Australian Standard®

Composite structures

Part 1: Simply supported beams

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The following interests are represented on Committee BD/32:

Australian Building Codes Board

Australian Institute of Steel Construction

AUSTROADS

Bureau of Steel Manufacturers of Australia

Cement and Concrete Association of Australia

CSIRO—Division of Building, Construction & Engineering

Institution of Engineers Australia

Metal Building Products Manufacturers Association

The Association of Consulting Engineers, Australia

University of Adelaide

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BHP Research—Melbourne Laboratories

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Composite structures

Part 1: Simply supported beams

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PREFACE

This Standard was prepared by the Standards Australia Committee on Composite Construction, as a revision of AS 2327.1—1980 *Composite construction in structural steel and concrete*, Part 1—*Simply supported beams*.

When first published in 1980, AS 2327.1 was the first of four independent parts, with the subsequent parts intended to cover composite continuous beams, slabs and columns respectively. Shortly thereafter, however, Standards Australia adopted a policy of converting the major structural Standards to limit-state format. Work on the remaining parts was therefore suspended while the primary Standards on which AS 2327.1 was based, namely AS 1480—*SAA Concrete Structures Code*, and AS 1250—*SAA Steel Structures Code* were being revised in accordance with this policy. These revisions resulted in the publication of AS 3600—*Concrete structures* in 1988 and AS 4100—*Steel structures* in 1990.

Subsequently, the Committee delegated the task of updating AS 2327.1 to Subcommittee BD/32/2—Beams. The objective of the revision is to provide designers with an updated version of AS 2371, which references AS 3600 and AS 4100 as well as other associated Standards.

This Standard is a complete revision of AS 2327.1—1980 and incorporates a number of major improvements. The principal differences are briefly outlined in the following:

(a) *Partial shear connection* This Standard introduces the concept of partial shear connection, which allows the possibility of a reduction in the total number of shear connectors previously required.

(b) *Non-prismatic beam* Cross-sectional variations along the length of a beam can now be taken into account for both strength and deflection calculations.

(c) *Steel sections* The range of steel sections has been widened to include doubly-symmetric and mono-symmetric sections in hot-rolled, cold-formed or fabricated steels.

(d) *Construction loads* Rules are given for minimum construction loads at the various stages of construction from bare steel to full composite action. Such loads are not given in detail in AS 1170—*Minimum design loads on structures,* Part 1: *Dead and live loads and load combinations.*

(e) *Shear connectors* Shear connectors now include high-strength structural steel bolts, channels and manually or automatically welded studs. The tabulated nominal shear capacities of the connectors have been verified, for commonly used Australian forms of construction, in both push-out tests and tests on full-scale prototype beams carried out by BHP Research, Melbourne Laboratories. The Committee wishes to acknowledge the generosity of that organization in making the data from their extensive test program available for use in this document.

(f) *Profiled steel sheeting* Rules for designing shear connectors in composite slabs incorporating profiled steel sheeting with narrow steel ribs are given in this Standard. Through careful detailing it has been possible to maintain the same design shear capacities as in solid slabs. It is envisaged that future design rules will address the implications of using other types of profiled steel sheeting.

(g) *Encased beams, precast concrete floor elements, prestressed-concrete slabs and haunched slabs* Rules for designing encased beams, and beams incorporating precast-concrete floor elements, prestressed-concrete slabs or haunched slabs have not been included due to lack of relevant limit-state design information.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard

Composite structures—Simply supported beams

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE This Standard sets out minimum requirements for the design, detailing and construction of simply supported composite beams composed of a steel beam and a concrete slab interconnected with shear connectors, including applications where the slab incorporates profiled steel sheeting, as defined in Clause 1.2.

This Standard does not cover the design of composite beams—

(a) where the elements of the steel beam are less than 3 mm thick or the value of the yield stress (f_{yb}) assumed in design exceeds 450 MPa (see Note 1);

(b) where the strength grade of the slab concrete exceeds 40 MPa;

(c) where the slab is precast or prestressed;

(d) with negative design moments (see Note 2);

(e) subjected to dynamic loads;

(f) for road or railway bridges (see Note 3); or

(g) for fatigue.

NOTES:

1 This does not preclude the use of steels with a minimum yield strength greater than 450 MPa.

2 For the design of composite beams with negative design moments reference may be made to BS 5950:3:1990, Code of Practice for Design of Simple and Continuous Composite Beams.

3 For the design of composite bridge beams, reference should be made to the AUSTROADS Bridge Design Code, or the ANZRC Railway Bridge Design Manual as applicable.

1.2 GENERAL

1.2.1 Components This Standard applies only to composite beams for which the components satisfy the requirements specified in Clauses 1.2.2 to 1.2.5.

1.2.2 Steel beam The steel beam shall be entirely below, but in contact with, the soffit of the concrete slab, and shall be of structural steel, symmetrical about its vertical axis (i.e. doubly-symmetric or monosymmetric), suitably proportioned (see Note) and have one of the following forms (see Figure 1.2.2)—

(a) a hot-rolled I, or channel section;

(b) a welded I-section;

(c) a rectangular cold-formed hollow section;

(d) a fabricated I, Tee, channel or rectangular hollow section; or

(e) any of the above sections as appropriate with an additional plate welded to the bottom flange.

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NOTE: Steel beams with a slender section (i.e. $\lambda_e > \lambda_{ey}$ for any top flange or web plate element either partially or fully in compression (see Clause 5.2.3.3)) are not permitted.

When a fire resistance level (FRL) must be achieved, a fire protection material may be used to protect the exposed surfaces of the steel beam.

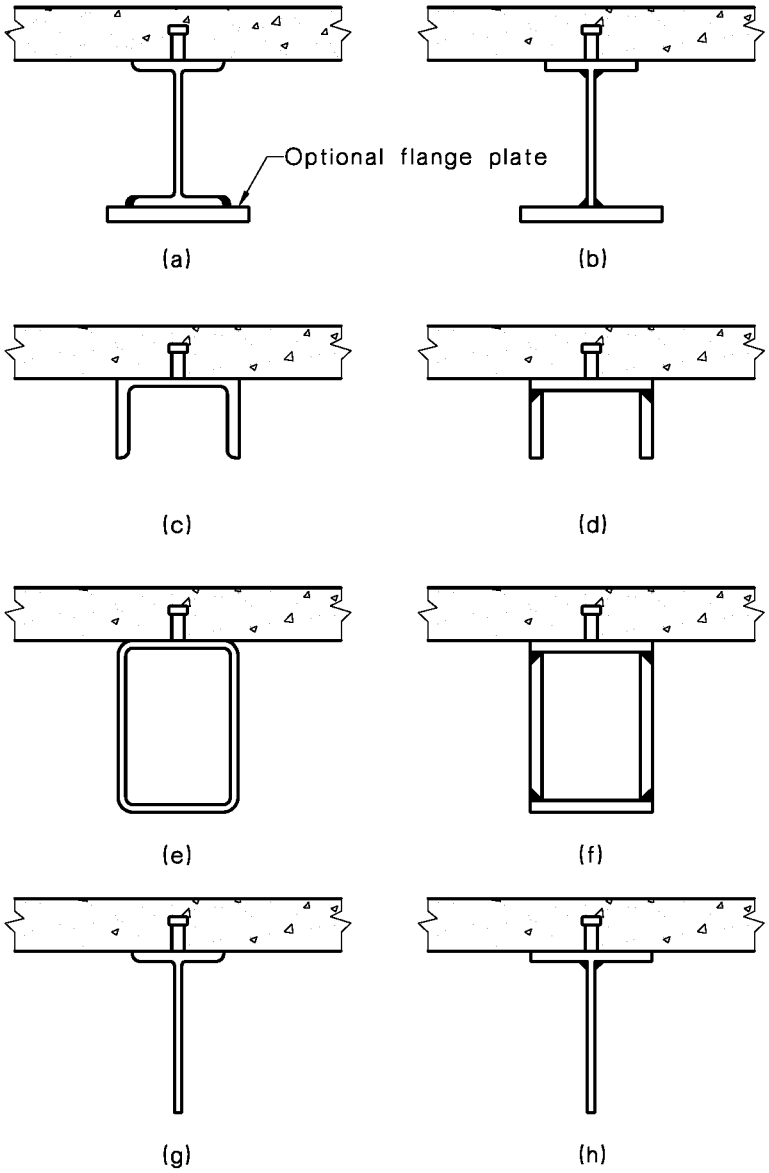

FIGURE 1.2.2 ALTERNATIVE STEEL BEAM TYPES

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1.2.3 Concrete slab The concrete slab shall be of reinforced, non-prestressed concrete complying with AS 3600, and be either a solid slab (without a haunch) or a composite slab (see Figure 1.2.3):

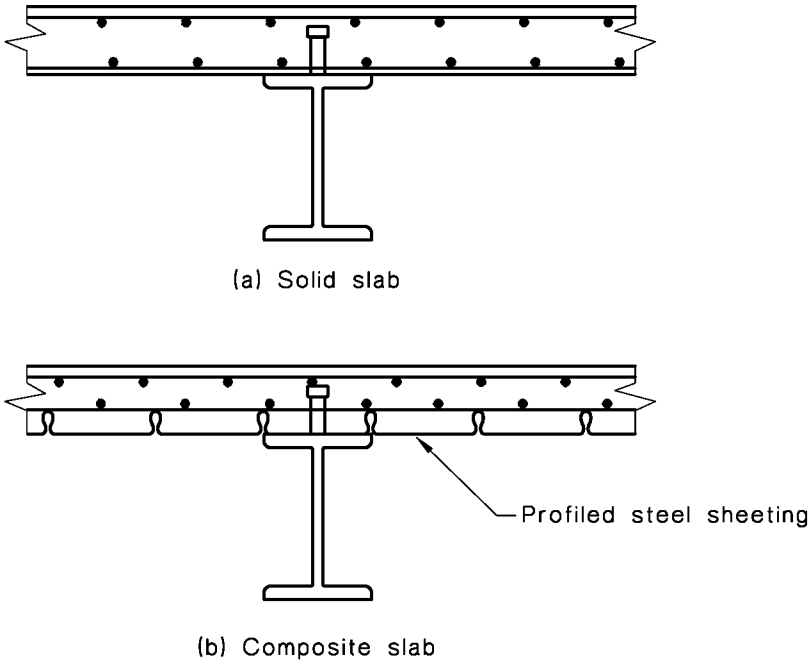

FIGURE 1.2.3 ALTERNATIVE CONCRETE SLAB TYPES

1.2.4 Profiled steel sheeting The geometry of the profiled steel sheeting incorporated in a composite slab shall satisfy all of the following requirements (see Figure 1.2.4(a)):

(a) The overall height of a steel rib (h_r) shall be not greater than 80 mm, excluding any embossments.

(b) The width of the opening at the base of a steel rib (b_b) shall be not greater than 20 mm.

(c) The area of the voids formed by the steel ribs in the concrete shall be not greater than 20 percent of the area of the concrete within the depth of the steel ribs.

(d) The width of the concrete between the mid-height of adjacent steel ribs (b_{cr}) shall be not less than 150 mm.

(e) The cover slab thickness (i.e. the thickness of the concrete above the steel ribs which equals $D_c - h_r$) shall be not less than 65 mm.

Longitudinal stiffeners in the pans of the sheeting with an overall height (h_s) greater than 10 mm, measured from the same face of the sheet (see Figure 1.2.4(b)), shall be deemed to be steel ribs for the purpose of this Standard.

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