

TABLE OF CONTENTS

NORTH AMERICAN SPECIFICATION FOR THE DESIGN OF COLD-FORMED STEEL STRUCTURAL MEMBERS 2007 EDITION

PREFACE.....	iii
SYMBOLS AND DEFINITIONS.....	xi
A. GENERAL PROVISIONS.....	1
A1 Scope, Applicability, and Definitions	1
A1.1 Scope	1
A1.2 Applicability	1
A1.3 Definitions.....	2
A1.4 Units of Symbols and Terms	7
A2 Material	7
A2.1 Applicable Steels	7
A2.2 Other Steels	8
A2.3 Ductility	8
A2.4 Delivered Minimum Thickness.....	10
A3 Loads	10
A4 Allowable Strength Design	10
A4.1 Design Basis	10
A4.1.1 ASD Requirements	11
A4.1.2 Load Combinations for ASD.....	11
A5 Load and Resistance Factor Design	11
A5.1 Design Basis	11
A5.1.1 LRFD Requirements	11
A5.1.2 Load Factors and Load Combinations for LRFD	11
A6 Limit States Design.....	11
A6.1 Design Basis	11
A6.1.1 LSD Requirements.....	12
A6.1.2 Load Factors and Load Combinations for LSD	12
A7 Yield Stress and Strength Increase from Cold Work of Forming	12
A7.1 Yield Stress.....	12
A7.2 Strength Increase from Cold Work of Forming	12
A8 Serviceability	13
A9 Referenced Documents	13
B. ELEMENTS.....	16
B1 Dimensional Limits and Considerations.....	16
B1.1 Flange Flat-Width-to-Thickness Considerations	16
B1.2 Maximum Web Depth-to-Thickness Ratios	17
B2 Effective Widths of Stiffened Elements	17
B2.1 Uniformly Compressed Stiffened Elements.....	17
B2.2 Uniformly Compressed Stiffened Elements with Circular or Non-Circular Holes	19

B2.3	Webs and Other Stiffened Elements under Stress Gradient	20
B2.4	C-Section Webs with Holes under Stress Gradient.....	22
B3	Effective Widths of Unstiffened Elements	23
B3.1	Uniformly Compressed Unstiffened Elements.....	23
B3.2	Unstiffened Elements and Edge Stiffeners with Stress Gradient.....	23
B4	Effective Width of Uniformly Compressed Elements with a Simple Lip Edge Stiffener ...	26
B5	Effective Widths of Stiffened Elements with Single or Multiple Intermediate Stiffeners or Edge Stiffened Elements with Intermediate Stiffener(s)	28
B5.1	Effective Widths of Uniformly Compressed Stiffened Elements with Single or Multiple Intermediate Stiffeners	28
B5.1.1	Specific Case: n Identical Stiffeners, Equally Spaced	29
B5.1.2	General Case: Arbitrary Stiffener Size, Location, and Number	29
B5.2	Edge Stiffened Elements with Intermediate Stiffener(s)	31
C.	MEMBERS	32
C1	Properties of Sections	32
C2	Tension Members	32
C3	Flexural Members	32
C3.1	Bending.....	32
C3.1.1	Nominal Section Strength [Resistance]	32
C3.1.2	Lateral-Torsional Buckling Strength [Resistance].....	34
C3.1.2.1	Lateral-Torsional Buckling Strength [Resistance] of Open Cross-Section Members.....	35
C3.1.2.2	Lateral-Torsional Buckling Strength [Resistance] of Closed Box Members	37
C3.1.3	Flexural Strength [Resistance] of Closed Cylindrical Tubular Members.....	38
C3.1.4	Distortional Buckling Strength [Resistance]	39
C3.2	Shear	43
C3.2.1	Shear Strength [Resistance] of Webs without Holes	43
C3.2.2	Shear Strength [Resistance] of C-Section Webs with Holes	44
C3.3	Combined Bending and Shear	44
C3.3.1	ASD Method.....	44
C3.3.2	LRFD and LSD Methods.....	45
C3.4	Web Crippling	46
C3.4.1	Web Crippling Strength [Resistance] of Webs without Holes	46
C3.4.2	Web Crippling Strength [Resistance] of C-Section Webs with Holes	51
C3.5	Combined Bending and Web Crippling	51
C3.5.1	ASD Method.....	51
C3.5.2	LRFD and LSD Methods.....	52
C3.6	Combined Bending and Torsional Loading	54
C3.7	Stiffeners.....	54
C3.7.1	Bearing Stiffeners.....	54
C3.7.2	Bearing Stiffeners in C-Section Flexural Members	55
C3.7.3	Shear Stiffeners	56
C3.7.4	Non-Conforming Stiffeners.....	57
C4	Concentrically Loaded Compression Members	57

C4.1	Nominal Strength for Yielding, Flexural, Flexural-Torsional and Torsional Buckling.....	57
C4.1.1	Sections Not Subject to Torsional or Flexural-Torsional Buckling	58
C4.1.2	Doubly- or Singly-Symmetric Sections Subject to Torsional or Flexural-Torsional Buckling.....	58
C4.1.3	Point-Symmetric Sections.....	59
C4.1.4	Nonsymmetric Sections	59
C4.1.5	Closed Cylindrical Tubular Sections	59
C4.2	Distortional Buckling Strength [Resistance].....	60
C5	Combined Axial Load and Bending	62
C5.1	Combined Tensile Axial Load and Bending	62
C5.1.1	ASD Method.....	62
C5.1.2	LRFD and LSD Methods.....	63
C5.2	Combined Compressive Axial Load and Bending.....	64
C5.2.1	ASD Method.....	64
C5.2.2	LRFD and LSD Methods.....	65
D. STRUCTURAL ASSEMBLIES AND SYSTEMS	68	
D1	Built-Up Sections	68
D1.1	Flexural Members Composed of Two Back-to-Back C-Sections	68
D1.2	Compression Members Composed of Two Sections in Contact	68
D1.3	Spacing of Connections in Cover Plated Sections	69
D2	Mixed Systems	69
D3	Lateral and Stability Bracing	70
D3.1	Symmetrical Beams and Columns	70
D3.2	C-Section and Z-Section Beams	70
D3.2.1	Neither Flange Connected to Sheathing that Contributes to the Strength and Stability of the C- or Z- section	70
D3.3	Bracing of Axially Loaded Compression Members	72
D4	Cold-Formed Steel Light-Frame Construction.....	72
D4.1	All-Steel Design of Wall Stud Assemblies	73
D5	Floor, Roof, or Wall Steel Diaphragm Construction.....	73
D6	Metal Roof and Wall Systems	74
D6.1	Purlins, Girts and Other Members	74
D6.1.1	Flexural Members Having One Flange Through-Fastened to Deck or Sheathing	74
D6.1.2	Flexural Members Having One Flange Fastened to a Standing Seam Roof System	75
D6.1.3	Compression Members Having One Flange Through-Fastened to Deck or Sheathing	75
D6.1.4	Compression of Z-Section Members Having One Flange Fastened to a Standing Seam Roof	77
D6.2	Standing Seam Roof Panel Systems	77
D6.2.1	Strength [Resistance] of Standing Seam Roof Panel Systems	77
D6.3	Roof System Bracing and Anchorage.....	78
D6.3.1	Anchorage of Bracing for Purlin Roof Systems Under Gravity Load with Top Flange Connected to Metal Sheathing	78

D6.3.2 Alternate Lateral and Stability Bracing for Purlin Roof Systems	82
E. CONNECTIONS AND JOINTS	83
E1 General Provisions	83
E2 Welded Connections	83
E2.1 Groove Welds in Butt Joints	83
E2.2 Arc Spot Welds.....	84
E2.2.1 Shear	84
E2.2.1.1 Minimum Edge Distance	84
E2.2.1.2 Shear Strength [Resistance] for Sheet(s) Welded to a Thicker Supporting Member.....	86
E2.2.1.3 Shear Strength [Resistance] for Sheet-to-Sheet Connections.....	87
E2.2.2 Tension.....	88
E2.3 Arc Seam Welds	89
E2.4 Fillet Welds	90
E2.5 Flare Groove Welds	92
E2.6 Resistance Welds.....	94
E2.7 Rupture in Net Section of Members other than Flat Sheets (Shear Lag).....	95
E3 Bolted Connections.....	95
E3.1 Shear, Spacing, and Edge Distance.....	96
E3.2 Rupture in Net Section (Shear Lag).....	96
E3.3 Bearing.....	96
E3.3.1 Strength [Resistance] without Consideration of Bolt Hole Deformation ..	97
E3.3.2 Strength [Resistance] with Consideration of Bolt Hole Deformation ..	97
E3.4 Shear and Tension in Bolts	98
E4 Screw Connections	98
E4.1 Minimum Spacing.....	99
E4.2 Minimum Edge and End Distances.....	99
E4.3 Shear	99
E4.3.1 Connection Shear Limited by Tilting and Bearing	99
E4.3.2 Connection Shear Limited by End Distance	99
E4.3.3 Shear in Screws	99
E4.4 Tension	99
E4.4.1 Pull-Out.....	100
E4.4.2 Pull-Over.....	100
E4.4.3 Tension in Screws	101
E4.5 Combined Shear and Pull-Over.....	101
E4.5.1 ASD Method.....	101
E4.5.2 LRFD and LSD Methods.....	102
E5 Rupture	102
E6 Connections to Other Materials.....	103
E6.1 Bearing.....	103
E6.2 Tension	103
E6.3 Shear	103
F. TESTS FOR SPECIAL CASES.....	104
F1 Tests for Determining Structural Performance	104

F1.1	Load and Resistance Factor Design and Limit States Design.....	104
F1.2	Allowable Strength Design.....	108
F2	Tests for Confirming Structural Performance	108
F3	Tests for Determining Mechanical Properties	109
F3.1	Full Section.....	109
F3.2	Flat Elements of Formed Sections.....	109
F3.3	Virgin Steel.....	110
G.	DESIGN OF COLD-FORMED STEEL STRUCTURAL MEMBERS AND CONNECTIONS FOR CYCLIC LOADING (FATIGUE).....	111
G1	General	111
G2	Calculation of Maximum Stresses and Stress Ranges	113
G3	Design Stress Range	113
G4	Bolts and Threaded Parts.....	114
G5	Special Fabrication Requirements	114
APPENDIX 1: DESIGN OF COLD-FORMED STEEL STRUCTURAL MEMBERS USING THE DIRECT STRENGTH METHOD		1-3
1.1	GENERAL PROVISIONS	1-3
1.1.1	Applicability	1-3
1.1.1.1	Pre-qualified Columns	1-3
1.1.1.2	Pre-qualified Beams.....	1-5
1.1.2	Elastic Buckling	1-6
1.1.3	Serviceability Determination.....	1-6
1.2	MEMBERS	1-6
1.2.1	Column Design	1-6
1.2.1.1	Flexural, Torsional, or Flexural-Torsional Buckling	1-7
1.2.1.2	Local Buckling	1-7
1.2.1.3	Distortional Buckling.....	1-8
1.2.2	Beam Design	1-8
1.2.2.1	Lateral-Torsional Buckling	1-8
1.2.2.2	Local Buckling	1-9
1.2.2.3	Distortional Buckling.....	1-9
APPENDIX 2: SECOND-ORDER ANALYSIS		2-2
2.1	General Requirements	2-2
2.2	Design and Analysis Constraints	2-2
2.2.1	General	2-2
2.2.2	Types of Analysis.....	2-2
2.2.3	Reduced Axial and Flexural Stiffnesses.....	2-2
2.2.4	Notional loads	2-3
APPENDIX A: PROVISIONS APPLICABLE TO THE UNITED STATES AND MEXICO.....		A-3
A1.1a	Scope.....	A-3
A2.2	Other Steels	A-3
A2.3.1a	Ductility	A-3
A3	Loads	A-4

A3.1	Nominal Loads	A-4
A4.1.2	Load Combinations for ASD	A-4
A5.1.2	Load Factors and Load Combinations for LRFD	A-4
A9a	Referenced Documents	A-4
C2	Tension Members.....	A-4
D4a	Light-Frame Steel Construction	A-5
	D6.1.2 Flexural Members Having One Flange Fastened to a Standing Seam Roof System	A-5
	D6.1.4 Compression of Z-Section Members Having One Flange Fastened to a Standing Seam Roof	A-5
	D6.2.1a Strength [Resistance] of Standing Seam Roof Panel Systems	A-6
E2a	Welded Connections	A-7
E3a	Bolted Connections.....	A-7
E3.1	Shear, Spacing and Edge Distance.....	A-8
E3.2	Rupture in Net Section (Shear Lag)	A-9
E3.4	Shear and Tension in Bolts	A-11
	E4.3.2 Connection Shear Limited by End Distance	A-13
E5	Rupture	A-13
E5.1	Shear Rupture.....	A-13
E5.2	Tension Rupture.....	A-13
E5.3	Block Shear Rupture	A-13
APPENDIX B: PROVISIONS APPLICABLE TO CANADA.....		B-3
A1.3a	Definitions.....	B-3
A2.1a	Applicable Steels	B-3
A2.2	Other Steels	B-3
	A2.2.1 Other Structural Quality Steels.....	B-3
	A2.2.2 Other Steels.....	B-3
	A2.3.1a Ductility	B-3
A3	Loads	B-4
A3.1	Loads and Effects	B-4
A3.2	Temperature, Earth, and Hydrostatic Pressure Effects	B-4
	A6.1.2 Load Factors and Load Combinations for LSD	B-4
	A6.1.2.1 Importance Categories	B-5
	A6.1.2.2 Importance Factor (I).....	B-6
A9a	Reference Documents.....	B-7
C2	Tension Members.....	B-7
C2.1	Yielding of Gross Section.....	B-7
C2.2	Rupture of Net Section.....	B-7
D3a	Lateral and Stability Bracing	B-8
D3.1a	Symmetrical Beams and Columns.....	B-9
	D3.1.1 Discrete Bracing for Beams	B-9
	D3.1.2 Bracing by Deck, Slab, or Sheathing for Beams and Columns	B-9
D3.2a	C-Section and Z-Section Beams	B-9
	D3.2.2 Discrete Bracing	B-9
	D3.2.3 One Flange Braced by Deck, Slab, or Sheathing	B-9
	D3.2.4 Both Flanges Braced by Deck, Slab, or Sheathing	B-10

D6.1.2 Flexural Members Having One Flange Fastened to a Standing Seam Roof System	B-10
E2a Welded Connections	B-10
E2.2a Arc Spot Welds.....	B-10
E2.3a Arc Seam Welds	B-10
E3a Bolted Connections.....	B-10
E3.1 Shear, Spacing, and Edge Distance.....	B-11
E3.2 Rupture of Net Section (Shear Lag).....	B-11
E3.3a Bearing.....	B-12
E3.4 Shear and Tension in Bolts	B-12
E4.3.2 Connection Shear Limited by End Distance	B-12
E5 Rupture	B-12