- (f) Referencing of AS/NZS 5131:2016 for the majority of requirements in the fabrication and erection sections of this Standard ([Sections 14](#) and [15](#)).
- (g) Alignment with AS/NZS 1252.1:2016, which includes introduction of an “alternative bolt assembly type” to EN 14399-3 System HR for grade 8.8 bolts and an “additional bolt assembly type” to EN 14399-3 System HR for grade 10.9 bolts. The Australian Steel Institute (ASI), Technical Note TN-001, *High strength structural bolt assemblies to AS/NZS 1252:2016*, provides background and basis for the revision to AS/NZS 1252:1996 ([Clauses 9.1.6](#), [9.3](#), [15.2](#)).
- (h) New specification of geometrical tolerances for fabrication and erection aligned with AS/NZS 5131 ([Clauses 14.4](#) and [15.3](#)).
- (i) New [Appendix K](#) “Statistical data”, aligned with AS/NZS 5100.6.
- (j) Inclusion of shear modulus  $G$  at elevated temperature in [Clause 12.4.2](#) and a new [Clause 12.4.3](#), Slenderness at elevated temperature

[Table M.2](#), Criteria affecting the target value of  $Z_{Ed}$ , was adapted with permission from Table 3.2 of EN 1993-1-10. Copyright © 2005. CEN, Belgium. [www.cen.eu](http://www.cen.eu)

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

# Contents

|   |           |
|---|-----------|
| <b>Preface</b> .....                                      | <b>ii</b> |
| <b>Section 1 Scope and general</b> .....                  | <b>1</b>  |
| 1.1 Scope and exclusions.....                             | 1         |
| 1.1.1 Scope.....  | 1         |
| 1.1.2 Exclusions.....                                     | 1         |
| 1.2 Normative references.....                             | 1         |
| 1.3 Terms and definitions.....                            | 3         |
| 1.4 Notation.....   | 10        |
| 1.5 Use of alternative materials or methods.....          | 24        |
| 1.5.1 General.....  | 24        |
| 1.5.2 Existing structures.....                            | 24        |
| 1.6 Design.....   | 24        |
| 1.6.1 Design data.....                                    | 24        |
| 1.6.2 Design details.....                                 | 24        |
| 1.7 Workmanship.....                                      | 25        |
| 1.7.1 General.....  | 25        |
| 1.7.2 Construction category.....                          | 25        |
| 1.7.3 Architecturally exposed structural steelwork.....   | 25        |
| 1.7.4 Fabrication and erection.....                       | 26        |
| <b>Section 2 Materials</b> .....                          | <b>27</b> |
| 2.1 Yield stress and tensile strength used in design..... | 27        |
| 2.1.1 Yield stress.....                                   | 27        |
| 2.1.2 Tensile strength.....                               | 27        |
| 2.2 Structural steel.....                                 | 28        |
| 2.2.1 Australian Standards.....                           | 28        |
| 2.2.2 Acceptance of steels.....                           | 29        |
| 2.2.3 Unidentified steel.....                             | 29        |
| 2.2.4 Properties of steel.....                            | 29        |
| 2.2.5 Through-thickness deformation properties.....       | 29        |
| 2.3 Fasteners.....  | 30        |
| 2.3.1 Steel bolts, nuts and washers.....                  | 30        |
| 2.3.2 Equivalent high strength fasteners.....             | 30        |
| 2.3.3 Welds.....  | 31        |
| 2.3.4 Welded studs.....                                   | 31        |
| 2.3.5 Explosive fasteners.....                            | 31        |
| 2.3.6 Anchor bolts.....                                   | 31        |
| 2.3.7 Mechanical and chemical anchors.....                | 31        |
| 2.4 Steel castings.....                                   | 31        |
| <b>Section 3 General design requirements</b> .....        | <b>32</b> |
| 3.1 Design.....   | 32        |
| 3.1.1 Aim.....  | 32        |
| 3.1.2 Requirements.....                                   | 32        |
| 3.2 Loads and other actions.....                          | 32        |
| 3.2.1 Loads.....  | 32        |
| 3.2.2 Other actions.....                                  | 32        |
| 3.2.3 Design load combinations.....                       | 33        |
| 3.2.4 Notional horizontal forces.....                     | 33        |
| 3.2.5 Structural robustness.....                          | 33        |
| 3.3 Stability limit state.....                            | 33        |
| 3.4 Strength limit state.....                             | 33        |
| 3.5 Serviceability limit state.....                       | 34        |
| 3.5.1 General.....  | 34        |
| 3.5.2 Method.....   | 35        |
| 3.5.3 Deflection limits.....                              | 35        |

|                  |  |           |
|------------------|--|-----------|
| 3.5.4            | Vibration of beams .....   | 35        |
| 3.5.5            | Bolt serviceability limit state .....                            | 35        |
| 3.5.6            | Corrosion protection .....                                       | 35        |
| 3.6              | Strength and serviceability limit states by load testing .....   | 36        |
| 3.7              | Brittle fracture .....   | 36        |
| 3.8              | Lamellar tearing .....   | 36        |
| 3.9              | Fatigue .....  | 36        |
| 3.10             | Fire .....   | 36        |
| 3.11             | Earthquake .....   | 36        |
| 3.12             | Other design requirements .....                                  | 37        |
| 3.13             | Reliability management .....                                     | 37        |
| <b>Section 4</b> | <b>Methods of structural analysis .....</b>                      | <b>38</b> |
| 4.1              | Methods of determining action effects .....                      | 38        |
| 4.1.1            | General .....  | 38        |
| 4.1.2            | Definitions .....  | 38        |
| 4.2              | Forms of construction assumed for structural analysis .....      | 38        |
| 4.2.1            | General .....  | 38        |
| 4.2.2            | Rigid construction .....   | 38        |
| 4.2.3            | Semi-rigid construction .....                                    | 38        |
| 4.2.4            | Simple construction .....  | 39        |
| 4.2.5            | Design of connections .....                                      | 39        |
| 4.3              | Assumptions for analysis .....                                   | 39        |
| 4.3.1            | General .....  | 39        |
| 4.3.2            | Span length .....  | 39        |
| 4.3.3            | Arrangements of live loads for buildings .....                   | 39        |
| 4.3.4            | Simple construction .....  | 39        |
| 4.4              | Elastic analysis .....   | 40        |
| 4.4.1            | General .....  | 40        |
| 4.4.2            | First-order elastic analysis .....                               | 40        |
| 4.5              | Plastic analysis .....   | 46        |
| 4.5.1            | Application .....  | 46        |
| 4.5.2            | Limitations .....  | 46        |
| 4.5.3            | Assumptions of analysis .....                                    | 46        |
| 4.5.4            | Second order effects .....                                       | 47        |
| 4.6              | Member buckling analysis .....                                   | 47        |
| 4.6.1            | General .....  | 47        |
| 4.6.2            | Member elastic buckling load .....                               | 47        |
| 4.6.3            | Member effective length factor .....                             | 47        |
| 4.7              | Frame buckling analysis .....                                    | 51        |
| 4.7.1            | General .....  | 51        |
| 4.7.2            | In-plane frame buckling .....                                    | 51        |
| <b>Section 5</b> | <b>Members subject to bending .....</b>                          | <b>53</b> |
| 5.1              | Design for bending moment .....                                  | 53        |
| 5.2              | Section moment capacity for bending about a principal axis ..... | 54        |
| 5.2.1            | General .....  | 54        |
| 5.2.2            | Section slenderness .....  | 54        |
| 5.2.3            | Compact sections .....   | 55        |
| 5.2.4            | Non-compact sections .....                                       | 55        |
| 5.2.5            | Slender sections .....   | 56        |
| 5.2.6            | Elastic and plastic section moduli .....                         | 56        |
| 5.3              | Member capacity of segments with full lateral restraint .....    | 56        |
| 5.3.1            | Member capacity .....  | 56        |
| 5.3.2            | Segments with full lateral restraint .....                       | 57        |
| 5.3.3            | Critical section .....   | 58        |
| 5.4              | Restraints .....   | 58        |
| 5.4.1            | General .....  | 58        |
| 5.4.2            | Restraints at a cross-section .....                              | 59        |

|        |   |    |
|--------|---|----|
| 5.4.3  | Restraining elements.....   | 61 |
| 5.5    | Critical flange.....  | 62 |
| 5.5.1  | General.....  | 62 |
| 5.5.2  | Segments with both ends restrained.....                                     | 62 |
| 5.5.3  | Segments with one end unrestrained.....                                     | 62 |
| 5.6    | Member capacity of segments without full lateral restraint.....             | 62 |
| 5.6.1  | Segments fully or partially restrained at both ends.....                    | 62 |
| 5.6.2  | Segments unrestrained at one end.....                                       | 65 |
| 5.6.3  | Effective length.....   | 67 |
| 5.6.4  | Design by buckling analysis.....  | 69 |
| 5.7    | Bending in a non-principal plane.....                                       | 69 |
| 5.7.1  | Deflections constrained to a non-principal plane.....                       | 69 |
| 5.7.2  | Deflections unconstrained.....  | 69 |
| 5.8    | Separators and diaphragms.....  | 69 |
| 5.9    | Design of webs.....   | 70 |
| 5.9.1  | General.....  | 70 |
| 5.9.2  | Definition of web panel.....  | 70 |
| 5.9.3  | Minimum thickness of web panel.....   | 70 |
| 5.10   | Arrangement of webs.....  | 70 |
| 5.10.1 | Unstiffened webs.....   | 70 |
| 5.10.2 | Load bearing stiffeners.....  | 71 |
| 5.10.3 | Side reinforcing plates.....  | 71 |
| 5.10.4 | Transversely stiffened webs.....  | 71 |
| 5.10.5 | Webs with longitudinal and transverse stiffeners.....                       | 71 |
| 5.10.6 | Webs of members designed plastically.....                                   | 71 |
| 5.10.7 | Openings in webs.....   | 72 |
| 5.11   | Shear capacity of webs.....   | 72 |
| 5.11.1 | Shear capacity.....   | 72 |
| 5.11.2 | Approximately uniform shear stress distribution.....                        | 72 |
| 5.11.3 | Non-uniform shear stress distribution.....                                  | 73 |
| 5.11.4 | Shear yield capacity.....   | 73 |
| 5.11.5 | Shear buckling capacity.....  | 74 |
| 5.12   | Interaction of shear and bending.....                                       | 76 |
| 5.12.1 | General.....  | 76 |
| 5.12.2 | Proportioning method.....   | 76 |
| 5.12.3 | Shear and bending interaction method.....                                   | 76 |
| 5.13   | Compressive bearing action on the edge of a web.....                        | 77 |
| 5.13.1 | Dispersion of force to web.....   | 77 |
| 5.13.2 | Bearing capacity.....   | 77 |
| 5.13.3 | Bearing yield capacity.....   | 77 |
| 5.13.4 | Bearing buckling capacity.....  | 78 |
| 5.13.5 | Combined bending and bearing of rectangular and square hollow sections..... | 79 |
| 5.14   | Design of load bearing stiffeners.....                                      | 81 |
| 5.14.1 | Yield capacity.....   | 81 |
| 5.14.2 | Buckling capacity.....  | 82 |
| 5.14.3 | Outstand of stiffeners.....   | 83 |
| 5.14.4 | Fitting of load bearing stiffeners.....                                     | 83 |
| 5.14.5 | Design for torsional end restraint.....                                     | 83 |
| 5.15   | Design of intermediate transverse web stiffeners.....                       | 83 |
| 5.15.1 | General.....  | 83 |
| 5.15.2 | Spacing.....  | 84 |
| 5.15.3 | Minimum area.....   | 84 |
| 5.15.4 | Buckling capacity.....  | 84 |
| 5.15.5 | Minimum stiffness.....  | 85 |
| 5.15.6 | Outstand of stiffeners.....   | 85 |
| 5.15.7 | External forces.....  | 85 |
| 5.15.8 | Connection of intermediate stiffeners to web.....                           | 85 |
| 5.15.9 | End posts.....  | 86 |

|                  |   |            |
|------------------|---|------------|
| 5.16             | Design of longitudinal web stiffeners .....   | 86         |
| 5.16.1           | General .....   | 86         |
| 5.16.2           | Minimum stiffness .....   | 86         |
| <b>Section 6</b> | <b>Members subject to axial compression .....</b>   | <b>87</b>  |
| 6.1              | Design for axial compression .....  | 87         |
| 6.2              | Nominal section capacity .....  | 87         |
| 6.2.1            | General .....   | 87         |
| 6.2.2            | Form factor .....   | 87         |
| 6.2.3            | Plate element slenderness .....   | 88         |
| 6.2.4            | Effective width .....   | 88         |
| 6.3              | Nominal member capacity .....   | 89         |
| 6.3.1            | Definitions .....   | 89         |
| 6.3.2            | Effective length .....  | 90         |
| 6.3.3            | Nominal capacity of a member of constant cross-section subject to flexural buckling ..... | 90         |
| 6.3.4            | Nominal capacity of a member of varying cross-section .....                               | 93         |
| 6.4              | Laced and battened compression members .....  | 93         |
| 6.4.1            | Design forces .....   | 93         |
| 6.4.2            | Laced compression members .....   | 94         |
| 6.4.3            | Battened compression member .....   | 95         |
| 6.5              | Compression members back to back .....  | 96         |
| 6.5.1            | Components separated .....  | 96         |
| 6.5.2            | Components in contact .....   | 97         |
| 6.6              | Restraints .....  | 98         |
| 6.6.1            | Restraint systems .....   | 98         |
| 6.6.2            | Restraining members and connections .....   | 98         |
| 6.6.3            | Parallel braced compression members .....   | 98         |
| <b>Section 7</b> | <b>Members subject to axial tension .....</b>   | <b>99</b>  |
| 7.1              | Design for axial tension .....  | 99         |
| 7.2              | Nominal section capacity .....  | 99         |
| 7.3              | Distribution of forces .....  | 99         |
| 7.3.1            | End connections providing uniform force distribution .....                                | 99         |
| 7.3.2            | End connections providing non-uniform force distribution .....                            | 100        |
| 7.4              | Tension members with two or more main components .....                                    | 101        |
| 7.4.1            | General .....   | 101        |
| 7.4.2            | Design forces for connections .....   | 101        |
| 7.4.3            | Tension member composed of two components back-to-back .....                              | 101        |
| 7.4.4            | Laced tension member .....  | 101        |
| 7.4.5            | Battened tension member .....   | 101        |
| 7.5              | Members with pin connections .....  | 102        |
| <b>Section 8</b> | <b>Members subject to combined actions .....</b>  | <b>103</b> |
| 8.1              | General .....   | 103        |
| 8.2              | Design actions .....  | 103        |
| 8.3              | Section capacity .....  | 103        |
| 8.3.1            | General .....   | 103        |
| 8.3.2            | Uniaxial bending about the major principal x-axis .....                                   | 104        |
| 8.3.3            | Uniaxial bending about the minor principal y-axis .....                                   | 104        |
| 8.3.4            | Biaxial bending .....   | 105        |
| 8.4              | Member capacity .....   | 105        |
| 8.4.1            | General .....   | 105        |
| 8.4.2            | In-plane capacity — Elastic analysis .....  | 106        |
| 8.4.3            | In-plane capacity — Plastic analysis .....  | 107        |
| 8.4.4            | Out-of-plane capacity .....   | 109        |
| 8.4.5            | Biaxial bending capacity .....  | 110        |
| 8.4.6            | Eccentrically loaded double bolted or welded single angles in trusses .....               | 111        |
| <b>Section 9</b> | <b>Connections .....</b>  | <b>113</b> |

|                   |  |            |
|-------------------|--|------------|
| 9.1               | General  | 113        |
| 9.1.1             | Requirements for connections   | 113        |
| 9.1.2             | Classification of connections  | 113        |
| 9.1.3             | Design of connections  | 113        |
| 9.1.4             | Minimum design actions on connections                                    | 114        |
| 9.1.5             | Intersections  | 115        |
| 9.1.6             | Choice of fasteners  | 115        |
| 9.1.7             | Combined connections   | 115        |
| 9.1.8             | Prying forces  | 115        |
| 9.1.9             | Connection components  | 115        |
| 9.1.10            | Deductions for fastener holes  | 116        |
| 9.1.11            | Hollow section connections   | 117        |
| 9.2               | Design of bolts  | 117        |
| 9.2.1             | Bolts and bolting category   | 117        |
| 9.2.2             | Bolt strength limit states   | 118        |
| 9.2.3             | Bolt serviceability limit state  | 121        |
| 9.3               | Assessment of the strength of a bolt group                               | 122        |
| 9.3.1             | Bolt group subject to in-plane loading                                   | 122        |
| 9.3.2             | Bolt group subject to out-of-plane loading                               | 123        |
| 9.3.3             | Bolt group subject to combinations of in-plane and out-of-plane loadings | 123        |
| 9.4               | Design of a pin connection   | 123        |
| 9.4.1             | Pin in shear   | 123        |
| 9.4.2             | Pin in bearing   | 123        |
| 9.4.3             | Pin in bending   | 124        |
| 9.4.4             | Ply in bearing   | 124        |
| 9.5               | Design details for bolts and pins  | 124        |
| 9.5.1             | Minimum pitch  | 124        |
| 9.5.2             | Minimum edge distance  | 125        |
| 9.5.3             | Maximum pitch  | 125        |
| 9.5.4             | Maximum edge distance  | 125        |
| 9.5.5             | Holes  | 125        |
| 9.6               | Design of welds  | 125        |
| 9.6.1             | Scope  | 125        |
| 9.6.2             | Complete and incomplete penetration butt welds                           | 126        |
| 9.6.3             | Fillet welds   | 129        |
| 9.6.4             | Plug and slot welds  | 135        |
| 9.6.5             | Compound weld  | 136        |
| 9.7               | Assessment of the strength of a weld group                               | 137        |
| 9.7.1             | Weld group subject to in-plane loading                                   | 137        |
| 9.7.2             | Weld group subject to out-of-plane loading                               | 137        |
| 9.7.3             | Weld group subject to in-plane and out-of-plane loading                  | 138        |
| 9.7.4             | Combination of weld types  | 138        |
| 9.8               | Packing in construction  | 138        |
| <b>Section 10</b> | <b>Brittle fracture</b>  | <b>139</b> |
| 10.1              | Methods  | 139        |
| 10.2              | Notch-ductile range method   | 139        |
| 10.3              | Design service temperature   | 139        |
| 10.3.1            | General  | 139        |
| 10.3.2            | Basic design temperature   | 139        |
| 10.3.3            | Modifications to the basic design temperature                            | 140        |
| 10.4              | Material selection   | 140        |
| 10.4.1            | Selection of steel type  | 140        |
| 10.4.2            | Limitations  | 141        |
| 10.4.3            | Modification for certain applications                                    | 141        |
| 10.4.4            | Selection of steel grade   | 142        |
| 10.5              | Fracture assessment  | 144        |
| <b>Section 11</b> | <b>Fatigue</b>   | <b>145</b> |

|                   |   |            |
|-------------------|---|------------|
| 11.1              | General   | 145        |
| 11.1.1            | Requirements  | 145        |
| 11.1.2            | Notation  | 145        |
| 11.1.3            | Limitation  | 146        |
| 11.1.4            | Designation of weld category  | 146        |
| 11.1.5            | Method  | 146        |
| 11.1.6            | Thickness effect  | 147        |
| 11.2              | Fatigue loading   | 147        |
| 11.3              | Design spectrum   | 148        |
| 11.3.1            | Stress determination  | 148        |
| 11.3.2            | Design spectrum calculation   | 148        |
| 11.4              | Exemption from assessment   | 149        |
| 11.5              | Detail category   | 149        |
| 11.5.1            | Detail categories for normal stress   | 149        |
| 11.5.2            | Detail categories for shear stress  | 149        |
| 11.6              | Fatigue strength  | 158        |
| 11.6.1            | Definition of fatigue strength for normal stress  | 158        |
| 11.6.2            | Definition of fatigue strength for shear stress   | 159        |
| 11.7              | Exemption from further assessment   | 160        |
| 11.8              | Fatigue assessment  | 160        |
| 11.8.1            | Constant stress range   | 160        |
| 11.8.2            | Variable stress range   | 161        |
| 11.9              | Punching limitation   | 161        |
| <b>Section 12</b> | <b>Fire</b>   | <b>162</b> |
| 12.1              | Requirements  | 162        |
| 12.2              | Definitions   | 162        |
| 12.3              | Determination of period of structural adequacy  | 163        |
| 12.4              | Variation of mechanical properties of steel with temperature                            | 163        |
| 12.4.1            | Variation of yield stress with temperature  | 163        |
| 12.4.2            | Variation of modulus of elasticity and shear modulus with temperature                   | 163        |
| 12.4.3            | Slenderness at elevated temperature   | 164        |
| 12.5              | Determination of limiting steel temperature   | 164        |
| 12.6              | Determination of time at which limiting temperature is attained for protected members   | 165        |
| 12.6.1            | Methods   | 165        |
| 12.6.2            | Temperature based on test series  | 166        |
| 12.6.3            | Temperature based on single test  | 167        |
| 12.7              | Determination of time at which limiting temperature is attained for unprotected members | 167        |
| 12.8              | Determination of PSA from a single test   | 168        |
| 12.9              | Three-sided fire exposure condition   | 168        |
| 12.10             | Special considerations  | 169        |
| 12.10.1           | Connections   | 169        |
| 12.10.2           | Web penetrations  | 169        |
| <b>Section 13</b> | <b>Earthquake</b>   | <b>171</b> |
| 13.1              | General   | 171        |
| 13.2              | Definitions   | 171        |
| 13.3              | Design and detailing requirements   | 171        |
| 13.3.1            | General   | 171        |
| 13.3.2            | Stiff elements  | 171        |
| 13.3.3            | Non-structural elements   | 172        |
| 13.3.4            | Structural ductility factor and structural performance factor                           | 172        |
| 13.3.5            | Requirements for "limited ductile" steel structures ( $\mu = 2$ )                       | 172        |
| 13.3.6            | Requirements for "moderately ductile" steel structures ( $\mu = 3$ )                    | 172        |
| 13.3.7            | Requirements for "fully ductile" structures ( $\mu > 3$ )                               | 173        |
| <b>Section 14</b> | <b>Fabrication</b>  | <b>174</b> |
| 14.1              | General   | 174        |

|                   |   |            |
|-------------------|---|------------|
| 14.2              | Material.....   | 174        |
| 14.2.1            | General.....  | 174        |
| 14.2.2            | Identification.....   | 174        |
| 14.3              | Fabrication procedures.....   | 174        |
| 14.3.1            | General.....  | 174        |
| 14.3.2            | Hole size.....  | 174        |
| 14.3.3            | Bolting.....  | 176        |
| 14.4              | Geometrical tolerances.....   | 176        |
| 14.4.1            | General.....  | 176        |
| 14.4.2            | Nonconformance of tolerances.....   | 177        |
| <b>Section 15</b> | <b>Erection.....</b>  | <b>178</b> |
| 15.1              | General.....  | 178        |
| 15.1.1            | Rejection of an erected item.....   | 178        |
| 15.1.2            | Safety during erection.....   | 178        |
| 15.2              | Erection procedures.....  | 178        |
| 15.2.1            | General.....  | 178        |
| 15.2.2            | Assembly of a connection involving bolts.....                                     | 178        |
| 15.3              | Geometrical tolerances.....   | 179        |
| 15.3.1            | General.....  | 179        |
| 15.3.2            | Nonconformance of tolerances.....   | 179        |
| <b>Section 16</b> | <b>Modification of existing structures.....</b>                                   | <b>180</b> |
| 16.1              | General.....  | 180        |
| 16.2              | Materials.....  | 180        |
| <b>Section 17</b> | <b>Testing of structures or elements.....</b>                                     | <b>181</b> |
| 17.1              | General.....  | 181        |
| 17.1.1            | Scope of Section.....   | 181        |
| 17.1.2            | Circumstances requiring tests.....  | 181        |
| 17.2              | Definitions.....  | 181        |
| 17.3              | Test requirements.....  | 181        |
| 17.4              | Proof testing.....  | 181        |
| 17.4.1            | Application.....  | 181        |
| 17.4.2            | Test load.....  | 181        |
| 17.4.3            | Criteria for acceptance.....  | 182        |
| 17.5              | Prototype testing.....  | 182        |
| 17.5.1            | Test specimen.....  | 182        |
| 17.5.2            | Test load.....  | 182        |
| 17.5.3            | Criteria for acceptance.....  | 182        |
| 17.5.4            | Acceptance of production units.....   | 182        |
| 17.6              | Report of tests.....  | 182        |
| <b>Appendix A</b> | <b>(normative) Not used.....</b>  | <b>184</b> |
| <b>Appendix B</b> | <b>(informative) Suggested deflection limits.....</b>                             | <b>185</b> |
| <b>Appendix C</b> | <b>(informative) Selection of corrosion protection requirements.....</b>          | <b>187</b> |
| <b>Appendix D</b> | <b>(normative) Advanced structural analysis.....</b>                              | <b>189</b> |
| <b>Appendix E</b> | <b>(normative) Second order elastic analysis.....</b>                             | <b>190</b> |
| <b>Appendix F</b> | <b>(normative) Moment amplification for a sway member.....</b>                    | <b>191</b> |
| <b>Appendix G</b> | <b>(normative) Braced member buckling in frames.....</b>                          | <b>192</b> |
| <b>Appendix H</b> | <b>(informative) Elastic resistance to lateral buckling.....</b>                  | <b>194</b> |
| <b>Appendix I</b> | <b>(informative) Strength of stiffened web panels under combined actions.....</b> | <b>200</b> |
| <b>Appendix J</b> | <b>(normative) Standard test for evaluation of slip factor.....</b>               | <b>203</b> |
| <b>Appendix K</b> | <b>(normative) Statistical data.....</b>  | <b>207</b> |
| <b>Appendix L</b> | <b>(informative) Guidance on determination of the construction category.....</b>  | <b>209</b> |

|  |            |
|--|------------|
| <b>Appendix M (informative) Selection of materials for the avoidance of lamellar tearing .....</b> | <b>212</b> |
| <b>Bibliography .....</b>  | <b>215</b> |

# Australian Standard®

## Steel structures

### Section 1 Scope and general

#### 1.1 Scope and exclusions

##### 1.1.1 Scope

This Standard sets out minimum requirements for the design and the engineering aspects of fabrication and erection, and modification of steelwork in structures in accordance with the limit states design method.

This Standard applies to buildings, structures and cranes constructed of steel.

NOTE For design of box and longitudinally stiffened girders, refer to AS/NZS 5100.6.

##### 1.1.2 Exclusions

This Standard does not apply to the following structures and materials:

- (a) Steel elements less than 3 mm thick, with the exception of sections in accordance with AS/NZS 1163 and packers.
- (b) Steel members for which the value of the yield stress used in design ( $f_y$ ) exceeds 690 MPa.
- (c) Cold-formed members, other than those in accordance with AS/NZS 1163, which are designed in accordance with AS/NZS 4600.
- (d) Composite steel-concrete members, which are designed in accordance with AS/NZS 2327.
- (e) Road, railway and pedestrian bridges, which are designed in accordance with AS 5100.1, AS 5100.2 and AS/NZS 5100.6.

NOTE The general principles of design, fabrication, erection, and modification embodied in this Standard may be applied to steel-framed structures or members not specifically mentioned herein.

#### 1.2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents for informative purposes are listed in the Bibliography.

AS 1101.3, *Graphical symbols for general engineering, Part 3: Welding and non-destructive examination*

AS 1110.1, *ISO metric hexagon bolts and screws—Product grades A and B, Part 1: Bolts*

AS 1110.2, *ISO metric hexagon bolts and screws—Product grades A and B, Part 2: Screws*

AS 1111.1, *ISO metric hexagon bolts and screws—Product grade C, Part 1: Bolts*

AS 1111.2, *ISO metric hexagon bolts and screws—Product grade C, Part 2: Screws*

AS 1112.1, *ISO metric hexagon nuts, Part 1: Style 1—Product grades A and B*

AS 1112.2, *ISO metric hexagon nuts, Part 2: Style 2—Product grades A and B*

AS 1112.3, *ISO metric hexagon nuts, Part 3: Product grade C*

AS 1112.4, *ISO metric hexagon nuts, Part 4: Chamfered thin nuts—Product grades A and B*