Illustrative Examples for Provisions in AISI S100-16(2020) w/S3-22

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Helen Chen, AISI

The 2016 edition of the *North American Specification for the Design of Cold-Formed Steel Structural Members With Supplement 3* (AISI S100-16 (2020) w/S3-22) provides many new provisions that are summarized in the Preface. The following SMath Studio examples illustrate some of these new provisions. See AISI S100-16(2020) w/S3-22 for the section numbers referenced in this document.

Note: SMath Studio (https://en.smath.com/view/SMathStudio/summary) is free software. The following examples developed using SMath can be used to generate outputs by revising the inputs.

I. **Open Cross-Section Properties:** The following examples calculate the section properties and buckling properties of any open cross-section using the Coordinate Method (see Item XV for detail). Examples 3 and 4 include the preprocessor to simplify the data input for eave struts and C-Sections, respectively.

1. Section properties for any open cross-section,
2. Section properties of any open cross-section with hole(s),
3. Section properties of a non-symmetric cross-section - eave strut, and
4. Section properties of C-Section.

II. **Required Bracing Force and Bracing Stiffness to Brace Multiple Axial Loaded Compressive Columns.** This example calculates the required brace force and stiffness needed to brace multiple axial-loaded compressive members in accordance with Section C2.3.2.

5. Multiple-column required brace force and brace stiffness.

III. **Shear Buckling Force.** This example calculates the shear buckling forces using the provisions in Sections 2.3.4 and G2.3.

6. Shear buckling force per Section 2.3.4 and Section G2.3.

IV. **Web Shear Strength of Members Without Holes.** This example calculates the shear strength of a member without web holes per Section G2.

7. Web shear strength of members without web holes.

V. **Web Shear Strength of Members With Holes.** This example calculates the shear strength for members with web holes per Section G3. The web hole type can be rectangular, square, circular, or slotted.

8. Web shear strength of members with web holes.

VI. **Web Transverse Stiffeners.** This example checks the web stiffeners needed for shear per Section G4.1.

9. Web transverse stiffener for shear.

VII. **Torsional Analysis Using Flexural Analogy.** This example illustrates how to use the flexural analogy to determine bimoments due to torsional force. The example calculates the maximum bimoment and the bimoment at the maximum bending moment for a simply supported beam under distributed vertical load eccentrically loaded from the shear center. The beam can have 0 to 3 equally spaced intermediate torsional brace(s).

10. Torsion analysis using the flexural analogy.

VIII. **Bimoment Strength.** This example calculates the bimoment strength of any type of open cross-section. The example is based on the provisions of Section G8.

11. Bimoment strength for any open cross-section.

IX. **Built-Up Member Compressive Global Buckling Strength and Shear Force in Connectors.** This example calculates a built-up member's compressive buckling force, the required shear force in connectors per Section I1.2, and the compressive strength per Section E2. For illustrative purpose, the local buckling of element members are not considered. The example is applicable to a built-up cross-section formed by up to 6 element members. Example 13 illustrates the calculation of a built-up member formed by two channels back-to-back.

12. Built-up member compressive buckling force, available strength due to global buckling, and required shear force in connectors, and
13. Two-channel back-to-back built-up member compressive buckling force, available strength due to global buckling, and required shear force in connectors.

X. **Global Buckling Force.** This example calculates the global buckling force about any two perpendicular centroidal axes of a cold-formed member with any open cross-section per Section 2.3.1.1.4.

14. Global buckling force of any open cross-section.

XI. **Lateral-Torsional Buckling Moment.** The following examples calculate the lateral-torsional buckling moment of an arbitrary cold-formed section under biaxial bending.

Example 16 illustrates the application of a channel section subject to biaxial bending. The calculation is based on the provisions included in Item 22 under XV, Supplement Materials.

15. Lateral-torsional buckling due to biaxial bending, and
16. Lateral-torsional buckling—A channel subjected to biaxial bending.

XII. **Distortional Buckling Force.** This example calculates the distortional buckling force for C- or Z-Section members with or without web holes per Section 2.3.3 of Appendix 2.

17. Distortional buckling force for C- or Z-section members with or without holes.

XIII. **Distortional Buckling Moment.** This example calculates the distortional buckling moments when bending about the axis perpendicular to the web or bending about the axis parallel to the web (with lip(s) in compression) per Section 2.3.3 of Appendix 2. The example is applicable to C- or Z-Section members with or without web holes.

18. Distortional buckling moments for C- or Z-section members with or without holes when bending about the axis perpendicular to the web or bending about the axis parallel to the web (with lip(s) in compression).

XIV. **Connection Rupture Strength.** These examples illustrate how the rupture strength is calculated per Section J6.

19. Rupture strength of a channel member connection, and
20. Connection strength of a plate connection.

XV. **Supplement Materials.** The Coordinate Method is included below. The method is applicable to any open cross-sections. In addition, Biaxial Bending design provisions and commentary are provided. Illustrative Examples 15 and 16 are based on these provisions.

21. The Coordinate Method, and
22. Biaxial Bending Design Provisions and Commentary.