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Australian/New Zealand Standard®

# Aluminium structures

# Part 1: Limit state design

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee BD/50, Aluminium Structures. It was approved on behalf of the Council of Standards Australia on 27 June 1997 and on behalf of the Council of Standards New Zealand on 11 July 1997. It was published on 5 September 1997.

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The following interests are represented on Committee BD/50:

Aluminium Development Council
Association of Consulting Engineers, Australia
Australian Building Codes Board
Institution of Professional Engineers New Zealand
University of Sydney

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# PREFACE

This Joint Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee BD/50, Aluminium Structures, to supersede, in part, AS 1664—1979, *Rules for the use of aluminium in structures (known as the SAA Aluminium Structures Code)*.

This Standard is technically equivalent to *The Aluminium Design Manual: Specifications and guidelines for aluminium structures, Part 1B: Specification for Aluminium Structures Load and Resistance Factor Design of Buildings and similar type structures* issued by the U.S. Aluminium Association Inc.

The objective of this Standard is to provide designers of aluminium building type structural load-carrying members and elements with limit state design criteria for use in design applications.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard.

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# Australian/New Zealand Standard

# Aluminium structures

## Part 1: Limit state design

## SECTION 1 GENERAL

**1.1 SCOPE** This Standard specifies requirements for the design of aluminium building type structural load-carrying members and elements. The limit state design (LSD) criteria are intended as an alternative to the allowable stress design (ASD) criteria (see AS 1664.2). One design specification (LSD or ASD) applies throughout the design of a single structure.

**1.2 MATERIALS** The principal materials to which these specifications apply are aluminium alloys that comply with AS 1734, AS 1865, AS 1866, AS 1867 and AS 2848.1. Those structural members frequently used are listed in Table 3.3(A).

**1.3 FACTORED LIMIT STATE STRESSES** The factored limit state stresses $\phi F_L$ shall be larger than or equal to the required stresses computed for the factored nominal loads acting on the structure. The factored limit state stresses are given in Sections 3 to 7, while the method of analysis, load factors and load combinations are defined in Section 2. The factor $\phi$ is the 'capacity factor' which accounts for the unavoidable uncertainties in the determination of the limit stresses. The capacity factor may be multiplied by a factor of 1.1 for secondary members (such as purlins, girts, mullions, wall panels and roof decks) subjected to short duration loads such as wind or earthquake, except that the $\phi$-factors shall not exceed 1.0.

Limit state stresses referred to herein shall be those for the strength limit state, unless noted otherwise.

**1.4 REFERENCED DOCUMENTS** The following documents are referred to in this Standard:

AS
1170 Minimum design loads on structures (known as the SAA Loading Code)
1170.1 Part 1: Dead and live loads and load combinations
1170.2 Part 2: Wind loads
1170.3 Part 3: Snow loads
1170.4 Part 4: Earthquake loads

1391 Methods for tensile testing of metals

AS/NZS
1664 Aluminium structures
1664.1 Supplement 1: Limit state design—Commentary
1664.2 Part 2: Allowable stress design

AS
1665 Welding of aluminium structures

1734 Aluminium and aluminium alloys—Flat sheet, coiled sheet and plate (adopted in New Zealand as NZS/AS 1734)

AS

1865 Aluminium and aluminium alloys—Drawn wire, rod, bar and strip (adopted in New Zealand as NZS/AS 1865)

1866 Aluminium and aluminium alloys—Extruded rod, bar, solid and hollow shapes (adopted in New Zealand as NZS/AS 1866)

1867 Aluminium and aluminium alloys—Drawn tubes (adopted in New Zealand as NZS/AS 1867)

2848 Aluminium and aluminium alloys—Composition and designations

2848.1 Part 1: Wrought products

NZS

4203 General structural design and design loadings for buildings

ASTM

B 557 Test methods of tension testing wrought and cast aluminium- and magnesium-alloy products

D 962 Specification for aluminium powder and paste pigments for paints

E 330 Test method for structural performance of exterior windows, curtain walls, and doors by uniform static air pressure difference

# SECTION 2 DESIGN PROCEDURE

**2.1 PROPERTIES OF SECTIONS** Properties of sections, such as cross-sectional area, moment of inertia, section modulus, radius of gyration, and torsion constants, shall be determined in accordance with accepted methods of structural analysis.

**2.2 PROCEDURE** Computation of forces, moments, stresses and deflections shall be in accordance with accepted methods of elastic structural analysis and structural design. Two types of limit states shall be considered. These are—

(a) strength limit states, the strength required to resist loads, so as to avoid yielding, fracture, buckling, crippling; and

(b) serviceability limit states, the ability to perform the intended function under normal service conditions, avoiding excessive deflection or the appearance of buckling.

The forces, moments and stresses for the strength limit states shall be determined by structural analysis for the factored loads as defined in Clause 2.4, and the deflections for the serviceability limit states shall be calculated for the unfactored loads.

**2.3 LOADING** The loads on the structure shall be in accordance with the applicable parts of AS 1170 (for Australia) or the applicable parts of NZS 4203 (for New Zealand).

**2.4 LOAD COMBINATIONS AND LOAD FACTORS** The required forces, moments and stresses for the applicable loads shall be determined by structural analysis for the load combinations as indicated in AS 1170.1 (for Australia) or the applicable parts of NZS 4203 (for New Zealand).

**2.5 EARTHQUAKE** If applicable, the following shall be considered for earthquake design:

(a) *For Australia* All structures shall be designed for the loads and load combinations specified in AS 1170.4. If aluminium members are used as the primary earthquake resistance element then the structural response factor ($R_f$) shall be less than or equal to 2.0 unless specified otherwise.

(b) *For New Zealand* All structures shall be designed for the loads and load combinations specified in NZS 4203 but subject to the following limitations:

(i) For the ultimate limit state, the structural ductility factor ($\mu$) shall be less than or equal to 1.25, unless a greater value (but not greater than 3.0) is justified by a special study. The factor ($\mu$) depends upon the structural form, the ductility of the material and structural damping characteristics.

(ii) For the serviceability limit state, the structural ductility factor ($\mu$) shall be equal to 1.0.

(iii) The structural performance factor ($S_p$) shall be equal to 0.67, unless a lower value (but not less than 0.4) is determined as appropriate by a special study. The factor ($S_p$) depends on the material, form and period of the earthquake resisting system, damping of the structure and the interaction of the structure with the ground.