

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Amendment No. 1
to
AS/NZS 2327:2017
Composite structures—Composite steel-concrete construction in buildings

REVISED TEXT

The 2017 edition of AS/NZS 2327 is amended as follows; the amendments should be inserted in the appropriate places.

SUMMARY: This Amendment applies to Section 1, Clauses 1.1, 1.1.1, 1.1.2, 1.1.7, 1.2.1.2, 1.2.1.5, 1.2.2.3.1, 1.2.2.3.2, 1.2.2.3.3, 1.3.2, 1.4.3, 1.6.2, 1.6.3, 2.2.2, 2.4.3, 2.6, 2.7.2, 2.7.3, 2.8.3.2, 3.4.2.1, 3.4.2.3, 3.4.3.3, 3.4.3.4, 3.5.2, 3.5.3, 3.5.4.2, 3.5.4.3, 3.5.4.5, 3.5.6, 3.5.8.3, 3.5.8.4.1, 3.5.8.4.2, 3.5.8.6, 3.6.1.2, 3.6.2.1, 3.6.2.4.1, 3.6.2.4.2, 3.6.2.5, 3.6.2.6, 3.6.2.8, 3.6.2.9, 3.8.2, 3.8.3, 3.8.4, 3.8.6, 3.8.7, 3.8.10, 3.10.3.2, 3.10.3.4, 4.1.1.4, 4.1.1.5, 4.1.1.6.1, 4.1.1.6.4, 4.1.2, 4.1.2.1, 4.1.2.2, 4.1.2.3, 4.1.2.5, 4.1.3, 4.1.3.1, 4.1.3.3, 4.1.3.4, 4.2, 4.2.1.3, 4.2.2, 4.2.3, 7.1.1, 7.3.3.2.1, 7.3.3.3.3., 7.7.3.1, 7.7.4.5.1, 7.7.4.5.2, 7.7.4.5.3, 7.7.4.5.4, 7.7.4.5.6, 8.3.2, 8.7.2.2.4, A3.3.1, B3, and I1.3, Figures 2.2.2, 3.5.4.3(B), 3.5.4.4, 3.5.4.5, 3.5.8.2, 3.5.8.6, 3.8.3, 3.8.4, 4.2.2, 5.1, 7.3.2.7 and 7.3.3.3.3, Tables 3.4.3.3, 3.4.3.4, 3.8.3, 4.1.1.6(A), 4.1.1.6(B), 4.5, 7.7.4.5.3, 8.5.5.1, B1 and B2, and Bibliography.

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Section 1

Delete the section title and *replace* with “GENERAL REQUIREMENTS”.

Clause 1.1

Delete the clause title and *replace* with “Scope and general”.

Clause 1.1.1

- 1 In Item (b), *delete* “100 MPa” and *replace* with “120 MPa”.
- 2 In the note, *delete* “the AUSTROADS Bridge Design Code”.

Clause 1.1.2

- 1 *Add* the following references:

AS	
4100	Steel structures
EN	
1992	Design of concrete structures
1992-1-2	Part 1-2: General rules—Structural fire design
13381	Test methods for determining the contribution to the fire resistance of structural members (series)
- 2 *Delete* the following references:

AS	
1275	Metric screw threads for fasteners
3610 Supp2	Formwork for concrete — Commentary (supplement No. 2 AS 3610—1995)

- AS/NZS
1252.2 Part 2: Verification testing for bolt assemblies
1365 Tolerances for flat-rolled steel products
2327 Composite structures
Part 1: Simply supported beams
- EN
1363 Fire resistance tests
1365 Fire resistance tests for loadbearing elements (series)
- 3 *Replace* reference “NZS 3404 Steel structures Standard—Materials, fabrication and construction” with “NZS 3404 Steel structures Standard”.

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Clause 1.1.7

- 1 *Insert* the following notations in the appropriate place:
 M_{Rd} = design value of the moment resistance of the composite section
 δ = deflection of the composite member
- 2 *Delete* the following notation:
 M_s = nominal moment capacity of steel beam section
- 3 In notation for h , *delete* “beam” and *replace* with “slab”.

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Clause 1.2.1.2

Delete the words “used for fabricating and erecting the steel beam”.

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Clause 1.2.1.5

Delete “AS/NZS 1365 (series) and”.

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Clause 1.2.2.3.1

Delete clause number and title.

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Clause 1.2.2.3.2

Delete clause number and title and *replace* with the following:

1.2.2.4 *Nominal size of concrete aggregate for composite slabs*

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Clause 1.2.2.3.3

Delete clause number and title and *replace* with the following:

1.2.2.5 *Nominal size of concrete aggregate for composite columns and beams*

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Clause 1.3.2

Delete “(see Clause 1.1.3.1.9)” and *replace* with “(see Clause 1.1.3.1.8)”.

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Clause 1.4.3

Delete Equation 1.4.3 with its notation, and *replace* with the following:

$$R_{Rd} = \Sigma \phi_i R_{u,i} \geq S^*$$

... 1.4.3



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where

ϕ_i = capacity factor for material i, not greater than the value given in Table 1.4.3

$R_{u,i}$ = nominal capacity of material i

R_{Rd} = design resistance

S^* = corresponding design action effect

Clause 1.6.2

- 1 At the end of the third paragraph, *delete* “taken as” and *replace* with “calculated as follows”.
 - 2 In Item (b), *delete* “in accordance with Clause 3.4.2”.
-

Clause 1.6.3

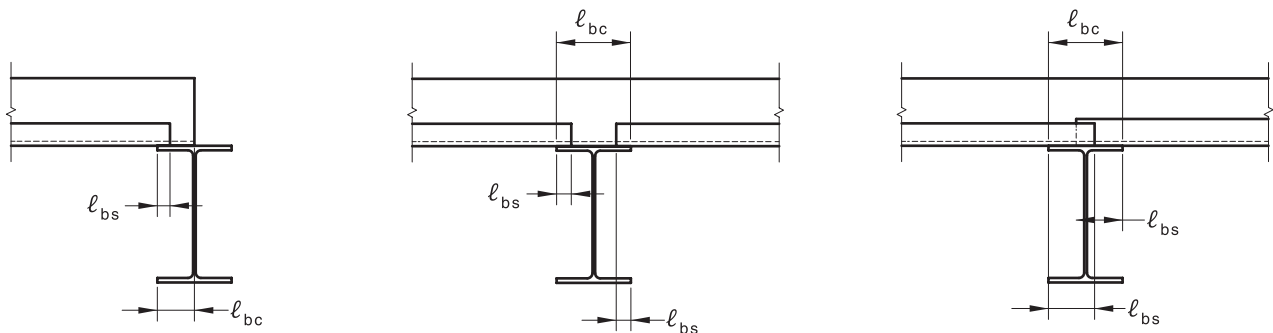
Delete Clause 1.6.3.

Clause 2.2.2

In Item (c), *delete* “and $\ell_{bc} = 100$ mm”.

Figure 2.2.2

Delete the diagrams in Figure 2.2.2(a) and *replace* with the following:



Clause 2.4.3

In the third paragraph, *delete* “concentrated line road” and *replace* with “concentrated line load”.

Clause 2.6

- 1 *Delete* the sixth paragraph.
- 2 *Delete* the seventh paragraph and *replace* with the following Note:

NOTE: The deflection should not exceed the values provided in Table B2.

Clause 2.7.2

- 1 In the twelfth paragraph immediately below Figure 2.7.2(C), *delete* “determined taking into account” and *replace* with “determined without taking into account”.
- 2 In the last paragraph [immediately above Equation 2.7.2(5)], *delete* “Clause 3.6.4.3.1” and *replace* with “Clause 3.6”.

- 3 In the notations for Equations 2.7.2(5) and 2.7.2(6) for “ $A_{pe,pb}$ ” *delete* “per unit length” and *replace* with “with width equal to the spacing between adjacent shear connectors along the length”.

Clause 2.7.3

- 1 *Delete* Equation 2.7.3(1) and *replace* with the following:

$$M_{Rd} = N_{c,d} z_c - N_{pre,d} z_{pre} + M_{pr,d} \quad \dots 2.7.3(1)$$

- 2 In Item (ii) of the notation for $N_{c,d}$, *delete* “ $\alpha_2=1.0 - 0.003f'_c$ (within the limits $0.67 \leq \alpha_2 \leq 0.85$) and $\gamma = 1.05 - 0.007f'_c$ (within the limits $0.67 \leq \gamma \leq 0.85$)” and *replace* with “ $\alpha_2 = 0.85 - 0.0015f'_c$ (with limits of $\alpha_2 \geq 0.67$) and $\gamma = 0.97 - 0.0025f'_c$ (with limits of $\gamma \geq 0.67$). For any section where the width reduces from the neutral axis towards the compression face, α_2 shall be reduced by 10%”.
- 3 In the notation for $N_{pre,d}$, *delete* reference “given by Equation 2.7.2(2)” and *replace* with “given by Equation 2.7.3(2)”.

Clause 2.8.3.2

Delete Item (c) and the following paragraph, including Equations 2.8.3.2(1) and 2.8.3.2(2), and *replace* with the following:

- (c) For a cantilever, the value at the support.

For the purpose of the above determinations, the value of I_{ef} at each of the cross-sections nominated in Items (a) to (c) above is given by:

When $M_s^* \leq M_{cr}$

$$I_{ef} = I_{ef,max} \quad \dots 2.8.3.2(1)$$

Otherwise

$$I_{ef} = \frac{I_{cr}}{1 - \left(1 - \frac{I_{cr}}{I_{uncr}}\right) \left(\frac{M_{cr}}{M_s^*}\right)^2} \leq I_{ef,max} \quad \dots 2.8.3.2(2)$$

where

$I_{ef,max}$ = maximum effective second moment of area and equal to I_{uncr}

I_{cr} = second moment of area of the cracked slab section (i.e. ignoring the contribution of the concrete in tension) with the steel reinforcement and steel sheeting transformed to an equivalent area of concrete

I_{uncr} = second moment of area of the uncracked slab section with the steel reinforcement and steel sheeting transformed to an equivalent area of concrete

M_s^* = maximum in-service moment resisted by the cross-section

$$M_{cr} = Z(f'_{ct,f} - \sigma_{cs} + \sigma_{cpre}) \geq 0 \quad \dots 2.8.3.2(3)$$

where

Z = section modulus of the uncracked section, referred to the extreme fibre at which cracking occurs

$f'_{ct,f}$ = characteristic flexural tensile strength of concrete in accordance with AS 3600 or NZS 3101

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σ_{cs} = maximum shrinkage-induced tensile stress on the uncracked section at the extreme fibre at which cracking occurs (see Clause 2.8.3.4). The design shrinkage strain of concrete to be used in this calculation should be the one related to the time when deflection is to be calculated

σ_{cpre} = compressive stress induced by the post-tensioning, accounting for all prestressing losses, at the time when deflection is to be calculated, at the extreme fibre at which cracking occurs

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Clause 3.4.2.1

In the notation for b_{ci} , *delete* “The value b ” and *replace* with “The value b_i ”.

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Clause 3.4.2.3

Delete Equation 3.4.2.3 and *replace* with the following:

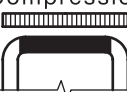
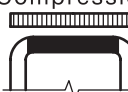
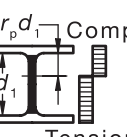
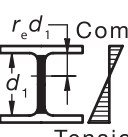
$$b_{eff} = \left(\frac{\sqrt{1.2 f'_c}}{40} \frac{32 d_b}{500} \frac{f_{sy}}{460} 1000 \right) + 2.5g \quad \dots 3.4.2.3$$

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Clause 3.4.3.3

- 1 In the second paragraph, *delete* “Steel beams with slender plate elements shall not be used (see Note 1). The effective portion of a steel beam with either compact (see Note 2) or non-compact (see Note 3)” and *replace* with “Steel beams with slender plate elements shall not be used (see Note 2). The effective portion of a steel beam with either compact (see Note 3) or non-compact (see Note 4)”.
- 2 In Item (c) and Note 2, *delete* “Table 3.4.3.3(A) or Table 3.4.3.3(B)” and *replace* with “Table 3.4.3.3”.
- 3 In Note 3, *delete* “Table 3.4.3.3(A)” and *replace* with “Table 3.4.3.3”.

Table 3.4.3.3Delete Table 3.4.3.3, but retain the Notes, and *replace* with the following:**TABLE 3.4.3.3****VALUES OF PLATE ELEMENT SLENDERNESS LIMITS**

Plate element type	Longitudinal edges supported	Residual stress	Plasticity limit (λ_{ep})	Stress distribution	Yield limit (λ_{ey})	Stress distribution	Deformation limit (λ_{ed})
Flat	One	SR HR LW, CF HW	10 9 8 8	Compression 	16 16 15 14	Compression 	35 35 35 35
(Uniform compression)							
Flat	One	SR HR LW, CF HW	10 9 8 8		25 25 22 22		— — — —
(Maximum compression at unsupported edge, zero stress or tension at supported edge)							
Flat	Both	SR HR LW, CF HW	30 30 30 30	Compression 	45 45 40 35	Compression 	90 90 90 90
(Uniform compression)							
Flat	Both	Any	82		115		—
(Compression at one edge, tension at the other, neutral axis at mid height)							
Flat	Both	Any	For $1.0 \geq r_p \geq 0.5$ $\frac{111}{4.7r_p - 1}$ For $r_p < 0.5$ $\frac{41}{r_p}$	 Tension	For $1.0 \geq r_e \geq 0$ $\frac{60}{r_e}$	 Tension	
(Web of beam with neutral axis not at mid height)							

LEGEND:

SR = stress relieved

HR = hot-rolled or hot-finished

CF = cold-formed

LW = lightly welded longitudinally

HW = heavily welded longitudinally

 r_p = ratio of the distance from the plastic neutral axis to the compression edge of the web to the depth of the web r_e = ratio of the distance from the elastic neutral axis to the compression edge of the web to the depth of the web

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Clause 3.4.3.4

- 1 First paragraph, *delete* “in pairs (one on each flange outstand)”.
- 2 First paragraph, *delete* “the requirements given in Table 3.4.3” and *replace* with “the requirements below. Compact slenderness limits shall be in accordance with Table 3.4.3.4.”
- 3 Second paragraph, *delete* “steel compression flange is deemed to be compact if the”.
- 4 Second paragraph, *delete* “is not greater than” and *replace* with “shall not be greater than”.
- 5 Third paragraph, *delete* equation and *replace* with $9t_f\sqrt{f_y/250}$.

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Table 3.4.3.4

In table header, *delete* equation and *replace* with $(b/t_f)(\sqrt{f_y/250})$.

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Clause 3.5.2

- 1 In Item (a)(i), *delete* “design moment capacity (ϕM_{bv})” and *replace* with “moment resistance (M_{Rd})”.
- 2 In Item (a)(i), *delete* “(i.e. $M_R \geq M^*$)” and *replace* with “(i.e. $M_{Rd} \geq M^*$)”.

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Clause 3.5.3

Last paragraph, *delete* “composite section M_R ” and *replace* with “composite section M_{Rd} ”.

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Clause 3.5.4.2

- 1 In Item (b), *delete* “ f_y ” and *replace* with “ $f_{y,d}$ ”.
- 2 In Item (d), *delete* “ f_c is the characteristic” and *replace* with “ f_{cd} is the design”.
- 3 In the fourth paragraph [immediately below Figure 3.5.4.2(A)], in the first sentence and in the notation for δ , *delete* “semi-compact” and *replace* with “non-compact”.
- 4 In notation for δ , *delete* the word “to” in both instances.

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Clause 3.5.4.3

- 1 In the second and third paragraphs and Equation 3.5.4.3, *delete* “ M_R ” and *replace* with “ M_{Rd} ”.
- 2 In the second paragraph, *delete* “ M_s and M_p ” and *replace* with “ $M_{s,Rd}$ and $M_{pl,Rd}$ ”.
- 3 Second paragraph, third line, after the words “structural steel section alone”, *insert* “(ϕM_s from AS 4100 and NZS 3404)”.

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Figure 3.5.4.3(B)

Delete figure and title and *replace* with the following:

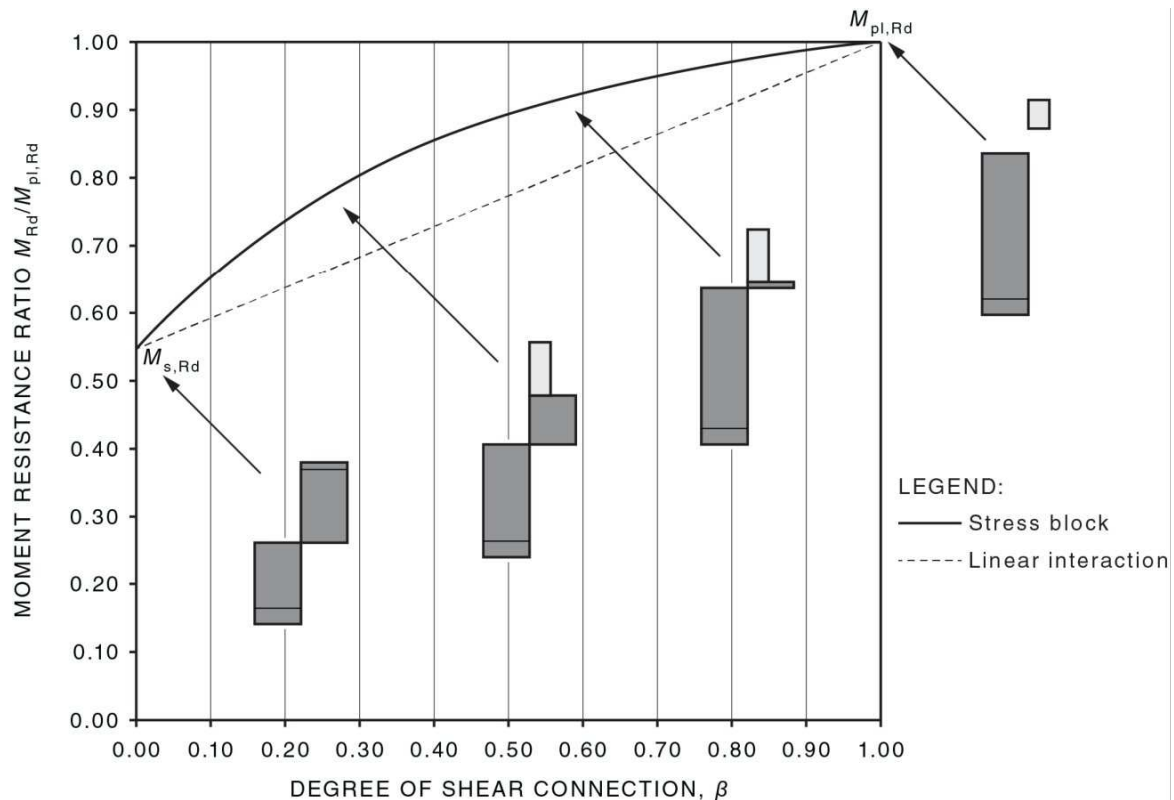
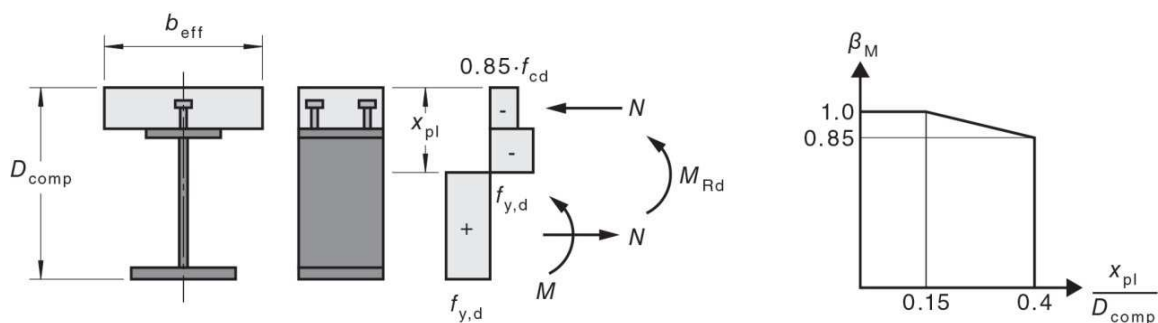


FIGURE 3.5.4.3(B) RELATIONSHIP BETWEEN M_{Rd} AND β FOR DUCTILE SHEAR CONNECTORS

Figure 3.5.4.4

Delete figure and replace with the following:



Clause 3.5.4.5

Delete the clause text and replace with the following:

These rules shall be applied when—

- an individual shear connector is not ductile according to Clause 3.6.1, because its characteristic slip capacity δ_{uk} is less than 6 mm (e.g. block connectors);
- the shear connection is not ductile, because the limits on the degree of shear connection given in Clause 3.5.8.3 have not been achieved; or
- for composite cross-sections with structural steel grade not less than 450 when $x_{pl}/D_{comp} > 0.4$, according to Clause 3.5.4.4.

Where the bending resistance of a composite cross-section is determined by non-linear theory, it shall be assumed that the composite cross-section remains plane and that the strain in reinforcement, whether in tension or compression, is the same as the mean strain in the surrounding concrete (i.e. perfect bond is assumed).

For a compact or non-compact composite cross-section with the concrete flange in compression, the non-linear resistance to bending M_{Rd} shall be determined as a function of the compressive force in the concrete F_c using the simplified Equations 3.5.4.5(1), (2) and (3), which are also shown graphically in Figure 3.5.4.5:

$$M_{Rd} = M_s^* + (M_{el,Rd} - M_s^*) F_c / F_{c,el} \quad \text{for } F_c \leq F_{c,el} \quad \dots 3.5.4.5(1)$$

$$M_{Rd} = M_{el,Rd} + (M_{pl,Rd} - M_{el,Rd}) (F_c - F_{c,el}) / (F_{cc} - F_{c,el}) \quad \text{for } F_{c,el} \leq F_c \leq F_{cc} \quad \dots 3.5.4.5(2)$$

with

$$M_{el,Rd} = M_s^* + k M_c^* \quad \dots 3.5.4.5(3)$$

where

M_s^* = design moment resistance applied to the structural steel section before composition behaviour

M_c^* = part of the design moment resistance applied to the composite section

k = lowest factor such that: the stress in the concrete is limited to f_{cd} ; or the stress in the steel is limited to f_{yd} (where un-propped construction is used, the sequence of construction shall be taken into account)

$F_{c,el}$ = compressive force in the concrete flange corresponding to moment $M_{el,Rd}$

$M_{el,Rd}$ = elastic moment resistance of the composite beam

For cross sections where Clause 3.5.4.4 applies, in Equation 3.5.4.5(2) and Figure 3.5.4.5 instead of $M_{pl,Rd}$ the reduced value $\beta_M M_{pl,Rd}$ shall be used.

Figure 3.5.4.5

Delete figure and replace with the following:

