

NZS 4230:2004

DESIGN OF REINFORCED CONCRETE MASONRY STRUCTURES

AMENDMENT NO.1

December 2006

REVISED TEXT

EXPLANATORY NOTE

This amendment brings NZS 4230 into line with AS/NZS 1170 *Structural design actions*, and NZS 1170.5:2004 *Structural design actions – Earthquake actions*.

APPROVAL

Amendment No. 1 was approved on 8 December 2006 by the Standards Council to be an amendment to NZS 4230:2004.

Contents Page (p. 3)

Add: “4.3 Governing reinforcing cover requirements 35”.

(Amendment No.1, December 2006)

Contents Page – Table (p. 5)

3.1: **delete** “nominal” and **substitute** “design compressive”.

10.1: **delete** “nominal” and **substitute** “design”.

C1: **delete** “Dependable strength in shear and tension of bolts...” and **substitute:**
“Design strength in shear and tension for bolts”.

(Amendment No.1, December 2006)

REFERENCED DOCUMENTS (p. 7)

NEW ZEALAND STANDARDS

Delete “NZS 1170.5:xxxx” and title and **substitute:**

“NZS 1170.5:2004 Structural design actions Part 5: Earthquake actions – New Zealand”.

Delete “NZS 3101:1995 The design of concrete structures” and **substitute:**

“NZS 3101.1& 2:2006 Concrete structures Standard”.

Delete “NZS 4203:1992 General structural design and design loadings for buildings”.

JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

After AS/NZS 1170:- - - Part 0:2002 **add:**

“Part 1:2002 Structural design actions – Permanent, imposed and other actions

Part 2:2002 Structural design actions – Wind actions

Part 3:2003 Structural design actions – Snow and ice actions”.

(Amendment No.1, December 2006)

REFERENCED DOCUMENTS (p. 8)

OTHER PUBLICATIONS

Delete “Building Industry Authority” and **substitute** “Department of Building and Housing”.

(Amendment No.1, December 2006)

Single User PDF Terms & Conditions

You have material which is subject to strict conditions of use. Copyright in this material is owned by the New Zealand Standards Executive. Please read these terms and conditions carefully, as in addition to the usual range of civil remedies available to Standards New Zealand on behalf of the New Zealand Standards Executive for infringement of copyright, under New Zealand law every person who infringes copyright may be liable to a fine of up to \$10,000 for every infringing copy or imprisonment of up to 5 years, or a fine of up to \$150,000 or imprisonment not exceeding 5 years.

You have access to a single-user licence to read this non-revisable Adobe Acrobat PDF file and print out and retain ONE printed copy only.

We retain title and ownership of the copyright in this PDF file and the corresponding permitted printed copy at all times.

Under this license use of both the PDF file and the single permitted printed copy of this PDF file you may make are restricted to you. Under no circumstances are you permitted to save, sell, transfer, or copy this PDF file, the one permitted printed copy of this PDF file, or any part of either of them.

You undertake that you will not modify, adapt, translate, reverse engineer, decompile, disassemble or create derivative works based on any of the downloaded PDF file, nor will you merge it with any other software or document, even for internal use within your organization.

Under no circumstances may this PDF file be placed on a network of any sort without our express permission.

You are solely responsible for the selection of this PDF file and any advice or recommendation given by us about any aspect of this PDF file is intended for guidance only and is followed or acted upon entirely at your own risk.

We are not aware of any inherent risk of viruses in this PDF file at the time that it is accessed. We have exercised due diligence to ensure, so far as practicable, that this file does not contain such viruses.

No warranty of any form is given by us or by any party associated with us with regard to this PDF file, and you accept and acknowledge that we will not be liable in any way to you or any to other person in respect of any loss or damage however caused which may be suffered or incurred or which may arise directly or indirectly through any use of this PDF file.

Regardless of where you were when you received this PDF file you accept and acknowledge that to the fullest extent possible you submit to New Zealand law with regard to this licence and to your use of this PDF file.

Copyright Standards New
Zealand

FOREWORD (p. 9)

In the final paragraph **delete** the last two sentences.

(Amendment No.1, December 2006)

1.2.4 Non-specific requirements (p. 12)

Add to end of each paragraph "or building consent authority." (Three entries)

(Amendment No.1, December 2006)

2 DEFINITIONS (p. 13)

ACTION.

Delete "The term load is also often used to describe direct actions" and **substitute** "The term "load" is also often used to describe direct actions".

(Amendment No.1, December 2006)

2 DEFINITIONS (p. 14)

Add a new definition:

"FLUE. An enclosed continuous horizontal or vertical space in a masonry element formed by the cells of the masonry units which make up that member."

(Amendment No.1, December 2006)

2 DEFINITIONS (p. 15)

STRUCTURAL.

Delete "from forces".

(Amendment No.1, December 2006)

C2.1 (p. 15)

Add to end of commentary:

"AS/NZS 1170 refers to the suite of Loading Standards comprising AS/NZS 1170.0, AS/NZS 1170.1, AS/NZS 1170.2, AS/NZS 1170.3 and NZS 1170.5."

(Amendment No.1, December 2006)

Table 3.1 (p. 18)

In the title **delete** "nominal" and **substitute** "design compressive".

In column 4 **delete** "design" from the column heading and **substitute** "specified".

(Amendment No.1, December 2006)

3.4.1 Masonry strengths (p. 19)

Delete "nominal" and **substitute** "design compressive".

(Amendment No.1, December 2006)

3.4.7 Strength reduction factors, f (p. 20)

Add:

"Design for fire exposure 1.0
Strut and tie models 0.75".

(Amendment No.1, December 2006)

3.5.1 General (p. 20)

In the 2nd sentence **delete** "factored loads and forces" and **substitute** "actions".

(Amendment No.1, December 2006)

3.5.2.2 Stiffness (p. 20)**Add** a new commentary clause:**“C3.5.2.2***For guidance on section properties to be used in seismic analysis refer to NZS 3101.”*

(Amendment No.1, December 2006)

3.5.2.3 Seismic actions (p. 20)**Add** to end of the clause “For the serviceability limit state, deflections shall be calculated using a structural performance factor, S_p , of 0.7 in the determination of the applied actions.”

(Amendment No.1, December 2006)

Delete the text box at the bottom of pages 20, 27, 46, 113, 122, 126, 135.

(Amendment No.1, December 2006)

3.5.2.5 Vibration (p. 21)**Delete** “forces” and **substitute** “actions”.

(Amendment No.1, December 2006)

C3.5.2.6 (p. 21)In the 4th paragraph:**Delete** “0.0004” and **substitute** “0.0006”.**Delete** “0.0007” and **substitute** “0.0010”.

(Amendment No.1, December 2006)

3.5.3.1 Design for strength (p. 23)In (a) **delete** “loads and forces giving rise to the”.

(Amendment No.1, December 2006)

On page 24 **add** the following new clauses after **3.5.3.3**:**“3.5.3.4 Seismic actions – ultimate limit state**

The ultimate limit state inter-storey deflection determined in accordance with NZS 1170.5 shall not exceed 2.5 % of the corresponding storey height.”

“3.5.4 Use of test data

Use of test data to satisfy the requirements of limit state design may be based on Appendix B of AS/NZS 1170.0. Use of data in this way is not part of the verification method for the Building Code.”

(Amendment No.1, December 2006)

3.6.1.1 Design forces (p. 24)**Delete** the title “Design forces” and **substitute** “Design action effects”.In the clause **delete** “effects of factored loads” and **substitute** “design action effects”.

(Amendment No.1, December 2006)

3.6.1.5 Moment redistribution (p. 24)In (a) **delete** “factored loads” and **substitute** “factored actions”.In (b) **delete** “unfactored loads” and **substitute** “unfactored actions”.In (c) **delete** “factored loads” and **substitute** “design actions”. (Twice)

(Amendment No.1, December 2006)

3.6.1.7 Effective widths for T-beam and flanged shear walls (p. 25)

In (c) (i) **delete** “factored load” and **substitute** “design action”.

(Amendment No.1, December 2006)

On page 25 **add** a new clause after **3.6.1.7**:

3.6.1.8 Structurally irregular buildings

Structurally irregular buildings are as defined in NZS 1170.5.”

(Amendment No.1, December 2006)

Table 3.2 – Design parameters for various design philosophies (p. 26)

In the row: Nominally ductile structures **delete** “0.7” for the structural performance factor S_p and **substitute** “0.9”.

In the row: Ductile structures **delete** “ $4 < 20 (1 - T_f) < 6$ ” for the structural ductility factor μ and **substitute** “4”.

After the table **add**:

“NOTE – The S_p is for the ultimate limit state condition and for the serviceability condition. See 3.5.2.3.”

(Amendment No.1, December 2006)

C3.7.1.1 (p. 26)

Add as the final sentence:

“The limit of $\mu = 4$ for ductile structures in table 3.2 has been set to ensure that the serviceability limit state design actions do not exceed the ultimate limit state design actions.”

(Amendment No.1, December 2006)

3.7.1.2 Interaction of structural and non-structural elements (p. 26)

In paragraph 2 **delete** “forces” and **substitute** “actions”.

(Amendment No.1, December 2006)

3.7.1.3 Design of floors and roofs (p. 26)

Delete “forces” and **substitute** “actions”.

(Amendment No.1, December 2006)

3.7.1.4 Use of structural ductility factor in equations (p. 26)

Delete “factored gravity load” and **substitute** “gravity load”.

(Amendment No.1, December 2006)

3.7.1.5 Design for concurrency (p. 26)

Delete the clause and **substitute**:

“The effects of concurrency in two-way horizontal force resisting systems in elastic and nominally ductile structures shall be accommodated in accordance with 5.3.1.2 of NZS 1170.5. Ductile structures designed using capacity design principles in accordance with 3.7.4 shall be designed for concurrency in accordance with 2.6.5.8 of NZS 3101.”

(Amendment No.1, December 2006)

3.7.1.6 Strength reduction factors (p. 27)

Delete “minimum strengths” and **substitute** “design strengths”.

Delete “factored static loads” and **substitute** “static loads”.

(Amendment No.1, December 2006)

3.7.1.8 Effects of cracking on stiffness (p. 27)**Add** a new commentary clause:**“C3.7.1.8***For guidance on section properties to be used in seismic analysis refer to NZS 3101.”*

(Amendment No.1, December 2006)

3.7.1.9 Structures outside those covered in this Standard (p. 27)**Add** to end of the clause “as defined in Appendix A of AS/NZS 1170.0.”

(Amendment No.1, December 2006)

3.7.3.3 Design using a simplified capacity design approach (p. 28)**Delete** (a) and **substitute**:

“(a) Structures designed using this design philosophy shall be wall structures not exceeding three storeys or four storeys with a light roof as defined in NZS 4229. The maximum storey height shall be 3.6m.”

In (c) **delete** “Flexural strength” and **substitute** “Design flexural strength”.In (d) **delete** “Shear strength” and **substitute** “Design shear strength”.**Add** a new clause:

“(f) The structure shall be classified as regular using the definitions provided in NZS 1170.5.”

(Amendment No.1, December 2006)

Section 3 REFERENCES (p. 30)**Delete** referenced document 3.2 and **substitute**:

‘Laursen, P.T., Wight, G., Ingham, J.M., “Assessing Creep and Shrinkage Losses in Post-tensioned Concrete Masonry”, ACI Material Journal, Nov-Dec 2006’.

(Amendment No.1, December 2006)

Table 4.1 (p. 35)In row 1: Sea spray, column 2: **NZS 3101 exposure classifications**:**Delete** “C” and **substitute** “B2”.

(Amendment No.1, December 2006)

Add a new clause 4.3 after table 4.1 (p. 35)**“4.3 Governing reinforcing cover requirements**

The requirements of section 5 for fire shall take precedence over masonry covers determined from section 4 where the required cover for durability is less than that required for fire resistance.”

(Amendment No.1, December 2006)

5.3.1 General and C5.3.1 (p. 38)**Delete** the clause and commentary and **substitute**:**“5.3.1 General**

A component shall be designed to have the required fire resistance rating for each of stability, integrity, and insulation. The requirements of section 4 for durability shall take precedence over masonry covers determined from this clause where the required cover for fire resistance is less than that required for durability.

C5.3.1

In designing boundary elements of a fire compartment for fire resistance, it may be assumed that such elements are exposed to fire from only one direction at a time for the purposes of interpreting this clause.”

(Amendment No.1, December 2006)

5.4.4 Stability of walls (p. 39)

In (a) **delete** “axial loads” and **substitute** “axial forces”.

(Amendment No.1, December 2006)

Section 5 REFERENCES (p. 50)

Add a new reference after 5.14:

“5.15 More detailed assessment of elastic modulus and strength values may be obtained from: Buchanan A. H., “Structural Design for Fire Safety”, John Wiley and Sons Ltd, Chichester, England, 2001.”

(Amendment No.1, December 2006)

Add a new clause after **6.3.1.3** (p. 52):

“6.3.1.4 Restrictions on in-line quenched and tempered reinforcement

Reinforcing bars manufactured by the in-line quenched and tempered process shall not be used where welding, galvanising, hot bending, or threading of bars occurs.”

(Amendment No.1, December 2006)

6.3.11 Concrete protection of reinforcement for durability and fire (p. 58)

Delete the clause and **substitute**:

“The minimum concrete cover provided for reinforcing bars shall be the greater of those derived in accordance with section 4 and section 5 of this Standard.”

(Amendment No.1, December 2006)

7.3.4.3 Minimum reinforcement (p. 63)

Delete the clause and **substitute**:

“All walls shall be reinforced both vertically and horizontally. The horizontal reinforcement shall be uniformly distributed up the wall height, except as allowed by 7.3.4.4 or 7.3.4.7.

Except as allowed by 7.3.4.4, the minimum area of reinforcement in each direction shall be 0.07 % of the gross cross-sectional area of the wall taken perpendicular to the orientation of the reinforcement considered. Minimum reinforcement shall comply with the following:

(a) Running bond

The sum of the horizontal and vertical reinforcement ratios shall be at least 0.2 % of the gross cross-sectional area in all cases.

(b) Stack bond

For stack bonded walls the minimum horizontal reinforcement ratio shall be:

- | | |
|--|--------|
| (i) For building importance level 1 | 0.07 % |
| (ii) For building importance level 2 or 3 | 0.14 % |
| (iii) For building importance level 4 or 5 | 0.25 % |

where the building importance level is determined by AS/NZS 1170.0.”

Commentary clause remains.

(Amendment No.1, December 2006)

7.4.1 Design compatibility (p. 65)

Delete “forces” and **substitute** “actions”.

(Amendment No.1, December 2006)

7.4.3 Assumed extent of potential plastic hinge region (p. 65)**Delete** “(c) 600 mm.”

(Amendment No.1, December 2006)

C7.4.6.1 (p. 68)In the 2nd paragraph:**Delete** “dependable flexural strength is provided” and **substitute** “design flexural strength is”.

(Amendment No.1, December 2006)

7.4.6.2 Confirmation of available ductility (p. 68)**Add** to end of the clause:

“For the purpose of assessing section curvatures, the effective plastic hinge length shall be found from special study or taken as the smaller of half the wall length, or $0.2M^*/V$, but need not be taken less than a quarter of the wall length.”

(Amendment No.1, December 2006)

7.4.6.4 Ultimate compression strain for confined masonry (p. 68)**Delete** the clause and **substitute**:

“Where confining plates in accordance with 7.4.6.5 are placed in critical mortar beds within the potential plastic hinge region, as defined in 7.4.3, available ductility shall be based on an ultimate compression strain of $\epsilon_u = 0.008$.”

(Amendment No.1, December 2006)

7.4.6.5 Requirements for confining plates (p. 69)In (d) **delete** “or 1.5 b, whichever is less”.

(Amendment No.1, December 2006)

C7.4.6.5 (p. 70)In the NOTE in figure 7.2 **delete** “shall” and **substitute** “should”.

(Amendment No.1, December 2006)

8.3.5.1 Effective widths for T-beam (p. 76)In (c) (i) **delete** “factored load” and **substitute** “factored actions”.

(Amendment No.1, December 2006)

8.4.1 Design to be compatible with principles in section 3 (p. 81)**Delete** “forces” and **substitute** “actions”.

(Amendment No.1, December 2006)

9.3.6.3 Spacing of hoop reinforcement (p. 88)**Delete** (b) and **substitute**:

“(b) Ties shall be arranged so that every corner bar and at least every alternate longitudinal bar is laterally supported by a corner of a tie with an included angle of not more than 135°. No unsupported longitudinal bar shall be further than 150 mm clear on each side along the tie from a laterally supported bar.”

(Amendment No.1, December 2006)

9.4.1 Design to be compatible with principles in section 3 (p. 89)**Delete** “forces” and **substitute** “actions”.

(Amendment No.1, December 2006)

C9.4.3.1 (p. 90)**Delete** the commentary clause.

(Amendment No.1, December 2006)

10.3.2.1 *Shear strength* (p. 96)**Delete** “and forces”.

(Amendment No.1, December 2006)

Table 10.1 (p. 99)**Delete** “nominal” from title and **substitute** “design”.

(Amendment No.1, December 2006)

C10.3.2.12 (p. 103)In first sentence **delete** “torsional forces” and **substitute** “torsion”.

(Amendment No.1, December 2006)

C10.3.2.13 (p. 104)3rd paragraph:In 2nd sentence **delete** “dependable” and substitute “design”.In last sentence **delete** “factored”.

(Amendment No.1, December 2006)

10.3.2.18 *Special provisions for shear from face loads* (p. 105)In (a) **delete** last “(ii)” and substitute “(iii)”.In (b) (i) **delete** “V*” and **substitute** “N*” (twice).In (b) (iii) **delete** “ $v_m = 0.30$ MPa” and **substitute** “ $v_m = 0.15$ MPa”.

(Amendment No.1, December 2006)

10.3.3.2 *Shear strength* (p. 106)In (a) **delete** “static transverse forces” and **substitute** “transverse actions”.In (b) **delete** “forces” and **substitute** “actions”.

(Amendment No.1, December 2006)

10.3.3.6 *Openings in the web* (p. 108)In (b) (iv) **delete** “seismic forces and deformations” and **substitute** “seismic actions”.

(Amendment No.1, December 2006)

11.3.1 *General design principles* (p. 112)In (b) **delete** “dependable strength” and **substitute** “design strength”.

(Amendment No.1, December 2006)

11.3.3 *Design forces* (p. 113)**Delete** the title “Design forces” and **substitute** “Design actions”.

In the clause:

Delete “forces acting” and **substitute** “actions”.**Delete** “loads” and **substitute** “actions”.

(Amendment No.1, December 2006)

C11.3.3 (p. 113)**Delete** 2nd sentence and **substitute**:

“Indirect actions resulting from time-dependent effects such as creep, shrinkage, or settlement should be considered.”

(Amendment No.1, December 2006)

12.1 Notation (p. 120)**Delete** “ R Risk factor according to AS/NZS 1170” and **substitute:**“ R_u Return period factor for the ultimate limit state (NZS 1170.5)”.**Add** a new notation:“ $C(T_1)$ The ordinate of the elastic site spectrum for the lowest translational period of vibration”.

(Amendment No.1, December 2006)

12.4.1.3 (p. 121)In (a) **delete** “The basic seismic coefficient” and **substitute** “ $C(T_1)$ ”.

(Amendment No.1, December 2006)

C12.4.1.2 and C12.4.1.3 (p. 122)**Delete** final paragraph and **substitute:**

“Ignoring the stiffness of secondary walls risks over-estimating the natural period, and an artificially low value for $C(T_1)$. Where the complexity of the secondary walls is such that a reasonable estimate of their stiffness cannot be made, the maximum value of $C(T_1)$, given in AS/NZS 1170, should be adopted.”

(Amendment No.1, December 2006)

12.5.1 General design principles (p. 123)**Delete** “in-plane and face-load forces” and **substitute** “in-plane loads and face loads”.

(Amendment No.1, December 2006)

12.5.1.2 (p. 125)**Delete** “AS/NZS 1170” and **substitute** “section 3”.

(Amendment No.1, December 2006)

12.5.1.3, 12.5.1.4, C12.5.1.4, 12.5.2 and C12.5.2 (p. 125)**Delete** all clauses and commentary clauses and **substitute:****“12.5.1.3**

In-fill panels with openings shall be subject to special study to ensure diagonal bracing action can be obtained, and to investigate the effects of structural modification caused by the openings.

C12.5.1.3

Openings in in-fill panels tend to destroy the diagonal bracing action of the in-fill, and cause modification of the structural action, often with premature shear failure of the in-fill. Consequently, openings should be avoided unless detailed studies are carried out to adequately define the modified behaviour, and to enable a rational design to be obtained. Minimum reinforcement requirements are the same as for structural walls. See also 7.4.8 for openings.

12.5.1.4

Structural in-fill panel reinforcement shall be connected to adjacent beams and columns by lapped starter bars, or by welding, or by other approved means, to ensure that composite action results.

12.5.1.5

In-fill panels separated from the structural system such that the ultimate limit state inter-storey deflections calculated in accordance with NZS 1170.5 are accommodated shall be considered to be partitions and shall comply with the requirements of 12.6.”

(Amendment No.1, December 2006)

12.6.1.1 (p. 126)**Delete** “in-plane and face-load forces” and **substitute** “in-plane loads and face loads”.

(Amendment No.1, December 2006)

C12.6.1.1 (p. 126)**Delete** “*In-plane forces*” and **substitute** “*In-plane loads*”.

(Amendment No.1, December 2006)

12.6.1.2 (p. 126)**Delete** the clause and **substitute**:

“Partitions shall be separated from the structural system such that the ultimate limit state inter-storey deflections calculated in accordance with NZS 1170.5 are accommodated.”

(Amendment No.1, December 2006)

12.6.2.1 (p. 126)**Delete** “shall be proportioned to the requirements of 7.3.3 and 7.3.4” and **substitute** “shall have a minimum thickness of 90 mm”.

(Amendment No.1, December 2006)

12.6.2.2 (p. 126)In (a) **delete** “a risk factor, $R = 1.6$ or 1.3 ; or” and **substitute** “an importance level of 3 or 4; or”.

(Amendment No.1, December 2006)

On page 126 **add** a new clause after **C12.6.2.2**:**“12.6.3 Partition reinforcement**

Reinforcing shall be detailed in accordance with 7.3.4”.

(Amendment No.1, December 2006)

Appendix A1 Notation (p. 127)**Delete** definition of “ G Dead load, N or kPa”.**Delete** definition of “ h Overall thickness of component, mm”.**Add** (in order) the following notations to p. 127:“ d_i Distance from extreme compression fibre to the i th prestress tendon in an unbonded prestressed wall f_m Compressive stress at wall base due to design vertical actions and tendon prestress f_{se} h_e Effective wall height in the plane of applied load, mm L_{ut} Length of unbonded tendon between anchorages, mm L_w Horizontal length of wall, in direction of applied shear forces, mm”.

(Amendment No.1, December 2006)

CA1 (p. 128)**Add**:“ f_{mi} Compressive stress in masonry immediately following initial prestress”.

(Amendment No.1, December 2006)

Table A1 (p. 130)

In II Stress case **delete** “variable loads” and **substitute** “imposed loads”.

In IV Stress case **delete** “transient loads” and **substitute** “imposed loads”.

(Amendment No.1, December 2006)

CA3.3 (p. 131)

In the first sentence **delete** “live loads” and **substitute** “imposed actions” and **delete** “forces” and **substitute** “actions”.

(Amendment No.1, December 2006)

A3.6.4 Approximate method for determining prestress and **CA3.6.4** (p. 134 & 135)

Delete the clause and commentary and **substitute**:

“A3.6.4 Approximate method for determining prestress

In lieu of the method defined in A3.6.3 the stress in prestressing tendons located in regions of flexural cracks may be determined as set out in this section.

CA3.6.4

The stress in prestress tendons at the design limit state is influenced by the geometry and deformation of the component and the nature of tendon bonding. For bonded tendons and for unbonded tendons of beams and columns, the expressions given in A3.6.4.1, A3.6.4.2 and A3.6.4.3 are adaptations of those in NZS 3101. Studies on unbonded prestressed masonry walls reported in reference A-6 have shown Equation A-8 to be more accurate for this component type.

A3.6.4.1 Tendon stress when using bonded tendons

For components using bonded prestress tendons and subject to axial design forces of less than $0.5 A_g f'_m$ the effect of axial load may be neglected and the tendon stress may be determined from:

$$f_{ps} = f_{pu} \left(1 - \frac{\gamma_p}{0.85} \left[\rho_p \frac{f_{pu}}{f'_m} + \frac{d}{d_p} (\omega - \omega') \right] \right) \dots\dots\dots \text{(Eq. A-5)}$$

If any compression reinforcement is taken into account when calculating f_{ps} by Equation A-5, the term

$$\left[\rho_p \frac{f_{pu}}{f'_m} + \frac{d}{d_p} (\omega - \omega') \right]$$

shall be taken not less than 0.17 and d shall be taken not greater than $0.15 d_p$.

Where the design axial forces are equal to or greater than $0.5 A_g f'_m$ the component is to be designed as a compression component in accordance with A3.1.2.

A3.6.4.2 Tendon stress in unbonded beams and in unbonded columns

(a) Where the span-to-depth ratio is 35 or less:

$$f_{ps} = f_{se} + 70 + \frac{f'_m}{100\rho_p} \dots\dots\dots \text{(Eq. A-6)}$$

but f_{ps} in Equation A-6 shall be taken not greater than f_{py} nor $(f_{se} + 400)$.

(b) Where the span-to-depth ratio is greater than 35:

$$f_{ps} = f_{se} + 70 + \frac{f'_m}{300\rho_p} \dots\dots\dots \text{(Eq. A-7)}$$

but f_{ps} in Equation A-7 shall be taken not greater than f_{py} nor $(f_{se} + 200)$.



A3.6.4.3 Tendon stress in unbonded walls

For masonry walls with multiple tendons the stress in each tendon shall be calculated separately using:

$$f_{ps} = f_{se} + \frac{20}{L_{ut}} \frac{f'_m}{f_m} \frac{h_e}{L_w} \left[d_i - 1.4 \frac{f_m}{f'_m} L_w \right] \dots\dots\dots (\text{Eq. A-8})$$

but f_{ps} in Equation A-8 shall be taken not greater than f_{py} .

CA3.6.4.3

Equation A-8 has been derived using the masonry stress-strain properties specified in 3.4.3 and 10.2.2.6 when using no confining plates and using the modulus of elasticity of reinforcement specified in 3.4.4. Reference A-6 may be consulted for adaptation of Equation A-8 when using materials having other material characteristics."

(Amendment No.1, December 2006)

CA3.10 (p. 136)

Delete second to last sentence of paragraph one and **substitute**:

"In general, load category III as described in table A1 will be used for buildings except where imposed loads may be of long duration."

(Amendment No.1, December 2006)

APPENDIX A REFERENCES (p. 138)

Delete references **A6 and A7** and **substitute**:

- " A6 Wight, G., Russell, A., Ingham, J.M., "Unbonded Prestressed Panel Tendon Stress at In-plane Nominal Flexural Strength", Combined New Zealand Concrete Industry Conference, Christchurch, Sept – Oct 2006.
- A7 ACI Committee 215 Report "Consideration for Design of Concrete Structures subject to Fatigue Loading", Journal ACI Proceedings, Vol 71, No. 3, March 1974, pp. 97-121."
- A8 Ingham J.M., Laursen P.T., and Voon K.C., "Appropriate Material Values for Use in Concrete Masonry Design", Journal of the Structural Engineering Society of NZ, Vol. 14, No. 1, 2001, pp. 13-27."

(Amendment No.1, December 2006)

B1.3.1 (p. 140)

In Equation B-1 **delete** " $f_m = 0.59 f_{cb} + 0.90(1-\alpha)f_g$ " and **substitute** " $f_m = 0.59 \alpha f_{cb} + 0.90(1-\alpha)f_g$ ".

(Amendment No.1, December 2006)

C1 (p. 145)

Delete "dependable loads on" and **substitute** "design strengths for".

(Amendment No.1, December 2006)

C6 (p. 145)

Delete "dependable strength" and **substitute** "design strength".

(Amendment No.1, December 2006)

Table C1 (p. 146)

Delete “Dependable strength” from title and **substitute** “Design strength”.

(Amendment No.1, December 2006)

C9.2 (p. 146)

Delete “Loads” and **substitute** “Design strengths”.

(Amendment No.1, December 2006)

D8 Fire design (p. 148)

Delete the clause.

(Amendment No.1, December 2006)

E1 Scope (p. 149)

In the last sentence **delete** “live load” and **substitute** “imposed action”.

(Amendment No.1, December 2006)

E3 Bracing capacity (p. 149)

Add to end of sentence “, but the strength reduction factors in this Standard may be used in lieu of those given in table A3.1 of NZS 4229.”

(Amendment No.1, December 2006)

F1.1 Specific design of veneers (p. 151)

Delete “and transitory”.

(Amendment No.1, December 2006)

F1.2 Influence of properties on design (p. 151)

Delete “earthquake forces” and **substitute** “earthquake actions”.

(Amendment No.1, December 2006)

F2.2 Minimum thickness of irregularly supported reinforced masonry veneers (p. 152)

In first sentence **delete** “regular” and **substitute** “irregular”.

(Amendment No.1, December 2006)

F3.2 Axial loads in wall ties (p. 153)

Delete “Axial loads” from title and **substitute** “Forces”.

In the clause **delete** “Axial loads” and **substitute** “Forces”.

(Amendment No.1, December 2006)