Building Official's Guide to Cold-Formed Steel Framing
FIELD INSPECTIONS

Cold-formed steel framing elements include steel studs, joists, rafters, trusses, accessories and other components that are used in construction systems. This includes C-shaped studs and joists, hat- and tube-shaped truss components, and unusual framing shapes such as those used in shaftwall assemblies. The American Iron and Steel Institute's *Standard for Cold-Formed Steel Framing, General Provisions* applies to "structural and nonstructural cold-formed steel framing members where the specified minimum base metal thickness is between 18 mils to 118 mils." In addition, Section 054 00 of architectural specifications typically apply to these types of members and their assembly.

Material: structural vs. nonstructural

Framing manufacturers typically make two different types of studs for different applications: Structural and Non-structural. The difference between the two is not how they are made, but rather in how they are used. According to ASTM C955 *Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases*, a Structural Member is "a member in a steel-framed system in which the loading exceeds any of the following conditions: a transverse load of 20 lbf/ft (290 N/m) of member length, or an axial load, exclusive of sheathing, of 200 lbf (890 N) per member."

Nonstructural walls studs, as defined in ASTM C645, *Standard Specification for Nonstructural Steel Framing Members*, can still carry a load – as long as it is less than the minimum found in ASTM C955. This means that nonstructural members are often used in building construction in assemblies other than walls, for example soffits, ceilings, ductwork and plenum enclosures.

This document is intended to provide building inspectors, contractors, architects, and engineers with a partial list of items to be reviewed during construction of a project. It provides some basic, but necessary, checks to assure that structural cold-formed steel framing is built per an approved design or recognized design standard. This document is intended only as an aid to the qualified inspector. For more specific information, a Design Professional experienced in cold-formed steel design should be consulted.

Limitations:

1. This guide is limited to steel materials that can be verified.
2. This guide is limited standard cold-formed steel products contained in the Steel Framing Industry Association *"Technical Guide for Cold-Formed Steel Framing Products."* Nonstandard/proprietary products may have certain limitations and requirements beyond the scope of this document, but which are provided in manufacturer literature.
2. This guide is limited to conventional framing practices with stud, joist, and truss framing spaced at 24"on-center, or less.
3. This guide should only be used as an aid to inspecting structural cold-formed steel framing. For specific details, refer to the approved design or recognized design standard.

Definitions:

1. Inspector - A building official, third party inspection agency, architect, or engineer who has responsibility for inspecting the cold-formed steel framing.
2. Design Professional - A licensed engineer or architect responsible for the structural design of the cold-formed steel framing.
3. Approved - Approved by a building official or Design Professional.
4. Cold-Formed Steel - Cold-formed sheet steel with thicknesses ranging from 97 mils (12 gauge) to 33 mils (20 gauge). Although not discussed in this document, thinner steels; i.e., 30 mil (20 gauge drywall), 27 mil (22 gauge) and 18 mil (25 gauge) may be used in non-structural conditions.
5. Contractor - Company responsible for receiving and erecting the cold-formed steel framing.
6. Structural Framing – Framing consisting of floor joists, rim tracks, structural studs, wall tracks in structural walls, ceiling joists, roof rafters, headers, or other members that are designed or intended to carry loads.

GENERAL REQUIREMENTS

1. All construction should conform to an approved design or recognized design standard, in addition to the following specific items.
2. All variations from the approved design or recognized design standard should be approved by the Design Professional.
3. Should there be a conflict between the information in this document (Tech Note 1010b) and the approved design or recognized design standard, the approved design or recognized design standard should govern and the Design Professional should be notified to resolve the conflict.
4. This document is intended to be an aid in the inspection of a project using cold-formed steel framing and does not imply that a specific project will be in compliance with local code requirements.
5. If any of the checklist items below are not satisfied, the contractor should correct the item or have it approved by the Design Professional or code official.

1.0 MATERIALS

1.1 Steel Verification: Confirm that the cold-formed steel members being installed match the project's specified size, type, mechanical properties and spacing.

1.1.1 Each member should bear a legible sticker, stamp, stencil, or embossment, spaced a maximum of 96 inches on center and located on the *web* of the framing member, indicating the minimum steel sheet thickness, metallic-coating designation, minimum yield strength, product designation, and name of manufacturer. In cases where members are not labeled, the contractor is responsible for verifying that the steel is in compliance with project specifications.

1.1.2 Member sizes; i.e., lengths of webs, flanges, and return lips, and material thickness should be the same as specified in the approved design or a recognized design standard.

1.1.3 The galvanized coating weight of structural members should be G60 or equivalent, per ASTM A1003, unless other coating weight is specified in the approved design or a recognized design standard for the project environmental conditions.

1.2 Member Condition: Verify that framing members are in good condition. Damaged members, members with cracking in the steel at the bend radius locations, and members with significant red rusting or scaling of the protective coating are unacceptable, unless approved by the Design Professional.

1.3 Web Holes: Confirm that factory punch-outs or field penetrations conform with the approved design or recognized design standard. Typically, web holes should not be spaced closer than 24" on-center or located closer than 10" from a bearing condition. The size of a web hole should typically not be larger than one-half the web depth, or 2-1/2" maximum in the web direction and not more than 4-1/2" long in the member direction. Web holes violating these dimensions should be reinforced or patched in accordance with an approved design or a recognized design standard, unless approved by the Design Professional.

1.4 Field Cuts and Notches: Verify that there are no field cuts or notches through the flanges or lips of any structural members unless specifically approved by the Design Professional.

2.0 CONNECTIONS

2.1 Screw Connections:

2.1.1 Review the approved design or recognized design standard for specified style and size used for specific applications. The contractor should provide data confirming the screws supplied will comply with the approved design or recognized design standard for screw shear, pull-out requirements, diameter, and point style in relation to the combined thickness of all connected steel frame members. Use of a larger than specified screw size should be permitted, providing that the minimum spacing and edge distance requirements are met.

2.1.2 Inspect screws to ensure they are fully driven and have a minimum penetration of three (3) threads through the last material joined. It is acceptable to reset under-driven screws.

2.1.3 Verify that screws penetrate individual components in the connection without causing permanent separation between the components.

2.1.4 Check for popped screw heads that may indicate improper installation methods, tool, screw type, or quality of screw. Screws with missing heads should be considered ineffective.

2.1.5 Check for stripped connections (i.e., screws that turn freely). Stripped screw fasteners in direct tension should be considered ineffective. Stripped screw fasteners in shear should be considered effective provided the number of stripped screw fasteners considered effective does not exceed twenty-five percent (25%) of the total number of screw fasteners considered effective in the connection. It is acceptable to remove stripped screws and replace them with screws of the next larger diameter.

2.1.6 Verify screw spacing and edge distance. For screw fasteners in steel-to-steel connections to be considered fully effective, the minimum center-to-center spacing and edge distance should be 3 times the nominal diameter, except when the edge is parallel to the direction of the applied force the minimum edge distance of screw fasteners should be 1.5 times the nominal diameter. When the minimum center-to-center spacing is 2 times the nominal diameter, screw fasteners should be considered 80 percent effective. For screws in sheathing-to-steel connections, the minimum center-to-center and edge distance requirements of the sheathing need to be met.

2.1.7 Confirm that the screws have the protective coating as specified in the approved design or a recognized design standard for the project environmental conditions.

2.2 Pneumatically Driven Pins:

2.2.1 Review the approved design or recognized design standard for specified style and size used for specific applications, noting the manufacturer's research report number or approved test data, head-marking, and values. The contractor should provide manufacturer data confirming the pins installed will comply with the approved design or recognized design standard.

2.2.2 Verify that the pins are fully driven and have a minimum penetration of 1/4" through the last material joined. No attempt should be made to reset under-driven pins; another pin should be installed in another location.

2.2.3 Confirm that the pins have the protective coating as specified on the approved design or recognized design standard for the project environmental conditions.

2.3 Welding: Verify that all welding was done in accordance with the approved design or recognized design standard and the "Structural Welding Code", AWS D1.1 and "Structural Welding Code Sheet Steel", AWS D1.3 for sheet steel. Welded areas should be treated with an approved treatment to retain the corrosion resistance of the welded area, as required by the approved design or recognized design standard.

2.4 Bolted Connections: Review the approved design or recognized design standard for size, type, and spacing of bolted connections. Typically, bolts should meet or exceed the requirements of ASTM A307 and should be installed with nuts and washers. Center-to-center spacing of bolts should be a minimum of three bolt diameters.

At the foundation sill track, preset anchor bolts, expansion bolts, or epoxy bolts are to be installed per manufacturer specification. Pre-drilled holes in the sill track for preset bolts should not be oversized more than 1/16" for bolt sizes up to 1/2" diameter and no more than 1/8" for bolt sizes larger than 1/2" in diameter. No burned holes are permitted.

2.5 Low Velocity Fasteners: Inspect the fastener type, spacing, and edge distance requirements for conformance to an approved design or a recognized design standard.

2.6 Other Connections: Verify that other types of connections are installed in accordance with an approved design or recognized design standard and manufacturers' recommendations.

3.0 FOUNDATION

3.1 Bearing Surfaces: Check that care has been taken to ensure that the foundation is level and free from defects beneath structural framing. If the foundation is not level, provisions should have been made to provide a uniform bearing surface with a maximum 1/4 inch gap between the bottom track or rim track and the foundation. This should be accomplished through the use of load bearing shims or grout provided between the underside of the wall bottom track or rim track and the top of the foundation wall or slab at stud or joist locations.

3.2 Ground Contact: Check that care has been taken to ensure that the framing is not in direct contact with the ground, unless specified by the *approved* design. Framing not in direct contact with the ground should be installed at a sufficient height above the ground in accordance with the local building code.

4.0 FLOOR, ROOF and CEILING FRAMING

4.1 Plumb: Floor and ceiling joists and trusses should be installed plumb and level, except where specifically designed as sloping members.

4.2 Bearing Width: Floor and ceiling joists and trusses should be installed with full bearing over the width of the bearing wall beneath, a minimum 1-1/2 inch (38 mm) bearing end, or in accordance with an approved design or recognized design standard.

4.3 Joist Stiffeners and Compression Blocking: Check that bearing stiffeners and compression

blocking conform with the approved design or recognized design standard.

4.4 Joist and Rafter Bracing: Check to ensure that joist and rafter bracing is installed in accordance with the approved design or recognized design standard. Bracing typically consists of gypsum board, structural-rated sheathing, steel strapping with blocking, or X-bracing.

4.5 Joist and Rafter Splicing: No joist or rafter splicing is permitted, unless approved by the Design Professional. Joists lapped over an interior support are not considered spliced.

4.6 Floor Cantilevers and Openings: Check that framing at floor cantilevers and openings is installed in accordance with the approved design or a recognized design standard.

4.7 Floor and Roof Trusses: Check that floor and roof trusses are installed in accordance with manufacturer recommendations.

5.0 WALL FRAMING

5.1 Stud End Bearing: Check to ensure that studs are seated tightly within the stud track. Gaps between the end of the stud and the track web should be no greater than 1/8", unless approved by the Design Professional.

5.2 Stud Alignment: Review the approved design or recognized design standard to identify if the stud wall system indicated is either "in-line" or a wall top plate distributor system" and that loads are properly transferred as appropriate to the system used.

5.2.1.1 For "In-line" framing, where the roof trusses, rafter, and floor joists are aligned over a bearing stud, the acceptable tolerance for alignment is 3/4" between the centerline of the bearing stud and centerline of the horizontal framing element, unless otherwise specified by the Design Professional.

5.2.1.2 For the "wall top plate distributor" system, check to make sure the top track is properly framed following the approved design or a recognized design standard.

5.3 Foundation Connection: Steel-framed walls should be anchored to foundations or floors in accordance with the approved design or a recognized design standard.

5.4 Stud Bracing: Check to ensure that stud bracing is installed in accordance with the approved design or recognized design standard. Bracing typically consists of gypsum board, structural-rated sheathing, steel strapping with blocking, or a combination of gypsum board or structural-rated sheathing and steel strapping with blocking.

5.5 Splicing: Studs and other structural members should not be spliced without an approved design. Track splices should be made continuous by means of splicing the track in accordance with an approved design or recognized design standard.

6.0 CURTAIN WALLS

6.1 For curtain wall framing resisting wind loads, with slip connections at the top to prevent unintended axial loads from building movement, lateral bracing of studs is required within 18 inches of the top when slip track is used.

6.2 Design thickness of the top slip track is to be calculated in accordance with AISI Standard for Cold-Formed Steel Framing—Wall Studs or an approved design.

6.3 Proprietary slip connectors may be used in place of slip track, when part of an approved design.

7.0 SHEAR WALLS

Review the approved design or a recognized design standard and identify the lateral load resisting shear wall system being used. This Guide addresses only "Sheathed" and "X-Braced" shear walls.

7.1 "Sheathed" Shear Walls: Verify that the following conforms to the approved design or a recognized design standard:

- 7.1.1 Panel sheathing type (i.e. structural-rated plywood or OSB, per current building codes, or other approved sheathing as indicated by the Design Professional as to thickness and type);
- 7.1.2 Roof diaphragm boundary to blocking fastener size and spacing;
- 7.1.3 Roof blocking to wall top track fastener size and spacing;
- 7.1.4 Panel sheathing boundary, and field fastener size and spacing;
- 7.1.5 Bottom wall track through floor diaphragm to rim track fastener size and spacing;
- 7.1.6 Floor rim track to top wall track fastener size and spacing;
- 7.1.7 Foundation track fastener type, size and spacing;
- 7.1.8 Holdown size, location, and fastener requirement.

7.2 "X-Braced" Shear Walls: Confirm that diagonal straps are installed taut and remain taut after all dead loads have been placed on the walls. Verify all track and rim track connections as detailed in section 5.1 above (as applicable).

7.3 Miscellaneous: Verify the following:

- 7.2.1 Screws or pins are driven so that the head is no more than 1/16" below surface of sheathing;
- 7.2.2 Sheathing is installed with continuous strap or other approved blocking detail at horizontal intermediate panel edges (if applicable);
- 7.2.3 Edge fasteners at multiple studs are driven into the member connected to the hold down device (if applicable);
- 7.2.4 Bottom track connection, to the foundation or structure, meets all requirements called out on the approved design or recognized design standard;
- 7.2.5 Blocking and/or shear transfer connections at the tops of the walls meet all requirements called out or detailed on the approved design or recognized design standard;
- 7.2.6 Shear wall ends have boundary studs (typically, a minimum of 2), per current code assemblies, or as required by the approved design or recognized design standard;
- 7.2.7 Where hold downs are indicated, all hold-downs are attached through the webs of (2) studs.
- 7.2.8 Where anchor bolts are used, nuts and washers are properly installed.

8.0 BUILT UP BEAMS AND HEADERS

8.1 Built-up Beam and Header Composition: Inspect built-up beams and headers to make sure they conform with the approved design or a recognized design standard. Inspect the members used to make built-up beams and headers for punchouts or other penetrations. Penetrations should be allowed only if shown on the approved design or recognized design standard, unless approved by the Design Professional.

8.2 Beam Stiffeners: Review the approved design or a recognized design standard for beam stiffener requirements. Unless otherwise noted, beams require stiffeners at the ends and at intermediate interior locations where point loads occur (i.e., girder truss bearing).

9.0 FLOOR AND ROOF TRUSSES

9.1 Truss Chord and Web Members and Panel Points: Check the approved design or recognized design standard for truss details. Pre-engineered trusses may be designed by others rather than the Design Professional, and therefore a separate set of truss design drawings may be required. Check the truss design drawings for design loads and spacings to confirm compliance with the approved design. Also, verify that they contain the approval seal of the Engineer of Record.

9.1 Truss Orientation: Check the orientation of installed trusses with particular attention to parallel chord trusses and trusses with interior bearings.

9.2 Truss-to-Wall Connections: Check that connections of truss to the top of the wall conforms with the approved design or recognized design standard.

9.3 Truss Bracing: Check that truss bracing conforms with the approved design or recognized design standard and the truss design drawings.

9.4 Truss Anchorage: Check the approved design to determine if truss hold-down connections are required. If required, the hold-down typically will attach to the truss and to the aligned stud below.

9.5 Shear Connector Blocking at Exterior Bearing Walls: Check the approved design or recognized design standard to determine if a strap, and intermediate blocking or continuous blocking, are required for the transfer of shear from the roof to wall diaphragms. If required, reference the approved design or recognized design standard for specific requirements.

References

1. AISI, *Specification for the Design of Cold-Formed Steel Structural Members*, American Iron and Steel Institute, Washington, DC.
2. AISI, *Standard for Cold -Formed Steel Framing - General Provisions*, American Iron and Steel Institute, Washington, DC.
3. AISI, *Standard for Cold -Formed Steel Framing – Wall Stud Design*, American Iron and Steel Institute, Washington, D.C.
4. AISI, *Standard for Cold -Formed Steel Framing – Floor and Roof System Design*, American Iron and Steel Institute, Washington, D.C.
5. AISI, *Standard for Cold -Formed Steel Framing – Header Design*, American Iron and Steel Institute, Washington, D.C.
6. AISI, *Standard for Cold -Formed Steel Framing – Truss Design*, American Iron and Steel Institute, Washington, D.C.
7. AISI, *Standard for Cold -Formed Steel Framing – Lateral Design*, American Iron and Steel Institute, Washington, D.C.
8. AISI, *Standard for Cold -Formed Steel Framing – Product Standard*, American Iron and Steel Institute, Washington, D.C.
9. ASTM, A1003/A1003M, *Standard Specification for Sheet Steel, Carbon, Metallic and Non-Metallic Coated for Cold-Formed Framing Members*, American Society for Testing and Materials, West Conshohocken, PA.
10. AWS, D1.1, *Structural Welding Code*, American Welding Society, Miami, FL.
11. AWS, D1.3, *Structural Welding Code-Sheet Steel*, American Welding Society, Miami, FL.

12. ICC-ES, AC 46, *"Acceptance Criteria for Steel Studs, Joists, and Track"*, International Conference of Building Officials , Whittier, CA
13. ICC-ES, AC 118, *"Acceptance Criteria for Tapping Screw Fasteners"*, International Conference of Building Officials , Whittier, CA
14. SAE, J78, *Steel Self-Drilling Tapping Screws*, Society of Automotive Engineers, Warrendale, PA.