Wei-Wen Yu Center for Cold-Formed Steel Structures

CCFSS technical bulletin

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AISI SUPPLEMENT 2004 TO THE NORTH AMERICAN SPECIFICATION

The AISI Supplement 2004 to the North American Specification for the Design of Cold-Formed Steel Structural Members, 2001 Edition, has been developed by a joint effort of the American Iron and Steel Institute Committee on Specifications, the Canadian Standards Association Technical Committee on Cold-Formed Steel Structural Members (S136), and Camara Nacional de la Industria del Hierro y del Acero (CANACERO) in Mexico to reflect the results of continuing research. Major changes to the Specification are briefly discussed in the subsequent sections. Copies of the document can be obtained from American Iron and Steel Institute, 1140 Connecticut Avenue, NW, Washington DC 20036 (www.steel.org).

A1.1 Scope and Limits of Applicability

Appendix 1 was added to provide alternative design provisions for several sections of Chapter C. Under Item (b), a new paragraph was added for safety factor and resistance factor when rational engineering analysis is used to determine the nominal strength for a failure mode already provided in the Specification.

A1.2 Terms

Under the title of "General Terms," two new terms "Direct Strength Method" and "Published Specification" were added.

A2.1 Applicable Steels

Editorial revisions were made in the first paragraph and for Grade 60 of A1008 steel. The ASTM Standard for A1003 steel was revised to be applicable only for ST Grades 50H, 40H, 37H, and 33H.

A2.3 Ductility

Under Item (a) of the Exception, the limit of the w/t ratio for $R_b = 1.0$ was revised from "E/F_y" to "$0.067E/F_{sy}$". In several places, the symbol of "F_y" was changed to "F_{sy}" and the term of "yield point" was changed to "specified minimum yield point."

A2.4 Delivered Minimum Thickness

The point symbol for Appendix B was removed.

A4.1.1 ASD Requirements

Both definitions for R_n and Ω were revised by adding Appendix 1.

A5.1.1 LRFD Requirements

Both definitions for R_n and ϕ were revised by adding Appendix 1.

A6.1.1 LSD Requirements

Both definitions for R_n and ϕ were revised by adding Appendix 1.

A7.2 Strength Increase from Cold Work of Forming

Equation (A7.2-1) was revised by adding a limit of F_{uv}.

A9 Referenced Documents
Three AISI Test Standards (TS-1-02, TS-6-04, TS-8-04) were added under Reference 1. Renumbered the existing References 1 and 2 to References 2 and 3. ASTM E1592-01 was added to the list of ASTM Standards. U.S. Army Corps of Engineers Standard CEGS-07416 and Factory Mutual Standard FM 4471 were added to the end of the section as new references.

B2.2 Uniformly Compressed Stiffened Elements with Circular Holes
Equation (B2.2-2) was revised by adding ($0.085d_h/w\lambda$) in the bracket for $\lambda > 0.673$.

B3.2 Unstiffened Elements and Edge Stiffeners with Stress Gradient
This section was completely rewritten by including definitions of various symbols and new equations for computing effective width, b, plate buckling coefficient, k, and the reduction factor, ρ , for unstiffened elements and edge stiffeners with stress gradient.

C3.1.1 Nominal Section Strength [Resistance]
In C3.1.1(b), editorial revision was made to Item (4). Definitions of "h", "t", and "w" were added. For computing C_y, minor editorial revisions were made for stiffened compression elements and new provisions were added for unstiffened compression elements.

C3.1.2.1 Lateral-Torsional Buckling Strength [Resistance] of Open Cross Section Members
Editorial revision was made at the end of the first sentence. Equation (C3.1.2.1-2) was replaced by a new paragraph to state that the member segment is not subject to lateral-torsional buckling at bending moments less than or equal to M_y. All subsequent equation numbers were revised.

C3.1.5 Strength [Resistance] of Standing Seam Roof Panel Systems
The first paragraph of Section C3.1.5 was revised for determining the strength of standing seam roof panel systems subjected to gravity loading and uplift loading. References were made to the Factory Mutual Standard FM 4471 and Corps of Engineers Standard CEGS-07416 for the tests under uplift loading.

C3.3.1 ASD Method
A square root sign was added to Equation (C3.3.1-1).

C3.3.2 LRFD and LSD Methods
A square root sign was added to Equation (C3.3.2-1).

C3.4.1 Web Crippling Strength [Resistance] of Webs without Holes
1. Revisions were made for "One-flange loading" in the fourth paragraph and for "Two-flange loading" in the fifth paragraph.
2. The resistance factor for Canada LSD listed in Table C3.4.1-4 for the Unfastened support condition of Interior One-Flange loading or reaction was revised from 0.75 to 0.70.
3. In Table C3.4.1-5 for Multi-Web Deck Sections, the coefficients, safety factors, and resistance factors were revised for end one-flange loading or reaction cases with either fastened to or unfastened to support conditions.

C3.4.2 Web Crippling Strength [Resistance] of C-Section Webs with Holes
In Requirement (6), the limit for corner radii was revised to greater than or equal to 2t.

C3.5 Combined Bending and Web Crippling
C3.5.1 ASD Method
This section was completely rewritten. The first paragraph was revised by adding the requirements of $M \le M_{nxo}/\Omega_b$ and $P \le P_n/\Omega_w$. All equations were revised with the rearrangement of definitions of symbols. The Exception clause for Equation (C3.5.1-2) was deleted.

C3.5.2 LRFD and LSD Methods
This section was completely rewritten. The first paragraph was revised by adding the requirements of $\overline{M} \le \phi_b M_{nxo}$ and $\overline{P} \le \phi_w P_n$. All equations were revised with the rearrangement of definitions of symbols. The Exception clause for Equation (C3.5.2-2) was deleted.

C3.6 Stiffeners
C3.6.1 Bearing Stiffeners
In the title and the text of this section, the term of "Transverse Stiffeners" was changed to "Bearing Stiffeners."
C3.6.2 Bearing Stiffeners in C-Section Flexural Members
This is a new section for two-flange loading of C-section flexural members with bearing stiffeners that do not meet the requirements of Section C3.6.1.
C3.6.3 Shear Stiffeners
The section number used in the title and all equations was changed from "C3.6.2" to "C3.6.3."
C3.6.4 Non-Conforming Stiffeners
The section number used in the title was changed from "C3.6.3" to "C3.6.4." Editorial revisions were made in the text.

C4.5 Built-Up Members
Item (3) was revised so that the intermediate fastener(s) or weld(s) at any longitudinal member tie location shall be capable of transmitting a force in any direction of 2.5% of the total force in the built-up member.

C4.6 Compression members Having One Flange Through-Fastened to Deck or Sheathing
Editorial revisions were made in the Note of this section.

C4.7 Compression of Z-Section Members Having One Flange Fastened to a Standing Seam Roof
This is a new section for the United States and Mexico. See Section C4.7 of Appendices A and C.

C5.2.1 ASD Method
The definitions of P_n and P_{no} were revised by adding Section C6.

C5.2.2 LRFD and LSD Methods
The definitions of P_n and P_{no} were revised by adding Section C6. In Equations (C5.2.2-4) and (C5.2.2-5), the symbol of "P_u" was changed to "$\overline{P}$ ".

C6.2 Compression
In Equation (C6.2-6), the denominator term of "$2F_e$" was changed to "$(2F_e)$".

D3.2.1 Anchorage of Bracing for Roof Systems under Gravity Load with Top Flange Connected to Sheathing
Editorial revisions were made in the first sentence of the first paragraph.

D3.2.2 Neither Flange Connected to Sheathing
This section was completely rewritten to provide new design equations for determining the intermediate brace forces applied at the top and bottom flanges of C- or Z-section under uniform loads or concentrated loads.

D4 Wall Studs and Wall Stud Assemblies
The introduction paragraph was revised to specify that wall studs shall be designed either on the basis of an all steel system in accordance with Section D4.1 or on the basis of sheathing braced design in accordance with an appropriate theory, tests, or rational engineering analysis.
D4.1 All Steel Design
The text of this section is the same as Item (a) of Section D4 of the 2001 edition of the North American Specification. This section was renumbered to Section D4.1.

[The provisions for Sheathing Braced Design included in Item (b) of Section D4 of the 2001 edition of the North American Specification together with subsections D4.1, D4.2, and D4.3 were deleted.]

D5 Floor, Roof or Wall Steel Diaphragm Construction
This section was completely rewritten using a simplified new Table D5 for safety factors and resistance factors for the design of diaphragms.

E2 Welded Connections

In the first paragraph, the thickness of the thinnest connected part was changed from "0.18 in. (4.57 mm)" to "3/16 in. (4.76 mm)". In the second paragraph, a sentence was added to state that for diaphragm applications, Section D5 shall be used.

E2.2 Arc Spot Welds
In the first paragraph, the first sentence was revised to permit the use of arc spot welds for sheet-to-sheet connections. In the second paragraph, a sentence was added to indicate that sheet-to-sheet welds do not require weld washers.

E2.2.1 Shear
This section was revised and reorganized into two subsections: E2.2.1.1 - Minimum Edge Distance, and E2.2.1.2 - Shear Strength [Resistance] for Sheet(s) Welded to a Thicker Supporting Member. A new subsection E2.2.1.3 - Shear Strength [Resistance] for Sheet-to-Sheet Connections was added.

E2.2.2 Tension
The U.S. customary unit and the SI metric unit were added for the limit of (td_aF_u).

E4 Screw Connections
Editorial revisions were made in the fourth paragraph. The definition for "P_{nt}" was deleted.

E4.3.3 Shear in Screws
The nominal shear strength of the screw was changed from "$0.8P_{ss}$" to "P_{ss}" with additional provisions for determining the safety factor and resistance factor.

E4.4.3 Tension in Screws
The nominal tension strength of the screw was changed from "$0.8P_{ts}$" to "P_{ts}" with additional provisions for determining the safety factor and resistance factor.

E4.5 Combined Shear and Pull-Over
This is a new section to include two subsections for screw connections subjected to a combination of shear and tension forces.

E4.5.1 ASD Method
This new subsection is for the ASD Method.

E4.5.2 LRFD and LSD Methods
This new subsection is for the LRFD and LSD Methods.

F1.1 Load and Resistance Factor Design and Limit States Design
In Table F1, the statistical data of "Bearing Strength" for "Screw Connections" were revised for V_M and V_F.

APPENDICES A and C

A2.2 Other Steels
This section was revised to include additional requirements for using other steels.

C3.1.4 Beams Having One Flange Fastened to a Standing Seam Roof System
Editorial revision was made for the definition of the reduction factor, R.

C4.7 Compression of Z-Section Members Having One Flange Fastened to a Standing Seam Roof
This is a new section. Alternative design values are permitted for a particular system.

E2a Welded Connections
The thickness of connected part was changed from "0.18 in. (4.57 mm)" to "3/16 in. (4.76 mm)" in two places.

E3a Bolted Connections
A paragraph was added to the end of the section for when the hole occurs within the lap of lapped and nested Z-members.

E5.3 Block Shear Rupture
This section was revised for connections in which the thickness of the thinnest part is less than 3/16 in. (4.76 mm). The design equations for determining the block shear rupture strength were revised.

APPENDIX B

A2.2.1 Other Structural Quality Steels
In this section, the wording of "published material Specification" was changed to "published Specification".

A2.4a Delivered Minimum Thickness
The entire section was deleted.

A3.1 Specified Loads
In this section, editorial revisions were made to the definitions of D, E, L, T, and W. Definitions of two new symbols (S and H) were added.

A3.2 Temperature, Earth and Hydrostatic Pressure Effects
The title and the text of this section were changed to consider the effects due to H and T.

A6.1.2 Load Factors and Load Combinations for LSD
This entire section and three subsections were revised. The newly revised section includes two new subsections: A6.1.2.1 - Importance Categories and A6.1.2.2 - Importance Factor (I).

A9a Reference Documents
The publication date for the National Building Code of Canada was updated from "1995" to "2005".

C2.2 Fracture of Net Section
In Equation (C2.2-4), the symbol of "L_v" was changed to "L_{nv}". New equations were added for the failure of coped beams. The definition of "L_v" was deleted and the definitions of two new symbols of "L_{gv}" and "L_{nv}" were added.

E2a Welded Connections
In the second paragraph, the thickness limit was changed from "4.57 mm" to "4.76 mm" in two places.

E3a Bolted Connections
At the end of the section, restrictions were added for slotted or oversized holes occurring within the lap of lapped and nested Z-members.

E3.4 Shear and Tension in Bolts
In the first line of the section, the wording "less than or equal to" was changed to "less than".

APPENDIX 1 - Design of Cold-Formed Steel Structural Members Using the Direct Strength Method, 2004 Edition

This is a new Appendix which provides alternative design procedures to portions of the North American Specification for the Design of Cold-Formed Steel Structural Members, Chapters A through G, and Appendices A through C. The Direct Strength Method requires determination of the elastic buckling behavior of the member, and then provides a series of nominal strength curves for predicting the member strength based on the elastic buckling behavior. The procedure does not require effective width calculations, nor iteration, and instead uses gross properties and the elastic buckling behavior of the cross-section to predict the strength.

SUPPLEMENT 2004 TO THE COMMENTARY ON THE NORTH AMERICAN SPECIFICATION FOR THE DESIGN OF COLD-FORMED STEEL STRUCTURAL MEMBERS, 2001 EDITION

This document provides the reasoning behind and justification for the revisions made in various sections of the Specification as outlined in above discussions. Readers who wish to have more complete information should refer to the original research publications cited in the Commentary.