NZS 3101:Part 1:1995

CONCRETE STRUCTURES STANDARD
Part 1
THE DESIGN OF CONCRETE STRUCTURES

AMENDMENT NO. 1

December 1998

REVISED TEXT

EXPLANATORY NOTE

This amendment is issued in response to comment from users of the Standard and to correct errors.

APPROVAL

Amendment No. 1 was approved on 16 November 1998 by the Standards Council to be an amendment to NZS 3101:Part 1:1995.

3.4.4.3 (page 27)
In line 1 **delete** "Assessment of structure deflections for" and **substitute** "Assessment of internal actions of indeterminate structures, and the period of vibration and deflections of structures, at".

(Amendment No. 1, December 1998)

4.3.5(c)(i) (page 35)
In line 2 **delete** ", or to" and **substitute** " , and to".

4.3.5(c)(ii) (page 35)
In line 1 **delete** "component" and **substitute** "part".

(Amendment No. 1, December 1998)

4.3.6.3(a) (page 36)
Delete 4.3.6.3(a) and **substitute**:

"(a) A continuous load path in floor and roof members as required in 4.3.6.1 shall provide a tensile capacity by way of longitudinal and transverse ties continuous over internal wall supports and between members and external walls. A nominal strength equivalent to not less than 22 kN per metre shall be separately provided along and across the building. Ties parallel to slab spans shall be spaced at not more than 3 m centres."

(Amendment No. 1, December 1998)

4.4.3.1 (page 39)
In line 1 **delete** "dependable" and **substitute** "design".

(Amendment No. 1, December 1998)

4.4.3.4(a) (page 40)
Delete item (a) and **substitute** the following:

"(a) The absolute maximum moment derived for any span from elastic analysis for any combination of earthquake forces and appropriately factored gravity loading shall not be reduced by more than 30 % as a result of redistribution".

(Amendment No. 1, December 1998)

Single User PDF Terms & Conditions

4.4.4.1 (page 40)
In line 3 **delete** "3.4.4.4" and **substitute** "3.4.4.3".

(Amendment No. 1, December 1998)

Add a new clause (page 45)

4.4.11.8
Individual foundations of a building shall be interconnected in two directions, generally at right angles, by members with a horizontal design strength not less than 10 % of the maximum vertical load applied under seismic conditions to the foundation element concerned.

Alternatively, foundations may be restrained by other means against differential lateral movement during an earthquake.

(Amendment No. 1, December 1998)

5.3.3.1 (page 48)
In lines 1 and 3 **delete** "ordinary Portland cement" and **substitute** "Type GP – general purpose Portland cement".

(Amendment No. 1, December 1998)

5.3.3.2 (page 48)
In lines 2 and 3 **delete** "ordinary Portland cement" and **substitute** "Type GP – general purpose Portland cement".

(Amendment No. 1, December 1998)

5.3.4 (page 48)
In line 3 **delete** "ordinary Portland cement" and **substitute** "Type GP – general purpose Portland cement".

(Amendment No. 1, December 1998)

5.6.2 (page 50)
In the second to last line **delete** "ordinary Portland cement" and **substitute** "Type GP – general purpose Portland cement".

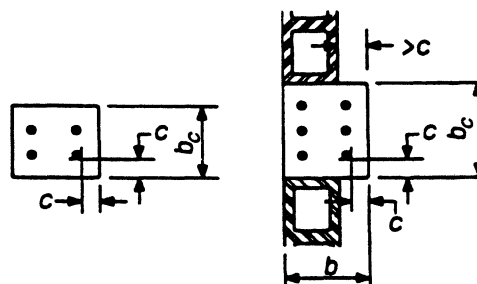*(Amendment No. 1, December 1998)*

Table 5.5 (page 59)
In the footnote **delete** "an ordinary Portland cement" and **substitute** "a Type GP – general purpose Portland cement".

(Amendment No. 1, December 1998)

Figure 6.3 (page 66)
Delete top part of the figure and **substitute** the following:

(Changes: Dimension b changed to b_c in two places.)

(Amendment No. 1, December 1998)

7.1 Notation (page 72)

Under the symbol for A_{tr} delete "$A_{tr} = A_t$" and substitute "$A_{tr} = A_t$ when n ≤ 6 ."

(Amendment No. 1, December 1998)

7.1 Notation (page 73)
Delete definition of n_L.

(Amendment No. 1, December 1998)

7.3.5.5 (page 75)
In lines 1 and 2 **delete** "not further apart than 2 times the wall or slab thickness" and **substitute** "not further apart than 3 times the wall or slab thickness".

(Amendment No. 1, December 1998)

7.3.7.3(c) (page 77)
Delete equation 7-5 and **substitute:**

$$ "\ \alpha_d = 1 + \sqrt{\left(\frac{A_{tr}}{s}\right)\left(\frac{f_{yt}}{80nd_b}\right)} \ \ \text{..} \ \ \text{(Eq. 7-5)"} $$

(Amendment No. 1, December 1998)

7.3.9.3 (page 77)

Delete "$\dfrac{A_{tr}}{s} \geq \dfrac{A_s}{600}$" and **substitute** "$\dfrac{A_{tr}}{s} \geq \dfrac{A_b}{600}$".

(Amendment No. 1, December 1998)

7.3.14.2 (page 79)
Delete the words "or 150 mm" .... from the (Eq. 7-11).

Add 2 new paragraphs after the line containing .... (Eq. 7-11).

"The development length, L_{dh}, determined from equation 7-11 shall apply when there is no likelihood of a failure mode of the pull-out of a cone of concrete from the volume of concrete in which the bar is anchored.

If a cone of concrete pull-out is likely then a rational analysis or suitable testing shall account for the effects of the proximity of the anchored bars to other loaded embedded items and to the edges of elements."

(Amendment No. 1, December 1998)

Add a new clause (page 80)

7.3.16.7
For bars spliced by lapping that involves offsetting of the bars by cranking, the slope of the inclined portion of bars with respect to the axis of the longitudinal bars shall not exceed 1 in 6. Transverse reinforcement or some other means of restraint at a bend in the cranked bar shall be provided to carry 1.5 times the transverse thrust that results because of the inclination of the bar. The magnitude of the transverse thrust shall be determined assuming that the bar is stressed to f_y. The resultant restraint force, provided by ties, spirals or other means of restraint, shall act through the centre of the bend of the cranked bar or bars.

(Amendment No. 1, December 1998)

7.3.22.4(b) (page 82)
In line 3 **delete** "$d/8b_b$;" and **substitute** "$d/8\beta_b$;".

(Amendment No. 1, December 1998)

7.3.25.1 (page 84)
In line 4 **after** "by ties, spirals", **insert** " , other means of restraint ".

In line 4 **delete** "Ties or spirals" , and **insert** "Ties, spirals or other means of restraint ".

In line 5 **delete** "within 2 d_b of the centre of the bend." and **substitute** "so that the resultant force, providing the horizontal support for the bursting forces, acts through the centre of the bend."

(Amendment No. 1, December 1998)

7.3.31.3 (page 86)
In line 7 **delete** "more than 2.5 times the thickness" and **substitute** "more than 3 times the thickness".

(Amendment No. 1, December 1998)

8.1 (page 91)
Add a new definition as follows:

d_b nominal diameter of bar, wire or prestressing strand, or in a bundle, the diameter of a bar of equivalent area, mm

(Amendment No. 1, December 1998)

8.4.1.5 (page 96)
In lines 1 and 2 **delete** "for members with transverse reinforcement conforming to either 8.4.7.1 or 8.4.7.2".

(Amendment No. 1, December 1998)

8.4.7.1(a) (page 97)
In line 4 **delete** "where A_g/A_c shall not be taken less than 1.2 and $p_t m$ shall not be greater than 0.4" and **substitute** "where A_g/A_c shall not be permitted to be greater than 1.5 unless it can be shown that the design strength of the column core can resist the design actions and $p_t m$ shall not be taken larger than 0.4".

(Amendment No. 1, December 1998)

8.4.7.2(a) (page 98)
In line 4 **delete** "where A_g/A_c shall not be taken less than 1.2 and $p_t m$ shall not be greater than 0.4" and **substitute** "where A_g/A_c shall not be permitted to be greater than 1.5 unless it can be shown that the design strength of the column core can resist the design actions and $p_t m$ shall not be taken larger than 0.4".

(Amendment No. 1, December 1998)

8.5.3.2(e) (page 103)
In lines 1 and 2 **delete** the words "within the width of the beam web".

(Amendment No. 1, December 1998)

8.5.4.2(c) (page 104)
Delete item (c) and **substitute**:

"(c) For longitudinal bars in potential plastic hinge regions, as defined in 8.5.4.1:

(i)   For a member with a rectangular cross section, the cross-linked bars shall not be spaced further apart between centres than the larger of 1/4 of the adjacent lateral dimension of the section or 200 mm.

(ii)   For a member with a circular cross section, the bars shall not be spaced further apart between centres than the larger of 1/4 of the diameter of the section or 200 mm.

    In any row or line of bars the smallest bar diameter used shall not be less than 2/3 of the largest bar diameter used."

(Amendment No. 1, December 1998)

8.5.4.3(a)(i) (page 105)
In line 4 **delete** "where A_g/A_c shall not be taken less than 1.2 and $p_t m$ shall not be greater than 0.4" and **substitute** "where A_g/A_c shall not be permitted to be greater than 1.5 unless it can be shown that the design strength of the column core can resist the design actions and $p_t m$ shall not be taken larger than 0.4".

(Amendment No. 1, December 1998)

8.5.4.3(b)(i) (page 105)
In line 5 **delete** "where A_g/A_c shall not be taken less than 1.2, $p_t m$ shall not be greater than 0.4" and **substitute** "where A_g/A_c shall not be permitted to be greater than 1.5 unless it can be shown that the design strength of the column core can resist the design actions and $p_t m$ shall not be taken larger than 0.4".

(Amendment No. 1, December 1998)

9.1 (page 107)
Add to Notation:

A_{st} total area of longitudinal reinforcement, mm^2

(Amendment No. 1, December 1998)

9.1 (page 109)
After "p_w $(A_s + A_{ps})/b_w d$" **insert**:

"For members with longitudinal reinforcement distributed relatively uniformly around the cross section, p_w may be taken as $0.3 A_{st}/b_w d$. For cross sections of members, other than rectangular, $b_w d$ may be replaced by the area enclosed by the centre of the peripheral transverse reinforcement."

(Amendment No. 1, December 1998)

9.3.6.3 (page 115)
In line 1 after "is used", **insert** "and the applied shear is parallel to the legs of rectangular stirrups or ties,".

Add a new sentence at the end of this clause:

"When the applied shear is not parallel to the legs of the shear reinforcement along the member, including the influence of stirrup and hoop sets that are not rectangular, the requirements of 9.3.6.10 shall be considered."

(Amendment No. 1, December 1998)

9.3.6.4 (page 115)
In line 1 **delete** "Where inclined stirrups" and **substitute** "Where bent-up bars or stirrups or ties, inclined to the axis of the member, ".

Add a new sentence at the end of this clause:

"When the applied shear is not parallel to the planes of the bent-up bars or the legs of the stirrups or ties, including the influence of stirrup and hoop sets that are not rectangular, the requirements of 9.3.6.10 shall be considered."

(Amendment No. 1, December 1998)

9.3.6.5 (page 115)
Add a new sentence at the end of this clause:

"When the applied shear is not parallel to the planes of the bent-up bars the requirements of 9.3.6.10 shall be considered."

(Amendment No. 1, December 1998)

9.3.8.4 (page 117)
In lines 1 and 3 **delete** "$A_t A_\ell / p_o$" and **substitute** "A_ℓ / p_o".

(Amendment No. 1, December 1998)

9.3.12.4 (page 120)
In equation 9-24 **delete** "$V_n =$" and **substitute** "$v_n \leq$ ".

(Amendment No. 1, December 1998)

9.3.12.9 (page 120)
In equation 9-28(b) **delete** "$A_v =$" and **substitute** "$A_{vh} =$ ".

(Amendment No. 1, December 1998)

9.3.15.2 (page 124)
Add at the end of the fourth line, after "or 9.3.15.4":

", and where b_o is the perimeter of the critical section defined in 9.3.15.1(b)."

(Amendment No. 1, December 1998)

9.3.15.2(a)(i) (page 124)
In line 3 **delete** "*and b_o is the perimeter of the critical section defined in 9.3.15(b),*"

(Amendment No. 1, December 1998)

9.3.15.2(b) (page 124)
In line 4 **delete** "b_o is the perimeter of the critical section defined in 9.3.15(b),"

(Amendment No. 1, December 1998)

9.4.5.3 (page 128)
In line 2 after "to ensure that" **insert** "in accordance with 9.4.7.3,"

(Amendment No. 1, December 1998)

11.3.2 (page 136)
In the last line **delete** "11.4" and **substitute** "17.3.8."

(Amendment No. 1, December 1998)

11.3.6 (page 136)
In equation 11-2 **delete** "$A_{jh} =$" and **substitute** "$A_{jv} =$".

(Amendment No. 1, December 1998)

11.4.2.2 (page 137)
In line 1 **delete** "in the joint, V_{jh}, in the joint shall" **substitute** "in the joint, V_{jh}, shall".

(Amendment No. 1, December 1998)

11.4.3.2 (page 137)
In equation 11-3 **delete** "$V_{jh} =$" and **substitute** "$v_{jh} =$".

(Amendment No. 1, December 1998)

12.4.4.5 (d) (page 146)
Delete ", or 150 mm".

(Amendment No. 1, December 1998)

12.4.4.5 (e) (page 146)
Change the subclause designation "(e)" to "(f)" and **add** a new subclause (e):

"(e) Each longitudinal bar or bundle of bars shall be laterally supported by the corner of a hoop having an included angle of not more than 135° or by a supplementary cross-tie, except that the following 2 cases of bars are exempt from this requirement:

(i)   Bars or bundles of bars that lie between 2 laterally supported bars or bundles of bars supported by the same hoop where the distance between the laterally supported bars or bundles of bars does not exceed 1/2 of the adjacent lateral dimension of the cross section.

(ii)   Inner layers of reinforcing bars within the concrete core centred more than 75 mm from the inside hoops."

(Amendment No. 1, December 1998)

12.4.4.5 (f) (page 146)
Delete the subclause designation "(f)" and **substitute** "(g)".

(Amendment No. 1, December 1998)

12.4.6.2 (page 147)
In line 2 after "shear and flexure" **insert** ", derived in accordance with 9.4.1.1,"

In equation 12-10 **delete** "0.1" and **substitute** "0.12".

(Amendment No. 1, December 1998)

12.4.7.4 (page 147)
In line 2 **delete** "7.3.16.5(c)" and **substitute** "7.3.16.6".

(Amendment No. 1, December 1998)

16.3.6.4 (page 177)
Delete equation 16-3 and **substitute**:

$$" f_{ps} = f_{pu}\left(1 - \frac{\gamma_p}{\beta_1}\left[p_p \frac{f_{pu}}{f'_c} + \frac{d}{d_p}(\omega - \omega')\right]\right) "$$

Delete the expression "$\left[p_p \dfrac{f_{pu}}{f'_c} + \dfrac{d}{d_p}(\omega - \omega_1)\right]$" and **substitute** "$\left[p_p \dfrac{f_{pu}}{f'_c} + \dfrac{d}{d_p}(\omega - \omega')\right]$".

(Amendment No. 1, December 1998)

17.3.6.5(b) (page 191)
In line 2 **delete** "0.8 times".

17.3.8.1 (page 194)
In line 1 after "limited ductility", **insert**:

"and in frames of elastically responding structures, subjected to seismic forces,"

Appendix A
A1 (page 201)
Delete the 6th item from bottom of page, defining N^*_Q and **substitute**:

N_{Qu} design axial load due to reduced live load for the ultimate limit state, N

A4.2.1 (page 204)
Delete the last 2 sentences of the paragraph (after "... factor is irrelevant.") and **substitute**:

"Apart from shear, at its base a column does not need to be capacity design protected. At this level, only the most adverse combination of gravity and live loads and earthquake actions, including axial loads, at the specified ultimate limit state need be considered. When design earthquake moments dominate, as an approximation, an equivalent $\phi_o = 1/\phi \approx 1.2$, or 1.3 may be used to determine the necessary nominal flexural strength at the base of columns of one-way and two-way frames, respectively."

A8.1 (b) (page 211)
In line 2 after "$V^*_{col} = (M_{o, col, bottom} + M_{o,col,top})/ L_n$" **insert** "$\geq 1.25 M_n$".

In Eq. A-8 **delete** " N " and **substitute** " N^* ".

At the end of the last paragraph, after "with 8.5.4.3 **add** " and 17.3.5.10. The background to Eq. A-8 can be found in reference A2."

A9 (page 212)
In Step 8, **delete** "N_Q" and **substitute**:

"N_{Qu}"

Appendix C (page 229)
Delete definition of n_L.

Index (page 247)
Delete

"Materials and workmanship   1.1.1"

and **substitute**:

"Materials and workmanship   1.1.2"

(Amendment No. 1, December 1998)

NZS 3101:Part 2:1995

CONCRETE STRUCTURES STANDARD
Part 2
COMMENTARY ON THE DESIGN OF CONCRETE STRUCTURES

AMENDMENT NO. 1

December 1998

REVISED TEXT

EXPLANATORY NOTE

This amendment is issued in response to comment from users of the Standard and to correct errors.

APPROVAL

Amendment No. 1 was approved on 16 November 1998 by the Standards Council to be an amendment to NZS 3101:Part 2:1995.

Contents (page 5)
Delete

"C8.11 The arrangement and size of stirrup-ties spaced at
100 mm between centres in potential plastic hinge ..... 125"

and **substitute**:

"C8.11 The arrangement and size of stirrup-ties spaced at
6 d_b between centres in potential plastic hinge .... 125"

(Amendment No. 1, December 1998)

- -

C3.4.4.3 (page 24)
In line 2 of the first paragraph, after the word "vibration" **add** "and particularly lateral deflection"

(Amendment No. 1, December 1998)

- -

C4.3.3.3 (page 35)
In line 1 of the third paragraph, **delete** "The limitation" and **insert** "Condition (c), the limitation".

(Amendment No. 1, December 1998)

- -

C4.4.1.2 (page 44)
Add at the end of the clause:

"Consideration must be made of the situation which generates the values of the ultimate limit state actions to be used in conjunction with this Standard. These actions include: axial load or forces, moments (flexure and torsion) and shear forces. The actions are either determined from:

(a) The factored loads and forces (design actions established from an appropriate limit state loadings standard)

or

(b) The actions associated with capacity design considerations (overstrength behaviour and the ductile failure mechanisms).

Depending on the situation, (a) or (b) above, the designer must ensure that the appropriate actions are used in the requirements of this Standard."

<div align="right">(Amendment No. 1, December 1998)</div>

C4.4.6.2 (page 50)
Delete equation C4-1 and **substitute**:

$$"V^*_{wall} = \omega_v \phi_o V_E < \mu V_E \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\text{(Eq. C4-1)"}$$

<div align="right">(Amendment No. 1, December 1998)</div>

Add a new clause (page 56)

C4.4.11.8
The interconnection of foundations is an important construction requirement to ensure that the building will act as a unit in an earthquake. This is best achieved by connections at ground level where the disturbance originates and where the connections provide a measure of safety if ground movements occur. Piled foundations, or spread footings, which are located in or on soils with a design bearing capacity less than 250 kPa, require restraint in any horizontal direction by means of structural ties, or other means, in order to limit differential horizontal movement of the foundation during earthquake ground motion. The ties, or other means, should provide a design restraint of at least 10 % of the maximum compression load in the column supported by the foundations.

In the case of shear walls, subject to seismic overturning effects, the maximum compression load should include contributions from the flexural compression block, treated as an isolated column, to that part of the foundation supporting the end of the shear wall.

Foundations on sloping sites require special attention.

Piles driven through soft subsoils should be designed for bending due to lateral loads.

For lightly loaded columns, or columns on stiff or rock foundation material, other means of restraint for foundations to satisfy clause 4.4.11.8 may include a design lateral (passive) resistance provided by the ground enclosing the foundation.

<div align="right">(Amendment No. 1, December 1998)</div>

C5.3.3 (page 64)
In line 3 of the fourth paragraph commence new paragraph at the words "For systems relying wholly ...".

In the sixth paragraph **delete** items (a) and (b) and **substitute**:

"(a) Water vapour transmission resistance less than 4 metres of air barrier.

(b) CO_2 diffusion resistance greater than 50 metres of air barrier."

<div align="right">(Amendment No. 1, December 1998)</div>

Figure C7.4(c) (page 83)

In figure C7.4(c) **delete** "c_p" and **substitute** "c_b".

Figure C7.5(d) (page 84)

In figure C7.5(d) **delete** the expression " $A_{tr} = \dfrac{6A_t}{n} \geq A_t$ " and **substitute** " $A_{tr} = \dfrac{6A_t}{n} \leq A_t$ "

C7.3.14 (page 86)
Add 5 new paragraphs after the first paragraph:

"One or more bars anchored by standard hooks with a development length according to equation 7-11, and in close proximity to each other, should develop the strength of the bars provided the bars are included in a viable "strut and tie" mechanism. A viable mechanism consists of equilibrating internal actions where the bond stresses along the hook and the bearing stresses in the bend of the hook are balanced by (i) compression fields in the surrounding concrete and (ii) tension fields produced by reinforcement bounding and passing through the volume of concrete in which the bars are anchored.

Note that reference 7.25 recommends that for the strut developed inside of the bend of the hook the angle of the strut to the straight shaft of the hook (length L_b , in Figure C7.1) should not be greater than 55°. If the angle is greater than 55° then the pull-out of a cone of concrete, before the yield strength of the bar is reached, is likely. This failure mode should be avoided. A typical situation where a concrete cone pull-out can occur at the connection of a floor to a wall, is where starter bars are anchored with a standard hook close to the adjacent face of the wall.

Typical situations where the "strut and tie" mechanism exists include: beam column joints, column and beam stubs (for anchoring bars outside the beam-column joints) and longitudinal bars terminated by standard hooks at (i) the end of cantilevers elements (slabs, beams and foundation pads) and (ii) where curtailment of the longitudinal bars occurs within elements, where the traditional shear "truss" or "strut and tie" mechanisms exist.

Where a "strut and tie" mechanism does not exist, the failure mode of the bar under tension may be the pull-out of a cone of concrete, before the yield strength of the bar is reached. It is possible to prevent the pull-out of a concrete cone and the bar embedded in it, by tying back the cone into the "strut and tie" mechanism with appropriate tension reinforcement.

Meshes or grillages of reinforcement in the plane of the concrete element, such as a wall panel, are ineffective in preventing a cone type of failure[7.25]. One method for determining adequate embedment or development lengths terminated with standard hooks (not complying with 7.3.14.2) may be found in reference 7.25."

Section 7 References (page 103)
Add to the reference list of Section 7:
"7.25   Restrepo, J.I., Crisafulli, F.J. and Park, R., "Earthquake Resistance of Structures: The Design and Construction of Tilt-up Reinforced Concrete Buildings", Research Report 96-11, Department of Civil Engineering, University of Canterbury, New Zealand, 1996."

C8.4.1.5 (page 108)
Delete the clause and **substitute**:

"The design axial load strength in compression with or without eccentricity is limited to 85 % of the design axial load strength without eccentricity in order to account for accidental eccentricities not considered in the analysis that may occur in a compression member and to recognize that at sustained high loads the concrete strength may be less than f'_c.

(Amendment No. 1, December 1998)

C8.4.7 (page 110)
Insert 2 new paragraphs between the current second and third paragraphs:

"The arrangement of transverse reinforcement should ensure that the ratio A_g/A_c does not exceed 1.5 unless it can be shown that the design strength of the core of the column, including the beneficial effect of the enhancement in the concrete compressive strength due to confinement if necessary, can resist the design actions given by the design loading combinations including earthquake effect. In that case $A_g = A_c$ and the value of $A_g/A_c = 1.0$ should be substituted in equations 8-6 and 8-8. If the gross area of the section A_g is used to resist the design actions, the limitation of $A_g/A_c \leq 1.5$ means that there is a practical minimum size of core concrete. This limitation on reduction of core area, as compared to the gross area of the section, may become critical for members with relatively small cross sectional areas in conjunction with relatively large covers to the transverse reinforcement.

The limitation on $p_t m$ means a maximum value of 0.4 shall be used in equations 8-6 and 8-8. This is not a physical limitation on $p_t m$. The selection of non-prestressed longitudinal reinforcement content p_t, f_y and f'_c may result in the actual $p_t m$ ratio exceeding 0.4."
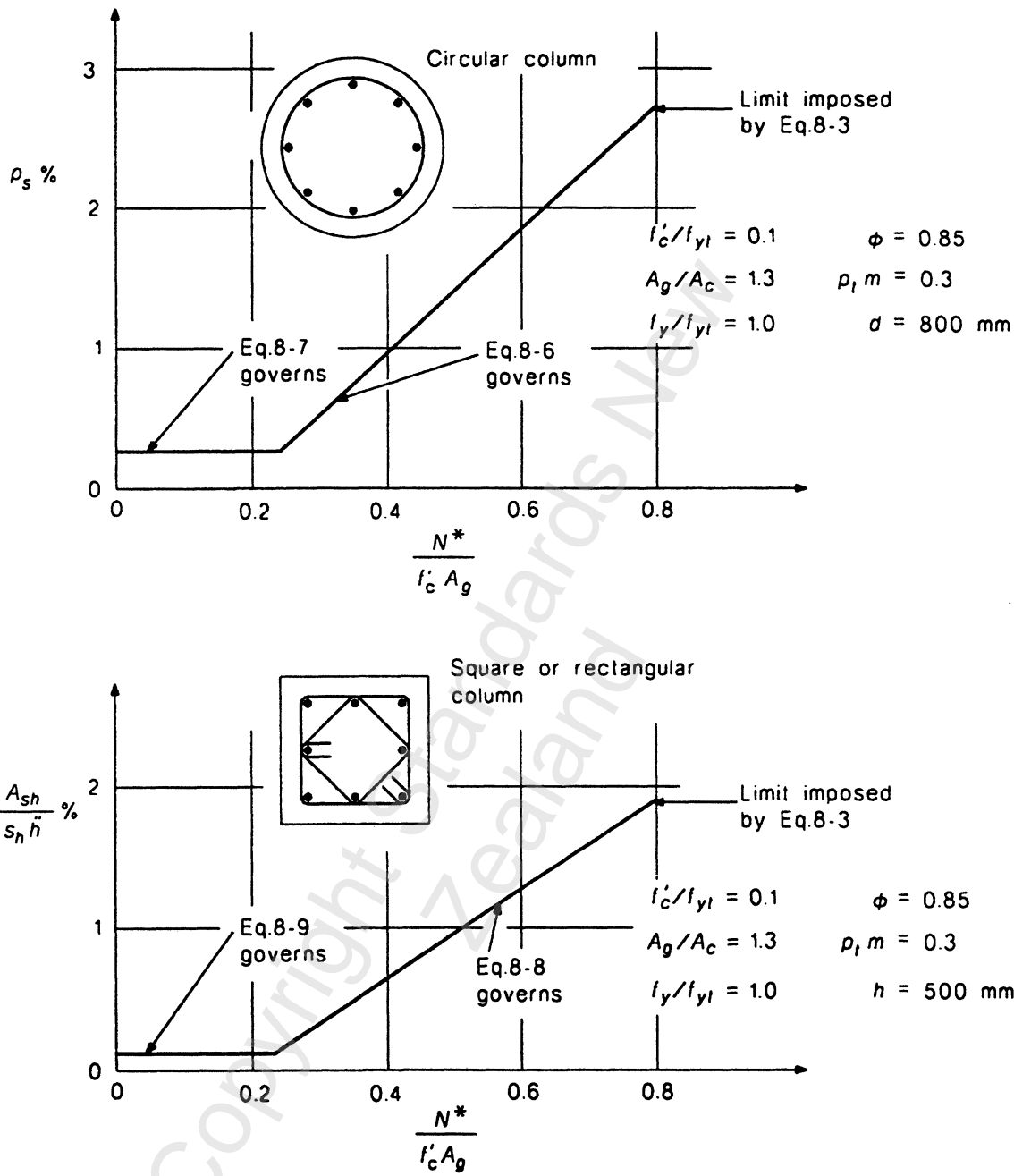
(Amendment No. 1, December 1998)

C8.4.7 (page 111)
Add a new paragraph at the end of this clause:

"The requirement for the minimum transverse reinforcement in columns stems from assuring a reasonable capability for inelastic deformation. The predominant situation visualised as producing these deformations is seismic loading. Therefore the combination of factored loads for the ultimate limit state for determining the quantity of transverse reinforcement for Eq. 8-6 and Eq. 8-8 should be taken as G & Q_u & E_u in these instances (G and Q_u are as defined by NZS 4203)."

(Amendment No. 1, December 1998)

Figure C8.2 (page 112)
Delete figure C8.2 and **substitute** the following:

Circular column

p_s %

Limit imposed
by Eq.8-3

$f_c'/f_{yt} = 0.1$ $\phi = 0.85$

$A_g/A_c = 1.3$ $p_t\, m = 0.3$

$f_y/f_{yt} = 1.0$ $d = 800$ mm

Eq.8-7
governs

Eq.8-6
governs

$\dfrac{N^*}{f_c'\,A_g}$

Square or rectangular
column

$\dfrac{A_{sh}}{s_h\,h''}$ %

Limit imposed
by Eq.8-3

$f_c'/f_{yt} = 0.1$ $\phi = 0.85$

$A_g/A_c = 1.3$ $p_t\, m = 0.3$

$f_y/f_{yt} = 1.0$ $h = 500$ mm

Eq.8-9
governs

Eq.8-8
governs

$\dfrac{N^*}{f_c'\,A_g}$

(Amendment No. 1, December 1998)

Figure C8.7 (page 120)
Delete figure and **substitute:**
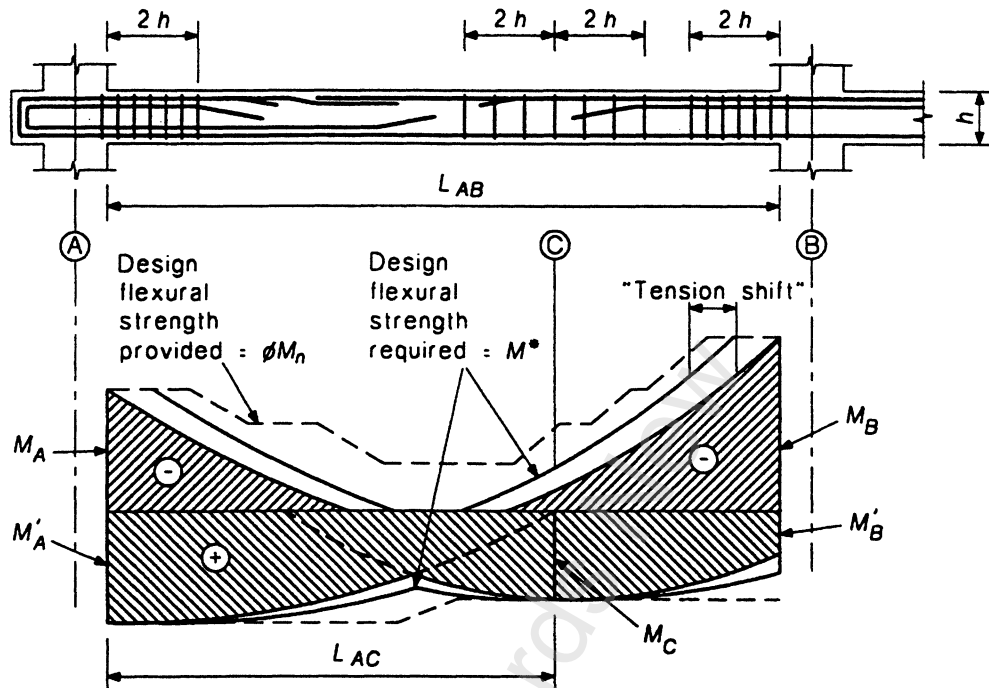
NOTE – Tension shift: accounts for the actual tension force in the flexural reinforcement, at a given section, being greater than that required to resist the bending moment at that section; being a function of the slope of the inclined crack or diagonal compression (typically assumed to be 45°), which is part of the truss mechanism that resists shear [8.1].
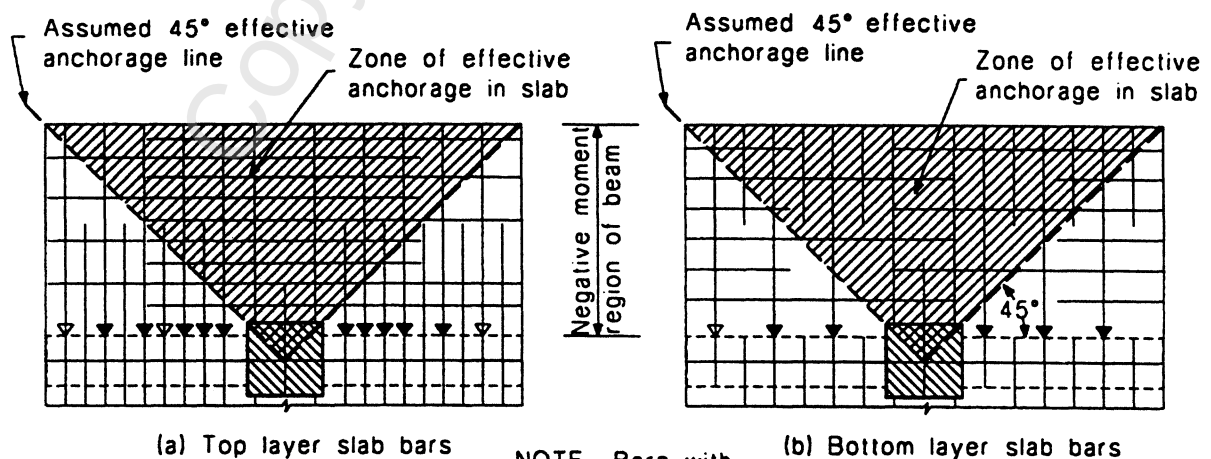
(Changes: Bar termination removed from centreline B. Flexural capacity required lines and tension shift added. Note added.)

(Amendment No. 1, December 1998)

C8.5.3.2(e) (page 122)
In line 2 **delete** the words "within the beam web".

(Amendment No. 1, December 1998)

Figure C8.10 (page 124)
Delete figure C8.10 and **substitute** the following:

(a) Top layer slab bars   NOTE – Bars with: ▼ full anchorage   ▽ partial anchorage   (b) Bottom layer slab bars

(Changes: Bars with full and partial anchorage in (a) changed.)

(Amendment No. 1, December 1998)

Figure C8.11(b) (page 125)
Delete part figure and **substitute**:
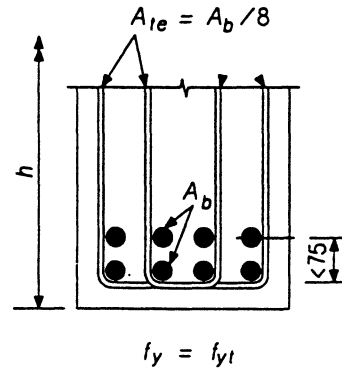
(b)

(Change: Dimension <75 taken to inside face of stirrup tie.)

Delete the caption and **substitute**:

"**Figure C8.11 - The arrangement and size of stirrup-ties spaced at 6 d_b between centres in plastic hinge regions.**"

(Amendment No. 1, December 1998)

C8.5.4.2(c) (page 127)
In line 3 after "The bars between the corner bars" **add** "in rectangular columns or between bars adjacent to the extreme tension or compression fibres in circular columns."

(Amendment No. 1, December 1998)

C8.5.4.3(a) and (b) (page 128)
**Insert** 2 new paragraphs between the current first and second paragraphs:

"The arrangement of transverse reinforcement should ensure that the ratio A_g/A_c does not exceed 1.5 unless it can be shown that the design strength of the core of the column, including the beneficial effect of the enhancement in the concrete compressive strength due to confinement if necessary, can resist the design actions given by the design loading combinations including earthquake effect. In that case $A_g = A_c$ and the value of $A_g/A_c = 1.0$ should be substituted in equations 8-24 and 8-26. If the gross area of the section A_g is used to resist the design actions, the limiation of $A_g/A_c \leq 1.5$ means that there is a practical minimum size of core concrete. This limitation on reduction of core area, as compared to the gross area of the section, may become critical for members with relatively small cross sectional areas in conjunction with relatively large covers to the transverse reinforcement.

The limitation on $p_t m$ means a maximum value of 0.4 shall be used in equations 8-24 and 8-26. This is not a physical limitation on $p_t m$. The selection of non-prestressed longitudinal reinforcement content p_t, f_y and f'_c may result in the actual $p_t m$ ratio exceeding 0.4."

C8.5.4.3(a) and (b) (page 129)
In line 5 of the fourth paragraph **delete** "contribution of R(2) times" and **substitute** "contribution of $\sqrt{2}$ times".
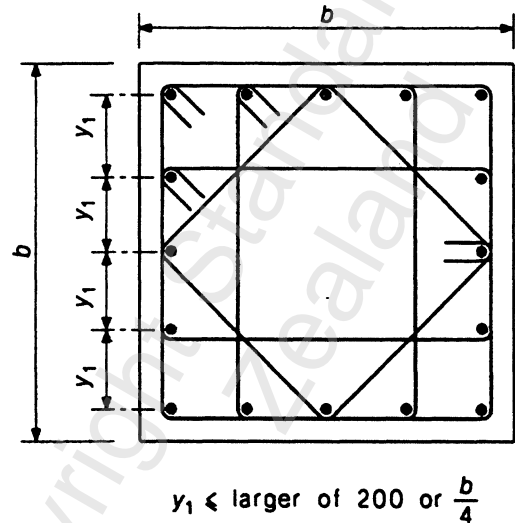
(Amendment No. 1, December 1998)

Figure C8.12(a) (page 130)
Delete the figure and **substitute:**

$$x_1 \leqslant \text{ larger of } 200 \text{ or } \frac{b_2}{4}$$
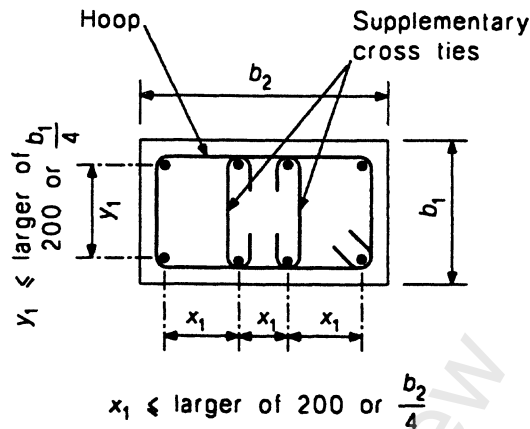
(Change: Dimension x_1 and y_1 taken to centrelines of longitudinal bars.)

(Amendment No. 1, December 1998)

Figure C8.13(b) (page 131)
Delete part figure and **substitute:**

$$y_1 \leqslant \text{ larger of } 200 \text{ or } \frac{b}{4}$$

(b) Four overlapping hoops

(Change: Dimension b to face of member, dimension y_1 to main bar centres.)

(Amendment No. 1, December 1998)

C9.3.6.10 (page 143)
**Add** at the end of the clause:

"When the direction of the applied shear is oblique to the legs of stirrups or ties allowances must be made for the reduced effectiveness of the shear reinforcement to resist the applied shear."

(Amendment No. 1, December 1998)

C9.4.4.2 (page 164)
Delete the last sentence of the first paragraph.

Figure C12.2 (page 203)
Delete the figure and **substitute:**
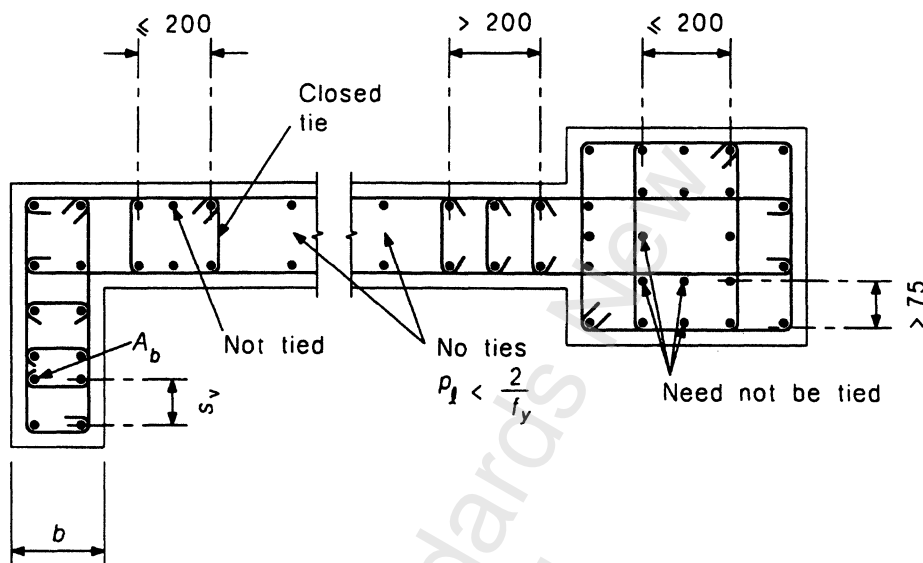
(Change: Dimension >75 taken to inside face of tie.)

C12.4.4.5 (page 204)
At beginning of third paragraph **change** the subclause designation "(e)" to "(f)" and **add** a new subclause (e):

"(e) The requirements that this clause are similar in purpose to those for confinement of columns. As the maximum strains and degree of degradation of the compression zone of the walls are likely to be less than that of columns, the maximum permissible spacing between longitudinal bars is less restrictive; that is, the centre-to-centre spacing may be larger than that in columns."

C12.4.4.5 (page 205)
At beginning of page 205 **change** the subclause designation "(f)" to "(g)".

C12.4.6.2 (page 207)
In lines 8 and 12 of the first paragraph **delete** "$L_n/h = 4$" in two places and **substitute** "$L_n/h = 3.33$".

C18.4.2.6 and **C18.4.3.7** (page 263)
Delete clause number "C18.4.2.6 and C18.4.3.7" and **substitute** "C18.4.2.6 and C18.4.3.6".

(Amendment No. 1, December 1998)

C18.4.2.7 and **C18.4.3.8** (page 263)
Delete clause number "C18.4.2.7 and C18.4.3.8" and **substitute** "C18.4.2.7 and C18.4.3.7".

(Amendment No. 1, December 1998)