New Zealand Society for Earthquake Engineering

Corrigenda No. 2 dated 15 June 2012 for

Assessment and Improvement of the Structural Performance for Buildings in Earthquakes:

Prioritisation, Initial Evaluation, Detailed Assessment, Improvement Measures

Recommendations of NZSEE Study Group on Earthquake Risk Buildings

June 2006

Page 2-4, 2.5 Adoption/Development of a Formal Policy, last line
Delete: "……Section 2.8."
Substitute: "…….Section 2.9."

Page 2-6, 2.6.2 Implementation Options, last line
Delete: "Section 2.8 outlines……"
Substitute: "Section 2.9 outlines……"

Page 2-9, 2.7.6 Prioritising Actions, fourth paragraph, last line
Delete: "…….Appendix 2B."
Substitute: "…….Appendix 2A."

Page 2-9, 2.7.6 Prioritising Actions, fifth paragraph, first line
Delete: "…….Appendix 2B are……."
Substitute: "…….Appendix 2A are……."

Page 2-10, 2.7.8 Timetables for Evaluation and Improvement,
third paragraph, third line
Delete: "…….in Appendix 2B."
Substitute: "…….in Appendix 2A."

Page 2-17, 2.9.3 Passive Programme, second paragraph
Delete: "The detailed steps in implementing a passive programme are set out in Appendix 2A."

Page 3-12, Table 3.1: Return period scaling factor, Return Period Scaling Factor, *C*
Delete: column "1976 - 92"
Substitute:

1976 - 92
2
1
1
0.9

Page 3-14, Table IEP-3, Step 3 – Assessment of Performance Achievement Ratio (PAR),
Delete:
"(Refer Appendix B – Section B3.2)"
Substitute:
"(Refer 3.4.3)"

Page 3-15, Table IEP-4, 4.1 Assessed Baseline (*%NBS*)$_b$
Delete:
"(from Table IEP - 1)"
Substitute:
"(from Table IEP – 2)"

Page 3-15, Table IEP-4, 4.2 Performance Achievement Ratio (PAR)
Delete:
"(from Table IEP - 2)"
Substitute:
"(from Table IEP – 3)"

Page 3-15, Table IEP-4, 4.4 Percentage New Building Standard *(%NBS*)
Delete:
"(Use lower of two values from Step 3.3)"
Substitute:
"(Use lower of the two values from Step 4.3)"

Page 3-16, 3.4.2 Step 2 – Procedure for assessment of (*%NBS*)$_b$ (Table IEP-2), Approach, fourth bullet point up from bottom of page
Delete:

- pre-1965: design for 0.1 g lateral force

Substitute:

- pre-1965: design for 0.08 g lateral force applied uniformly over the height or 0.06 g applied as an inverted triangle

Page 4-1, 4.1.1 Context and Background
Delete:
"The initial evaluation procedures described in Section B…"
Substitute:
"The initial evaluation procedures described in Section 3…"

Page 4-8, 4.3.2 Global Analysis Considerations
a) Critical Structural Weaknesses, third paragraph, first line
Delete:
"….. refer to Figure 3.5 in Section 3……"
Substitute:
"….. refer to Figure 3.7 in Section 3……"

Page 4-14, 4.4.2 General Requirements
a) Structural Configuration
Delete:
Paragraph 2 "Most of the details….preliminary work."

Page 4-16, 4.4.2 General Requirements
c) Material Properties, fourth paragraph
Delete:
"…. Section 5.3, along….."
Substitute:
"…. Section 7.1, along….."

Page 5-1, 5.2 Acceleration Response Spectra, equation …5(1)
Delete:
$K_\xi = [7/(2+\xi)]^{1/2}$ …5(1)
where ξ = equivalent viscous damping factor
Substitute:
$K_\xi = [7/(2+\xi_e)]^{1/2}$ …5(1)
where ξ_e = equivalent viscous damping factor

Page 5.5, 5.4 Acceleration-Displacement Response Spectra, equation …5(5)
Delete: $T = 2\pi(S_d/S_a)^2$
Substitute: $T = 2\pi\sqrt{(S_d/S_a)}$

Page 6-6, 6.3 Displacement-Based Methods, paragraphs 2, 3, 4 & 6, and equation …6(4)
Delete: " ξ_{eff} " in 7 places.
Substitute: " ξ_e " in 7 places.

Page 6-7, Figure 6.3 Summary of displacement=based assessment procedure, Step 6, 1st box & Step 7
Delete: " ξ" in 2 places.
Substitute: " ξ_e" in 2 places.

Page 6-8, Table 6.1 Typical values of ξ_{eff} for various structural types and materials, title and column heading
Delete: " ξ_{eff} " in 2 places.
Substitute: " ξ_e " in 2 places.

Page 6-9, 6.5 Non-linear Pushover Procedure, first paragraph, second line
Delete: "…. Procedure out lined above, the…."
Substitute: "…. Procedure outlined above, the…."

Page 7-1, 7.1.1 Material Strengths, b) Overstrength S_o , second paragraph, last line
Add: "…. and the ratio of overstrength in flexure to probable flexural strength, M_o/M_p, can be taken as 1.16."

Page 7-3, 7.1.1 Material Strengths, f) Concrete, third paragraph, last line
Delete: "…. Equations (5) to (11)."
Substitute: "…. Equations 7(5) to 7(11)."

Page 7-3, 7.2.1 Introduction, second paragraph
Delete:
Analysis of existing moment resisting frames typical of early reinforced concrete building structures, and observations of damage caused in recent earthquakes, have indicated that the major problem areas are Priestley (1995), Park (1996), Rodriguez and Park (1991), Hakuto et al (1995), Park et al (1995).
Inadequate ductility and shear strength of potential plastic hinge regions of beams and columns due to insufficient transverse reinforcement.

a) *Inadequate anchorage of transverse reinforcement due to poor anchorage details.*
b) *Inadequate shear strength of beam-column joints due to insufficient transverse reinforcement.*
c) *Inadequate anchorage of longitudinal reinforcement due to poor anchorage details.*
d) *Inadequate strength of footings and/or piles and their connections.*
e) *Uncertain behaviour of the structure as a result of the presence of nonstructural elements, typically infill walls, which can significantly alter the structural behaviour of the frame.*

Substitute:
Analysis of existing moment resisting frames typical of early reinforced concrete building structures, and observations of damage caused in recent earthquakes, have indicated that the major problem areas are:

a) *Inadequate ductility and shear strength of potential plastic hinge regions of beams and columns due to insufficient transverse reinforcement.*
b) *Inadequate anchorage of transverse reinforcement due to poor anchorage details.*
c) *Inadequate shear strength of beam-column joints due to insufficient transverse reinforcement.*
d) *Inadequate anchorage of longitudinal reinforcement due to poor anchorage details.*
e) *Inadequate strength of footings and/or piles and their connections.*
f) *Uncertain behaviour of the structure as a result of the presence of nonstructural elements, typically infill walls, which can significantly alter the structural behaviour of the frame.*

Priestley (1995), Park (1996), Rodriguez and Park (1991), Hakuto et al (1995), Park et al (1995)

Page 7-4, 7.2.1 Introduction, fifth paragraph, fourth line
Delete: "….(refer Step CF2 and….."
Substitute: "….(refer Step FF2 and….."

Page 7-4, 7.2.1 Introduction, sixth paragraph, sixth line
Delete: "….(refer Step CF6, method 1) ….."
Substitute: "….(refer Step FF6, method 1) ….."

Page 7-8, 7.2.2 Force-Based Procedure for Frame Structures
Shear strength of members and beam-column joints
First paragraph, fourth line
Delete: "…. in Step CF6."
Substitute: "…. In Step FF7."

Page 7-9, 7.2.2 Force-Based Procedure for Frame Structures
Shear strength of columns
First paragraph, third line
Delete: "…. Section, D is the column diameter and….. "
Substitute: "….Section, D is the total section depth or the column diameter as appropriate and …."

Page 7-9, 7.2.2 Force-Based Procedure for Frame Structures
Shear strength of beam-column joints
Equation …7(11)
Delete:
$V_{pjh} = 0.85 v_{ch} b_j h$

$= 0.85$ …….
Substitute:
$V_{pjh} = 0.85 v_{ch} b_j h$

$= 0.85k$…….

Page 7-10, 7.2.2 Force-Based Procedure for Frame Structures
Shear strength of beam-column joints, last paragraph, last line
Delete: "…. included in eqn 7(12)."
Substitute: "…. included in eqn 7(11)."

Page 7-10, 7.2.2 Force-Based Procedure for Frame Structures
Step FF2: The post-elastic mechanisms of the frame and the probable lateral seismic force capacity, second paragraph, second to last line
Delete: "…. Step CF1 will …. "
Substitute: "…. Step FF1 will …."

Page 7-11, 7.2.2 Force-Based Procedure for Frame Structures
Step FF2: The post-elastic mechanisms of the frame and the probable lateral seismic force capacity, fourth paragraph
Delete: "Equations 7(5) to 7(7) can be used …. lap splices."
Substitute: "Equations 7(2) to 7(4) can be used …. lap splices."

Page 7-13, 7.2.2 Force-Based Procedure for Frame Structures
Step FF2: The post-elastic mechanisms of the frame and the probable lateral seismic force capacity
Method 2, first paragraph, second line
Delete: "…. 7(13) is greater …."
Substitute: "…. 7(12) is greater …."

Page 7-14, 7.2.2 Force-Based Procedure for Frame Structures
Step FF5: Determination of the required structure ductility factor, last line
Delete: "…. drift (see Step F8)"
Substitute: "…. drift (see Step FF8)"

Page 7-14, 7.2.2 Force-Based Procedure for Frame Structures
Step FF6: Assessment of whether the plastic hinges have sufficient available ductility to match required structure ductility, first paragraph, fourth line
Delete: "…. in Step F7, the …."
Substitute: "…. in Step FF7, the …."

Page 7-14, 7.2.2 Force-Based Procedure for Frame Structures
Step FF6: Assessment of whether the plastic hinges have sufficient available ductility to match required structure ductility, third paragraph, last line
Delete: "…. in Step F5."
Substitute: "…. in Step FF5."

Page 7-16, 7.2.2 Force-Based Procedure for Frame Structures
Step FF7: Effect of ductility demand on the shear strength of beams, columns and their joints and bond strength, second paragraph, first line
Delete: "…. in Step F5 was …."
Substitute: "…. in Step FF5 was …."

Page 7-16, 7.2.2 Force-Based Procedure for Frame Structures
Step FF7: Effect of ductility demand on the shear strength of beams, columns and their joints and bond strength, second paragraph, second line
Delete: "…. in Step F1, which…."
Substitute: "…. in Step FF1, which …."

Page 7-16, 7.2.2 Force-Based Procedure for Frame Structures
Step FF7: Effect of ductility demand on the shear strength of beams, columns and their joints and bond strength, second paragraph, fifth line
Delete: "…. in Step F5, the…."
Substitute: "…. in Step FF6, the …."

Page 7-17, 7.2.2 Force-Based Procedure for Frame Structures
Step FF7: Effect of ductility demand on the shear strength of beams, columns and their joints and bond strength
Degradation of shear strength of beams and columns, first paragraph, sixth line
Delete: "…. in Step F1 when…."
Substitute: "…. in Step FF1 when…."

Page 7-17, 7.2.2 Force-Based Procedure for Frame Structures
Step FF7: Effect of ductility demand on the shear strength of beams, columns and their joints and bond strength
Degradation of shear strength of beams-columns joints, first paragraph, sixth line
Delete: "…. by Step F1 when…."
Substitute: "…. by Step FF1 when…."

Page 7-20, 7.2.3 Displacement-Based Procedure for Frame Structures
Step FD4: Shear strength and storey drift checks, second paragraph, last line
Delete: "…. Of Step D3."
Substitute: "…. Of Step FD3."

Page 7-21, 7.2.4 Determination of Available Ductility Capacity
a) Available curvature ductility factor and rotation capacity of plastic hinge regions, third paragraph, fourth line
Delete: "…. Approximation (see Figure 4.8.4) since …."
Substitute: "…. Approximation (see Figure 7.13) since …."

Page 7-27, 7.2.4 Determination of Available Ductility Capacity
d) Lateral plastic displacement capacity of frames, last paragraph, first line
Delete: "In eqn 7(20), …."
Substitute: "In eqn 7(28), …."

Page 7-29, 7.4.2 Force-Based Procedure for Wall Buildings
Step WF1, second paragraph, second line
Delete: "…. Stiffness (Table 4.3.1 SANZ 1995)."
Substitute: "…. Stiffness (Table C3.1 SANZ 1995)."

Page 7-31, 7.4.2 Force-Based Procedure for Wall Buildings
Step WF7, third paragraph, last line
Delete: "…. in Step WF4."
Substitute: "…. in Step WF6."

Page 7-32, 7.4.2 Force-Based Procedure for Wall Buildings
Step WF7, Figure 7.16: Torsional effects in walled buildings, right hand side of diagram
Delete: "e_{VX} = -0.01A"
Substitute: "e_{VX} = -0.1A"

Page 7-33, 7.4.2 Force-Based Procedure for Wall Buildings
Step WF8, b), second paragraph, first line
Delete: *"…… in Figure 4.17, which …."*
Substitute: *"…… in Figure 7.17, which …."*

Page 7-34, 7.4.2 Force-Based Procedure for Wall Buildings
Step WF9, first paragraph, first line
Delete: "With a factor of 1.75 being……."
Substitute: "With a factor of 1.**1**5 being……."

Page 7-34, 7.4.2 Force-Based Procedure for Wall Buildings
Step WF9, equation 7(38)
Delete: "1.75"
Substitute: "1.15"

Page 7-35, 7.4.2 Force-Based Procedure for Wall Buildings
Step WF10
Delete: "WF10"
Substitute: "WF12"

Page 7-35, 7.4.2 Force-Based Procedure for Wall Buildings
Step WF12, c), last line
Delete: "…. in Step WF7**"**
Substitute: "…. in Step WF8**"**

Page 7-39, 7.5.2 Assessment Procedure for Dual Frame-Wall Structures
Step DD2: Post-elastic mechanism of frames and their contribution to lateral force resistance, equation …7(49)
Delete: "$V_{pi} \cdot \Sigma M_{pi} / h_s$"
Substitute: "$V_{pi} = \Sigma M_{pi} / h_s$"

Page 7-41, 7.5.2 Assessment Procedure for Dual Frame-Wall Structures
Step DD3: The post-elastic mechanism of walls and their contribution to lateral force resistance, fifth paragraph, last line
Delete: "…. Magnification, 1.75, specified …."
Substitute: "…. Magnification, 1.15, specified …."

Page 9.6, 9.4 Out-of-Pane Behaviour of Infilled Panel Components
Equation …9(20)
Delete: "*… + 71.4(10)$^{-9}$ …"*
Substitute: "*… + 2.45(10)$^{-5}$ …"*

Page 9.6, 9.4 Out-of-Pane Behaviour of Infilled Panel Components, last paragraph, last line
Delete: "… kN-m)."
Substitute: "… kN-m^2)."

Page 9-7, 9.5 The influence of Infilled Components on Frame Members, first paragraph, second line
Delete: "…. should be based on aforementioned provisions in this ….."
Substitute: "…. should be based on Sections 7 and 8 of this …."

Page 10-6, 10.2.5, c) Modelling of the structure, last paragraph, line 2-3
Delete: *"Some examples in the companion volume use simple hand calculation for inelastic effects."*

Page 10-13, 10.3.1 Notation, Table 10.3: Notation, 3rd to last row
Delete: "… would caused instability."
Substitute: "… would cause instability."

Page 10-14, 10.3.3 General, fourth paragraph, first line
Delete: "…. to Figures 10.1 and 10.2, there …."
Substitute: "…. to Figures 10A.1 and 10A.2 (of Appendix 10A), there …."

Page 10-17, 10.3.4 Procedure for Walls Spanning Vertically between Floors and/or the Roof, 11, equation …10(14)
Delete: Calculate %NBS = $[(1.2)(0.6)\Delta_i]/[D_{ph})] = 0.72(\Delta_i/D_{ph})$ …10(14)
Substitute: Calculate *%NBS* = $100[(1.2)(0.6)\Delta_i]/[D_{ph})] = 72(\Delta_i/D_{ph})$ …10(14)

Page 10-17, 10.3.4 Procedure for Walls Spanning Vertically between Floors and/or the Roof, 11, last paragraph
Delete: *"If %NBS ≥ 1/3, then the wall may be classed as of moderate hazard only. If %NBS ≥ 2/3, then the wall may be classed as of low hazard. %NBS < 1/3 is not acceptable."*
Substitute: : *"If > 33%NBS but < 67%NBS, then the wall may be classed as of moderate hazard. If ≥ 67%NBS, then the wall may be classed as of low hazard. %NBS ≤ 33 is not acceptable.*"

Page 10-19, 10.3.4 Procedure for Walls Spanning Vertically between Floors and/or the Roof, b) Simplifications for regular walls, Table 10.4: Static instability deflection for uniform walls – various boundary conditions, Column heading
Delete: "Case number"
Substitute: "Boundary Condition Number"

Page 10-19, 10.3.5 Procedures for Vertical Cantilevers, 11, equation 10(19)
Delete: "$\%NBS = 0.72\Delta_i/D_{ph} = 0.72t/D_{ph}$. …10(19)"
Substitute: "$\%NBS = 72\Delta_i/D_{ph} = 72t/D_{ph}$. …10(19)"

Page 11-4, 11.3.2 Strength and Stiffness, first paragraph, third line
Delete: "….Appendix 4.12B can …."
Substitute: "….Appendix 11B can …."

Page 11-4, 11.3.2 Strength and Stiffness, first paragraph, fourth line
Delete: "…. in Table 4.12.1 may …."
Substitute: "…. in Table 11.1 may …."

Page 11-4, 11.3.2 Strength and Stiffness, second paragraph, first line
Delete: "….Appendix 4.12A can …."
Substitute: "….Appendix 11A can …."

Page 11-6, 11.4.2 Strength and Stiffness, first paragraph, third line
Delete: "….Appendix 4.12D can …."
Substitute: "….Appendix 11D can …."

Page 11-6, 11.4.2 Strength and Stiffness, first paragraph, fourth line
Delete: "…. in Table 4.12.1 may …."
Substitute: "…. in Table 11.1 may …."

Page 11-6, 11.4.2 Strength and Stiffness, second paragraph, first line
Delete: "….Appendix 4.12C can …."
Substitute: "….Appendix 11C can …."

Page 11-7, 11.5 Connections, first paragraph, third line
Delete: "…. In section 10.4(a) of Appendix 10B, and …."
Substitute: "…. In section 10B.4.1 of Appendix 10B, and …."

Page App-35, 4D.2.2 Approximate approach, i), 1st bullet point, 3rd line
Delete: "… free standing, over the height of the building …"
Substitute: "…free standing, applied above the height of the building …"

Page App-68, 10A.2, title
Delete: "Case 1: One-way vertically spanning face-loaded walls"
Substitute: "One-way vertically spanning face-loaded walls"

Page App-70, 10A.2.2 Limiting deflection for static instability, 2nd paragraph, 3rd line
Delete: "… displacements that $0.6\Delta_i$, …"
Substitute: "… displacements than $0.6\Delta_i$, …"

Page App-72, 10A.2.4 Period of free vibration, 3rd paragraph, 1st line
Insert: "(i.e. $\frac{\Delta_m}{\Delta_i}$ = 0.6)" after "… deflection ratio of interest is 0.6 …"

Page App-73, 10A.2.9, title
Delete: "10A.2.9 Approximate displacements for static instability"
Substitute: "a) Approximate displacements for static instability"

Page App-73, 10A.2.10, title
Delete: "10A.2.10 Approximate expression for period of vibration"
Substitute: "b) Approximate expression for period of vibration"

Page App-74, 10A.2.11, title
Delete: "10A.2.11 Participation Factor"
Substitute: "c) Participation Factor"

Page App-74, 10A.2.12, title
Delete: "10A.2.12 Maximum acceleration"
Substitute: "d) Maximum acceleration"

Page App-74, 10A.2.12 Maximum acceleration, last paragraph
Delete: "…, is given for the common cases regularly encountered in Table 10A.1."
Substitute: "…, is given in Table 10A.1 for the common cases regularly encountered."

Page App-74, 10A.2.13 Adjustments required when inter-storey displacement is large, title
Delete: "10A.2.13 …"
Substitute: "10A.2.9 …"

Page App-75, 10A.2.13 Adjustments required when inter-storey displacement is large, Table 10A.1, title
Delete: "… defection…"
Substitute: "… deflection …"

Page App-75, 10A.2.13 Adjustments required when inter-storey displacement is large, Table 10A.1, column heading
Delete: "Case number"
Substitute: "Boundary Condition Number"

Page App-75, 10A.3, title
Delete: "Case 2: Vertical cantilevers"
Substitute: "Vertical cantilevers"

Page App-75, 10A.3.1 General formulation, 2nd paragraph, last sentence
Delete: "Refer to examples for particular applications."

Page App-77, 10A.3.4 Participation Factor, first paragraph, first line
Delete: "…. is, $\gamma = Wh^2/2J$. This …."
Substitute: "…. is, $\gamma = Wh^2/2Jg$. This …."

Page App-81, 10B.3.2 Bed joint shear test, *Preparation of sample,*
first paragraph, second line
Delete: "…. joint (see Figure 10B.2)."
Substitute: "…. joint (see Figure 10B.3)."

Page App-82, 10B.3.2 Bed joint shear test, *Preparation of sample*,
title Figure 10B.2
Delete: "Figure 10B.2: Bed joint shear test arrangement"
Substitute: "Figure 10B.3: Bed joint shear test arrangement"

Page App-82, 10B.3.2 Bed joint shear test, *Determination of design values from tests*, first paragraph, second line
Delete: "…. in Table 4.11B.1."
Substitute: "…. in Table 10B.1."

Page App-83, 10B.3.2 Bed joint shear test, *Determination of design values from tests*, first paragraph, first line
Delete: "…. of Table 4.11B.1: if …."
Substitute: "…. of Table 10B.1: if …."

Page App-83, 10B.3.3 Tests on Doublets and Triplets, title Figure 10B.3
Delete: "Figure 10B.3: Schematic of an arrangement for testing doublets"
Substitute: "Figure 10B.4: Schematic of an arrangement for testing doublets"

Page App-89, 11B.1 Square sheathing, paragraph 3, last two lines
Delete:
where;

z = section modulus of the sheathing board = $\frac{b^2 t}{6}$.

Substitute:
where;

F_n = nominal nail strength
s = nail spacing
l = spacing between joists
b = width of sheathing board
B = depth of diaphragm
z = section modulus of the sheathing board = $\frac{b^2 t}{6}$.

Page App-89, 11B.2 Single diagonal sheathing, equation … 11B(4)
Delete:

$$W = \frac{F_n N B}{b} \qquad \ldots 11B(4)$$

Substitute:

$$V = \frac{F_n N B}{b} \qquad \ldots 11B(4)$$

Page App-89, 11B.2 Single diagonal sheathing, equation … 11B(5)
Delete:

$W = F_c Bt.$ …11B(5)

Substitute:

$V = F_c Bt.$ …11B(5)

where;

t = thickness of the sheathing board

Other symbols as defined in 11B.1

Page App-90, 11B.3 Double diagonal sheathing, equation … 11B(6)
Delete:

$W = 2F_c Bt.$ …11B(6)

Substitute:

$V = 2F_c Bt.$ …11B(6)

where;

F_c = characteristic stress in the sheathing board in compression parallel to the grain

Other symbols as defined in 11B.1.

Page App-93, 11D.1 Transverse sheathing, paragraph 3, last two lines
Delete:
where;

z = section modulus of the sheathing board = $\frac{b^2 t}{6}$.

Substitute:
where;

F_n = nominal nail strength
s = nail spacing
l = spacing between studs
b = width of sheathing board
B = depth of diaphragm

z = section modulus of the sheathing board = $\frac{b^2 t}{6}$.

Page App-94, 11D.2 Single diagonal sheathing
Insert after equation 11D(7):
where;

t = thickness of the sheathing board

Other symbols as defined in 11D.1

Page App-94, 11D.3 Double diagonal sheathing
Insert after equation 11D(9):
where;

F_c = characteristic stress in the sheathing board in compression parallel to the grain

Other symbols as defined in 11D.1.