



S100-07/S1-09



## **AISI** STANDARD

**Supplement No. 1 to the North  
American Specification for the  
Design of Cold-Formed Steel  
Structural Members, 2007 Edition**

AUGUST 2009

Approved in Canada by the  
Canadian Standards Association  
CSA S136-07/S1-09

Endorsed in Mexico by CANACERO



The material contained herein 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. The organizations and the committees have made a diligent effort to present accurate, reliable, and useful information on cold-formed steel design. The committees acknowledge and are grateful for the contributions of the numerous researchers, engineers, and others who have contributed to the body of knowledge on the subject. Specific references are included in this document.

With anticipated improvements in understanding of the behavior of cold-formed steel and the continuing development of new technology, this material may eventually become dated. It is anticipated that future editions of this Specification will update this material as new information becomes available, but this cannot be guaranteed.

The materials set forth herein are for general information only. They are not a substitute for competent professional advice. Application of this information to a specific project should be reviewed by a registered professional engineer. Indeed, in most jurisdictions, such review is required by law. Anyone making use of the information set forth herein does so at their own risk and assumes any and all resulting liability arising therefrom.

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## **PREFACE**

Supplement No. 1 to the North American Specification for the Design of Cold-Formed Steel Structural Members, 2007 Edition, modifies Section F1.1, Load and Resistance Factor Design and Limit States Design, to recognize that the behavior and probability of failure for a composite interior partition wall stud differs from the direct load-bearing system, and the reference to Supplement No. 1 of AISI S213, the North American Standard for Cold-Formed Steel Framing - Lateral Design is included. The Supplement also has included errata to the North American Specification.

American Iron and Steel Institute  
Canadian Standards Association  
Camara Nacional de la Industria del Hierro y del Acero  
August 2009

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**TABLE OF CONTENTS**  
**SUPPLEMENT NO. 1 TO THE NORTH AMERICAN SPECIFICATION**  
**FOR THE DESIGN OF COLD-FORMED STEEL**  
**STRUCTURAL MEMBERS, 2007 EDITION**  
**AND THE COMMENTARY**

**AUGUST 2009**

<b>SUPPLEMENT NO. 1 TO THE NORTH AMERICAN SPECIFICATION FOR THE DESIGN OF COLD-FORMED STEEL STRUCTURAL MEMBERS, 2007 EDITION .....</b>	<b>1</b>
Changes and Updates in Symbols and Definitions .....	1
Changes and Updates in Chapters A through G .....	1
Changes and Updates in Appendix 1 .....	2
Changes and Updates in Appendix A .....	2
Changes and Updates in Appendix B .....	2
D4a Light-Frame Steel Construction .....	2
<b>COMMENTARY ON SUPPLEMENT NO. 1 TO THE NORTH AMERICAN SPECIFICATION FOR THE DESIGN OF COLD-FORMED STEEL STRUCTURAL MEMBERS, 2007 EDITION .....</b>	<b>C-1</b>
Changes and Updates in Chapters A through G .....	C-1
F1.1 Load and Resistance Factor Design and Limit States Design .....	C-2

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**SUPPLEMENT NO. 1 TO THE NORTH AMERICAN SPECIFICATION  
FOR THE DESIGN OF COLD-FORMED STEEL  
STRUCTURAL MEMBERS, 2007 EDITION**

**AUGUST 2009**

**Changes and Updates in Symbols and Definitions**

1. On pages xvii and 41, change the definition of  $h_x$  to  
 $h_x = x$  distance from centroid of flange to flange/web junction
2. On pages xxvii and 41, change the definition of  $x_o$  used in Sections C3.1.4 and C4.2 to  
 $x_o = x$  distance from centroid of flange to shear center of flange
3. On pages xxviii and 42, change the definition of  $y_o$  to  
 $y_o = y$  distance from centroid of flange to shear center of flange

**Changes and Updates in Chapters A through G**

1. On page 29, revise the title of B5.1.1 to  
B5.1.1 Specific Case: Single or n Identical Stiffeners, Equally Spaced
2. On page 29, revise the first paragraph under Section B5.1.1 to  
For uniformly compressed elements with single, or multiple identical and equally spaced stiffeners, the plate buckling coefficients and effective widths shall be calculated as follows:
3. On page 29, revise the first paragraph under Section B5.1.2 to  
For uniformly compressed stiffened elements with stiffeners of arbitrary size, location and number, the plate buckling coefficients and effective widths shall be calculated as follows:
4. On page 51, revise " $d_o$ " in item (9) to " $d_h$ "
5. On page 60, change the first sentence to "... the exception of members that are designed in accordance with Sections D6.1.3 and D6.1.4."
6. On Page 60, change " $\Omega_b$ " on line 9 and " $\phi_b$ " on line 10 to " $\Omega_c$ " and " $\phi_c$ ", respectively.
7. In Table D6.3.1-1 on page 81, for Multiple Spans, with SS Roofs and Exterior Frame Line, change the value for C2 from "1.3" to "13"
8. On page 75, change item (14) to  
(14) The design yield stress of the member does not exceed 60 ksi (410 MPa or 4220 kg/cm<sup>2</sup>).
9. On page 105, change the definition for  $\beta_o$  to  
 $\beta_o$  = Target reliability index  
= 2.5 for *structural members* and 3.5 for connections for LRFD  
= 1.6 for LRFD and LSD for an interior partition wall stud in a composite steel-framed interior wall system with sheathing attached to both flanges and that is limited to a transverse (out-of-plane) nominal load of not more than 10 lb/ft<sup>2</sup> (0.48 kPa), a superimposed nominal axial load, exclusive of sheathing materials, of not more than 100 lb/ft (1.46 kN/m), or a

- superimposed nominal axial load of not more than 200 lbs (0.89 kN).
- = 1.5 for LRFD for beams having tension flange through-fastened to deck or sheathing and with compression flange laterally unbraced
- = 3.0 for structural members and 4.0 for connections for LSD
- = 3.0 for LSD for beams having tension flange through-fastened to deck or sheathing and with compression flange laterally unbraced

### **Changes and Updates in Appendix 1**

1. On page 1-3 of Appendix 1, change “A1.1” to “A1.2” on 8th line in the first paragraph, 5th line in the second paragraph, and 4th line in the 4th paragraph.
2. On page 1-4 of Appendix 1, in Table 1.1.1-1 for Hat Section, change from “ $b_o/t < 20$ ” to “ $b_o/t < 43$ ”
3. On page 1-7 of Appendix 1, change “A1.1(b)” to “A1.2(b)” on 5th line.
4. On page 1-8 of Appendix 1, change “A1.1(b)” to “A1.2(b)” on 7th line in Section 1.2.2.

### **Changes and Updates in Appendix A**

1. On page A-4, change the reference on line 7 under Section A9a to  
AISI S213-07/S1, North American Standard for Cold-Formed Steel Framing—Lateral Design with Supplement No. 1

### **Changes and Updates in Appendix B**

1. Add the following new section below Section D3.2.4 on page B-10:

#### **D4a Light-Frame Steel Construction**

In addition to the cold-formed steel framing standards listed in Section D4, the following standards shall be followed as applicable:

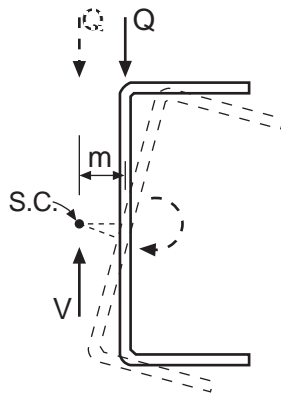
- (e) Light-framed shear walls and diagonal strap bracing (that is part of a structural wall) to resist wind, seismic and other in-plane lateral loads shall be designed in accordance with AISI S213.
2. Add the following to the end of Section A9a on page B-7:
  3. American Iron and Steel Institute, 1140 Connecticut Avenue, NW, Suite 705, Washington, DC 20036, USA.  
AISI S213-07, North American Standard for Cold-Formed Steel Framing—Lateral Design.

**COMMENTARY ON SUPPLEMENT NO. 1  
TO THE NORTH AMERICAN SPECIFICATION  
FOR THE DESIGN OF COLD-FORMED STEEL  
STRUCTURAL MEMBERS, 2007 EDITION**

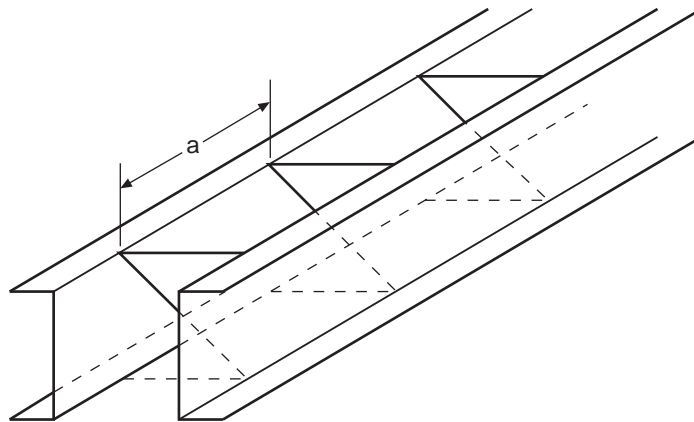
**AUGUST 2009**

**Changes and Updates in Chapters A through G**

1. Add the following two figures to page 104 before item (b):

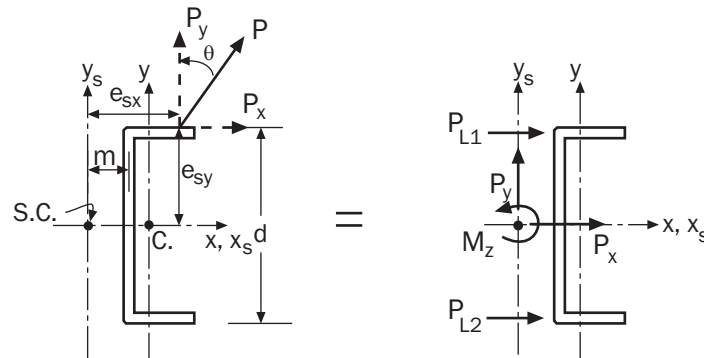


**Figure C-D3.2.1-1 Rotation of C-Section Beams**



**Figure C-D3.2.1-2 Two C-Sections Braced at Intervals Against Each Other**

2. Revise  $P_{L2}$  direction in Figure C-D3.2.1-6 as shown below:



**Figure C-D3.2.1-6 C-Section Member Subjected to a Concentrated Load**

3. Replace Section F1.1 as follows:

### **F1.1 Load and Resistance Factor Design and Limit States Design**

The determination of load-carrying capacity of the tested elements, assemblies, connections, or members is based on the same procedures used to calibrate the LRFD design criteria, for which the  $\phi$  factor can be computed from Equation C-A5.1.1-15. The correction factor  $C_P$  is used in *Specification* Equation F1.1-2 for determining the  $\phi$  factor to account for the influence due to a small number of tests (Pekoz and Hall, 1988b and Tsai, 1992). It should be noted that when the number of tests is large enough, the effect of the correction factor is negligible. In the 1996 edition of the *AISI Specification*, Equation F1.1-3 was revised because the old formula for  $C_P$  could be unconservative for combinations of a high  $V_P$  and a small sample size (Tsai, 1992). This revision enables the reduction of the minimum number of tests from four to three identical specimens. Consequently, the  $\pm 10$  percent deviation limit was relaxed to  $\pm 15$  percent. The use of  $C_P$  with a minimum  $V_P$  reduces the need for this restriction. In *Specification* Equation F1.1-3, a numerical value of  $C_P = 5.7$  was found for  $n = 3$  by comparison with a two-parameter method developed by Tsai (1992). It is based on the given value of  $V_Q$  and other statistics listed in *Specification* Table F1, assuming that  $V_P$  will be no larger than about 0.20. The requirements of *Specification* Section F1.1(a) for  $n = 3$  help to ensure this.

The 6.5 percent minimum value of  $V_P$ , when used in *Specification* Equation F1.1-2 for the case of three tests, produces safety factors similar to those of the 1986 edition of the *AISI ASD Specification*, i.e. approximately 2.0 for members and 2.5 for connections. The LRFD calibration reported by Hsiao, Yu and Galambos (1988a) indicates that  $V_P$  is almost always greater than 0.065 for common cold-formed steel components, and can sometimes reach values of 0.20 or more. The minimum value for  $V_P$  helps to prevent potential unconservatism compared to values of  $V_P$  implied in LRFD design criteria.

In evaluating the coefficient of variation  $V_P$  from test data, care must be taken to use the coefficient of variation for a sample. This can be calculated as follows:

$$V_P = \frac{\sqrt{s^2}}{R_m} \quad \text{C-F1.1-1}$$

where

$s^2$  = sample variance of all test results

$$= \frac{1}{n-1} \sum_{i=1}^n (R_i - R_m)^2 \quad \text{C-F1.1-2}$$

$R_m$  = mean of all test results

$R_i$  = test result  $i$  of  $n$  total results

Alternatively,  $V_P$  can be calculated as the sample standard deviation of  $n$  ratios  $R_i/R_m$ .

In 2009, *Specification* Section F1.1 was modified to recognize that the behavior and probability of failure for a composite interior partition wall stud differs from the direct load-bearing system. A composite interior wall stud is a stud in an interior application with full-height gypsum sheathing that is screw attached to both flanges and supports no axial load other than self-weight. The maximum permitted nominal lateral loads for composite design are stipulated in *Specification* Section F1.1. There is typically no dead load perpendicular to the wall. In the United States, these lateral loads are defined as live loads, thus, for LRFD the applicable load combination is 1.6L.

Traditional ASD practice for composite interior partition wall studs has employed an  $\Omega = 1.5$ . For acceptable levels of variability (i.e., reasonably low  $V_P$ ) this corresponds to a  $\beta_o = 1.6$  (for LRFD and LSD with  $M_m = 1.10$ ,  $V_m = 0.10$ ,  $F_m = 1.00$  and  $V_F = 0.05$ ). Note that for these lower levels of reliability,  $\phi$  calculated per *Specification* Equation F1.1-2 may be greater than 1.0. A  $\phi$  greater than 1.0 (just like a  $\phi$  less than 1.0) simply reflects the necessary change in the nominal strength such that the target reliability is achieved.

Calibration of  $\beta_o$  to past practice reflects that for composite interior partition wall studs, as defined in *Specification* F1.1, the consequences of failure are less severe than for other structural members. In addition, the  $\beta_o$  of *Specification* Section F1.1 is calculated for a 50-year return period. Based on occupancy statistics, average tenancy is eight years (Galambos and Ellingwood 1986). The traditional 50-year  $\beta_o$  may be converted to an eight-year time period via Equation C-F1.1-3:

$$\beta_{8\text{yr}} = -\Phi^{-1} [\Phi(-\beta_o) (8/50)] \quad \text{C-F1.1-3}$$

where  $\Phi$  is the cumulative distribution function (CDF) of the standard normal distribution. For  $\beta_o = 1.6$  using Equation C-F1.1-3,  $\beta_{8\text{yr}} = 2.4$ , which provides a more accurate assessment of the reliability of the wall over its expected service life.

These provisions only apply to the case of determining the strength of composite interior partition wall studs as defined in *Specification* Section F1.1 through tests. Where an all-steel design is used, the provisions of *Specification* Section D4 apply.

For beams having tension flange through-fastened to deck or sheathing and with compression flange laterally unbraced (subject to wind uplift), the calibration is based on a load combination of 1.17W-0.9D with  $D/W = 0.1$  (see Section D6.1.1 of this *Commentary* for detailed discussion).

The statistical data needed for the determination of the resistance factor are listed in *Specification* Table F1. The data listed for screw connections were added in 1996 on the basis of the study of bolted connections reported by Rang, Galambos, and Yu (1979b). The same

statistical data of  $M_m$ ,  $V_M$ ,  $F_m$ , and  $V_F$  have been used by Pekoz in the development of the design criteria for screw connections (Pekoz, 1990).

In 1999, two entries were added to Table F1—one for “Structural Members Not Listed Above” and the other for “Connections Not Listed Above”. It was considered necessary to include these values for members and connections not covered by one of the existing classifications. The statistical values were taken as the most conservative values in the existing table.

In 2004, the statistic data  $V_M$  for screw bearing strength was revised from 0.10 to 0.08. This revision is based on the tensile strength statistic data provided in the UMR research report (Rang, Galambos, and Yu, 1979b). In addition,  $V_f$  was revised from 0.10 to 0.05 to reflect the tolerance of the cross-sectional area of the screw.

In 2007, additional entries were made to Table F1 to provide statistical data for all limit states included within the *Specification* for the standard connection types. The entry “Connections Not Listed Above” is intended to provide statistical data for connections other than welded, bolted, or screwed.

Also in 2007, the *Specification* more clearly defined the appropriate material properties that are to be used when evaluating test results by specifying that supplier-provided properties are not to be used.





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