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Specification for the Design of Cold-formed Steel Structural Members

American Iron and Steel Institute

AMERICAN IRON AND STEEL INSTITUTE
SPECIFICATION FOR THE DESIGN OF COLD-FORMED STEEL STRUCTURAL MEMBERS
1968 EDITION

ADDENDUM NO. 2
February 4, 1977

The following modifications of the 1968 Edition of the Specification for the Design of Cold-Formed Steel Structural Members were recommended by the Advisory Group on the Specification for the Design of Cold-Formed Steel Structural Members and approved by AISI's Committee on Construction Codes and Standards on February 4, 1977.

Note: New material is underlined; deleted material is crossed out.

Revise Section 1, General, of the 1968 Edition as follows, and delete Addendum No. 1 dated November 19, 1970:

1.1 Scope

This Specification shall apply to the design of structural members cold formed to shape from carbon or low-alloy, ~~sheet or strip steels~~ steel sheet, strip, plate or bar not more than one inch in thickness and used for load-carrying purposes in buildings. It may also be used for structures other than buildings provided appropriate allowances are made for dynamic effects.

1.2 Material

1.2.1 General

This Specification contemplates the use of steel of structural quality as defined in general by the provisions of the following specifications of the American Society for Testing and Materials:

~~Flat-Rolled Carbon Steel Sheets of Structural Quality, ASTM A245~~

~~High Strength Low Alloy Cold Rolled Steel Sheets and Strip, ASTM A374~~

~~High Strength Low Alloy Hot Rolled Steel Sheets and Strip, ASTM A375~~

Steel Sheet, Zinc-coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality, ASTM A446

Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality, ASTM A570

Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, High Strength, Low Alloy, with Improved Corrosion Resistance, ASTM A606

Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, High Strength, Low Alloy Columbium and/or Vanadium, ASTM A607

Steel, Cold-Rolled Sheet, Carbon, Structural, ASTM A611

Structural Steel, ASTM A36

High-Strength Low-Alloy Structural Steel, ASTM A242

High-Strength Low-Alloy Structural Manganese Vanadium Steel, ASTM A441

High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality, ASTM A572

High-Strength Low-Alloy Structural Steel with 50,000 psi Minimum Yield Point to 4 in. Thick, ASTM A588

Structural Steel with 42,000 psi Minimum Yield Point (½ in. Maximum Thickness), ASTM A529

1.2.2 Other Steels

The ~~above~~ listing in Section 1.2.1 does not exclude the use of steel up to and including one-~~half~~ inch in thickness ordered or produced to other than the listed specifications provided such steel conforms to the chemical and mechanical requirements of one of the listed specifications or other published specifications which establishes its properties and suitability, and provided it is subjected by either the producer or the purchaser to analyses, tests and other controls to the extent and in the manner prescribed by one of the listed specifications.

1.3 Delivered Minimum Thickness

The uncoated minimum steel thickness of the cold-formed product as delivered to the job site shall not at any location be less than 95 per cent of the thickness, t, used in its design; however, thicknesses may be less at bends, such as corners, due to cold-forming effects.

Modify **Section 3.5, Web Crippling of Beams,** *of the 1968 Edition by making the following addition to Section 3.5 (a) (2):*

(2) For reactions of interior supports or for concentrated loads located anywhere on the span: For inside corner radius equal to or less than the thickness of sheet

$$P_{max} = t^2 [305 + 2.30 (N/t) - 0.009 (N/t) (h/t) - 0.5 (h/t)] \times [1.22 - 0.22 (F_y/33)] \times (F_y/33)$$

For other corner radii up to 4t, the value P_{max} given by the above formula is to be multiplied by $(1.06 - 0.06\ R/t)$

In the presence of a moment larger than 0.3 M_{max}, the allowable concentrated load or reaction must be multiplied by the reduction factor $1.3 - M/M_{max}$

Add the following definitions:

M = applied bending moment, at or immediately adjacent to P, kip – in.

M_{max} = allowable bending moment permitted if bending stress only exists, kip – in.

COMMENTS ON ADDENDUM NO. 2

These comments are intended to explain the revisions in the Specification and are not considered part of the Specification.

1.1 Scope

The 1968 edition of the Specification included steels up to ½ in. in thickness. Research[1,2] initiated in 1971 at the University of Missouri—Rolla verified the applicability of the design provisions to members cold formed from steel up to one inch in thickness.

1.2 Material

The listing of ASTM Specifications has been expanded to include plate and bar specifications corresponding to the increase in thickness maximum. Also, ASTM Specifications A245, 374 and 375 have been dropped and A606, 607 and 611 added. These three latter steels were included in Addendum No. 1.

1.3 Delivered Minimum Thickness

Sheet and strip steels, both coated and uncoated, may, in most cases, be ordered to nominal or minimum thickness. If the steel is ordered to minimum thickness, all thickness tolerances are over (+) and nothing under (−). If the steel is ordered to nominal thickness, the thickness tolerances are divided equally between over (+) and under (−). Therefore, in order to provide some equity between the two methods of ordering sheet and strip steel in keeping with the past philosophy of the cold-formed steel specification, it was decided to require that the delivered thickness of the cold-formed product be at least 95 percent of the design thickness. Thus, it is apparent that a portion of the factor of safety may be considered to cover minor negative thickness tolerances.

Measurements of thickness should be taken at locations so as to be an indication of the gross strength of the product. Generally, thickness measurements should be made in the center of flanges. For decking and siding, measurements should be made as close as practical to the center of the first full flat on each edge of the sheet. In any case, thickness measurements should not be made closer to edges than the minimum distances specified in ASTM A568. These minimum distances are ¾ in. for mill edges of hot-rolled sheet; and ⅜ in. for cut edges of hot-rolled sheet, for side edges of cold-rolled sheet and hot-dipped galvanized sheet, and for edges of strip 1 in. or more in width. Thickness measurement equipment should be designed to prevent indentation of the sheet. If micrometers are used, they should be equipped with flat anvils and ratchet stops or other friction-limiting devices. All thickness measurements should obtain the base steel thickness exclusive of coatings.

The responsibility of meeting this requirement is clearly that of the manufacturer of the cold-formed product, not the steel producer.

Section 3.5 Web Crippling of Beams

Concentrated loads or reactions, applied over short lengths, produce distortions of the compression flanges as well as the webs of beams. Tests reported by Baehre[3], and Ratliff[4], indicate that these concentrated loads also reduce the capacity of beams to resist bending.

The reduction factor for combined bearing and bending which is added in Addendum No. 2 is identical to a provision in a Swedish Specification[5] also described by Baehre[3]. This factor is based on 151 tests of corrugated-sheet beams. Ratliff[4] confirmed the validity of the factor with 9 tests of C sections.

The interaction formula for combined bearing and bending is applicable only to single unreinforced webs such as C- and Z-sections, deck webs, and the like. The limited information[4] now available on reinforced webs indicates that they are not as vulnerable to bearing-bending interaction as unreinforced webs.

[1] Yu, Wei-Wen, Liu, Victor A.S., and McKinney, William M., "Structural Behavior of Thick Cold-Formed Steel Members," Journal of the Structural Division, ASCE, Vol. 100, No. ST11, Proc. Paper 10907, November, 1974, pp. 2191-2204.

[2] McKinney, William M., Liu, Victor Ai-Shen, and Yu, Wei-Wen, "Study of Cold-Formed Steel Structural Members Made of Thick Sheets and Plates", Final Report, Civil Engineering Study 75-1 Structural Series, April, 1975, A Research Project Sponsored by American Iron and Steel Institute, Department of Civil Engineering, University of Missouri—Rolla, Rolla, Missouri.

[3] Baehre, R., "Sheet Metal Panels for Use in Building Construction—Recent Research Projects in Sweden", Proceedings of the Third International Specialty Conference on Cold-Formed Steel Structures, Department of Civil Engineering, University of Missouri—Rolla, Rolla, Missouri 65401, November 24-25, 1975, pp. 383-455.

[4] Ratliff, G. D., Jr., "Interaction of Concentrated Loads and Bending in C-Shaped Beams," Proceedings of the Third International Specialty Conference on Cold-Formed Steel Structures, Department of Civil Engineering, University of Missouri—Rolla, Rolla, Missouri 65401, November 24-25, 1975, pp. 337-356.

[5] Tunnplakskonstruktioner, Godkännanderegler nr. 3. Swedish Specification for design of thin-walled cold formed structural members. The national Swedish Board of Urban Planning, 1975.

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