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COLD-FORMED STEEL ENGINEERS INSTITUTE

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TECHNICAL NOTE

On Cold-Formed Steel Construction

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GUIDELINES FOR INSPECTING COLD-FORMED STEEL STRUCTURAL FRAMING IN LOW RISE BUILDINGS

This Technical Note updates and replaces LGSEA Technical Notes 1010b and 1010c

Summary: The purpose of this document is to provide guidance for inspecting cold-formed steel structural framing in buildings not greater than 3 stories in height.

Disclaimer: Designs cited herein are not intended to preclude the use of other materials, assemblies, structures or designs when these other designs demonstrate equivalent performance for the intended use; CFSEI documents are not

Limitations of this Document

1. These guidelines are limited to repetitive framing; i.e., conventional framing practices with stud, joist and truss framing spaced at a maximum 24" on-center and located within the building envelope in buildings not greater than 3 stories in height.
2. These guidelines should only be used as an aid to inspecting structural cold-formed steel framing as defined by the *Code of Standard Practice for Cold-Formed Steel Structural Framing* (AISI S202-11).
3. For specific details, refer to the approved design or approved design standard.

General Requirements

1. All construction should conform to an approved design or approved design standard.
2. All variations from the approved design or approved design standard should be approved by the Design Professional.
3. Should there be a conflict between the information in these guidelines (Tech Note G500) and the approved design or approved design standard, the approved design or approved 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 guidelines below are not satisfied, the contractor should correct the item or have it approved by the Design Professional or Authority Having Jurisdiction.

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 − An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the state, province or territory in which the project is to be constructed.
3. Approved − Approved by a building official or Design Professional.
4. Cold-Formed Steel − Sheet steel or strip steel that is manufactured by (1) press braking blanks sheared from sheets or cut length of coils or plates, or by (2) continuous roll forming of cold- or hot-rolled coils of sheet steel; both forming operations are performed at ambient room temperature, that is, without any addition of heat such as would be required for hot forming.
5. Contractor − The individual or organization that is contracted to assume full responsibility for the construction of the structure.
6. Cold-Formed Steel Structural Framing − The elements of the structural frame, as given in Section B1 of the *Code of Standard Practice for Cold-Formed Steel Structural Framing* (AISI S202-11).

1.0 Materials

1.1 Steel Verification: Confirm that the cold-formed steel structural members being installed match the 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 indicating the steel designation thickness, protective coating designator, minimum yield strength , 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 an approved design standard.

1.1.3 The minimum metallic coating weight requirements of structural members should be CP60, which includes G60, A60, AZ50, GF30 per AISI S200, unless another coating weight is specified in the approved design or a approved design standard for the project environmental conditions.

1**.2 Member Condition:** Verify that framing members are not damaged. Damaged members must be replaced or repaired in accordance with an approved design or approved design standard, unless approved by the Design Professional.

1.3 Web Holes: Confirm that factory punchouts or field penetrations conform with the approved design or a approved design standard. 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 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 approved 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 shown in the approved design or approved design standard or approved by the Design Professional.

2.0 Connections

2.1 Screw Connections:

2.1.1 Review the approved design or approved design standard for specified screw style, size and finish used for specific applications. Confirm that the screws installed comply with the approved design or approved design standard. Verify that the screws satisfy shear and 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 may be permitted provided that the minimum center-to-center spacing and edge distance requirements are met.

2.1.2 Inspect steel-to-steel and structural sheathing-to-steel screws to ensure they extend through the steel connection a minimum penetration of three (3) exposed 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 missing screw heads. (These may indicate improper installation methods, tool, screw type, or quality of screw.) Screws with missing heads should be considered ineffective and replaced.

2.1.5 Check for stripped screws (i.e., screws that turn freely). Stripped screw fasteners in direct tension shall 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 for stripped screws to be removed and replaced with screws of the next larger diameter.

2.1.6 Check that screw spacing and edge distance requirements are met. For screw fasteners in steel-to-steel connections to be considered fully effective, the minimum center-to-center spacing and edge distance should be three (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. If the minimum center-to-center spacing is less than three (3) but greater than two (2) times the nominal diameter, it is acceptable for the installer to add one (1) additional screw for every four (4) screws required by the approved design or approved design standard. (Screws are 80 percent effective when the center-to-center spacing is two (2) times the nominal diameter.) (Figure 1 & Table 1) For screws in sheathing-to-steel connections, the minimum center-to-center and edge distance requirements of the sheathing need to be met.

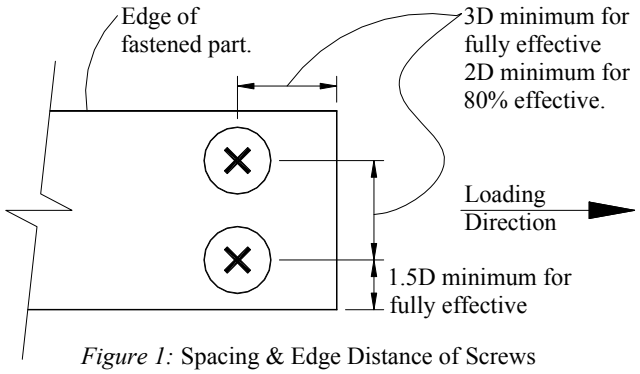


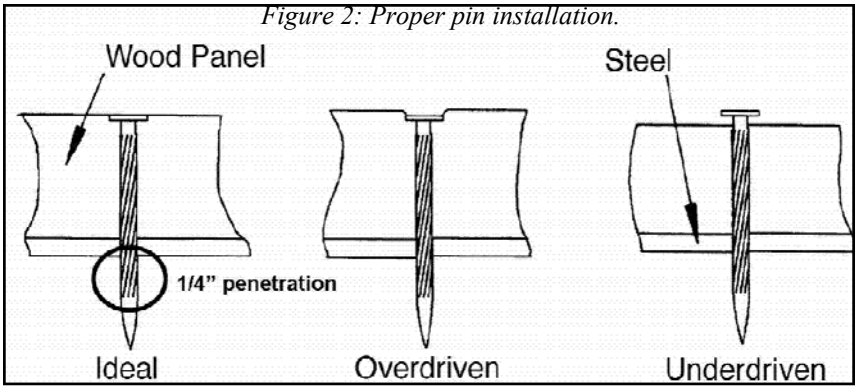
Figure 1: Spacing & Edge Distance of Screws

Table 1 **Minimum Screw Spacing & Edge Distance (inches)[1,2]**

Nominal Screw Size	Diameter	3 x dia.	2 x dia.	1.5 x dia.
#6	0.138	13/32	9/32	7/32
#8	0.164	1/2	5/16	1/4
#10	0.190	9/16	3/8	9/32
#12	0.216	21/32	7/16	5/16
1/4" or #14	0.250	3/4	1/2	3/8

[1] Spacing and edge distance are measured from center of screw.
[2] Values are rounded to nearest 1/32 of an inch.

Figure 2: Proper pin installation.



2.2 Pneumatically Driven Pins:
2.2.1 Review the approved design or recognized design standard for specified style, size and finish used for specific applications, noting the manufacturer's research report number or approved test data, head-marking, and values. Confirm that the pins installed comply with the approved design or approved design standard.
2.2.2 Verify that the pins are fully driven, as shown in Figure 2, 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.

2.3 Welding: Verify that all welding was done in accordance with the approved design or approved design standard and the "Structural Welding Code," AWS D1.1 and "Structural Welding Code Sheet Steel," AWS D1.3 for sheet steel, as applicable. 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 approved design standard.

2.4 Bolted Connections: Review the approved design or approved design standard for size, type and spacing of bolted connections. Bolts should meet or exceed the requirements of ASTM A307 and should be installed with nuts and washers, unless specified otherwise in an approved design or approved design standard. Center-to-center spacing of bolts should be a minimum of three (3) bolt diameters. At the foundation sill track, preset anchor bolts, expansion bolts, or epoxy bolts are to be installed per the manufacturer's 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 unless shown in the approved design or approved design standard or approved by the Design Professional. 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 approved design standard.

2.6 Other Connections: Verify that other types of connections are installed in accordance with an approved design or approved 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 load bearing walls. If the foundation is not level, provisions should have been made to provide a uniform bearing surface with a maximum 1/4"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 an approved design. Framing not in direct contact with the ground should be installed at a height above the ground in accordance with the applicable building code.

4.0 Floor, Roof and Ceiling Framing

4.1 Plumbness: 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" (38 mm) bearing end, or in accordance with an approved design or approved design standard.

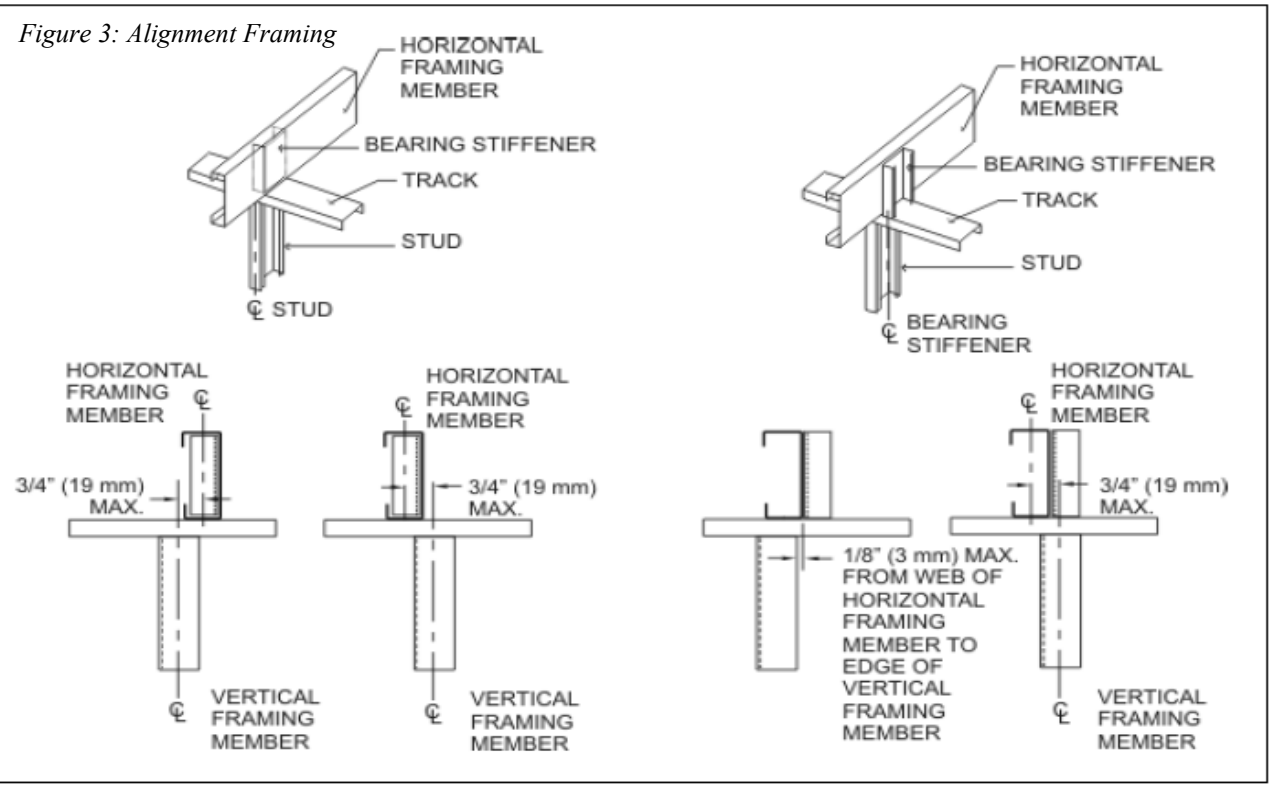
4.3 Joist Stiffeners and Compression Blocking: Check that bearing stiffeners and compression blocking conform to the approved design or approved design standard.

4.4 Joist and Rafter Bracing: Check to ensure that joist and rafter bracing is installed in accordance with the approved design or approved 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 approved design standard.

Figure 3: Alignment Framing



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

5.0 Wall Framing

5.1 Stud End Bearing: Check to ensure that studs have square end cuts and are seated tight against the stud track. For axial load bearing applications, gaps between the end of the stud and the track web should be no greater than 1/8", unless approved by the Design Professional. For curtain wall applications gaps between the end of the stud and the track web shall be no greater than 1/4".

5.2 Stud Alignment: Review the approved design or approved 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 For "in-line" framing, where the roof trusses, rafter, and floor joists are aligned over a bearing stud, the acceptable tolerance for alignment is defined by Figure 3, unless otherwise specified by the Design Professional.
5.2.2 For the "wall top plate distributor" system, check to make sure the top track is properly framed following the approved design or a approved design standard.

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

5.4 Stud Bracing: Check to ensure that stud bracing is installed in accordance with the approved design or approved 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 approved design standard.

6.0 Shear Walls

Review the approved design or a approved design standard and identify the lateral load resisting shear wall system being used. These guidelines (TN G500) addresses only "Sheathed" and "X-Braced" shear walls.

6.1 "Sheathed" Shear Walls: Verify that the following conforms to the approved design or an approved design standard:
6.1.1 Panel sheathing type (i.e. structural-rated plywood or oriented strand board (OSB), per current building codes, or other approved sheathing as indicated by the Design Professional as to thickness and type);
6.1.2 Roof diaphragm boundary to blocking fastener size and spacing;
6.1.3 Roof blocking to wall top track fastener size and spacing;

6.1.4 Panel sheathing boundary, and field fastener size and spacing;
6.1.5 Bottom wall track through floor diaphragm to rim track fastener size and spacing;
6.1.6 Floor rim track to top wall track fastener size and spacing;
6.1.7 Foundation track fastener type, size and spacing;
6.1.8 Hold-down size, location, and fastener requirement.

6.2 "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).

6.3 Miscellaneous: Verify the following:
6.3.1 Screws or pins are driven so that the head is no more than 1/16" below surface of sheathing;
6.3.2 Sheathing is installed with continuous strap or other approved blocking detail at horizontal intermediate panel edges (if applicable);
6.3.3 Edge fasteners at multiple studs are driven into the member connected to the hold-down device (if applicable);
6.3.4 Bottom track connection, to the foundation or structure, meets all requirements called out on the approved design or recognized design standard;
6.3.5 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;
6.3.6 Shear wall ends have boundary studs (typically, a minimum of two), per current code assemblies, or as required by the approved design or recognized design standard;
6.3.7 Where hold-downs are indicated, all hold-downs are attached through the webs of (2) studs, unless there is only a single boundary stud required by the approved design or approved design standard.
6.3.8 Where anchor bolts are used, nuts and washers are properly installed.

7.0 Built-up Beams and Headers

7.1 Built-up Beam and Header Composition: Inspect built-up beams and headers to make sure they conform to the approved design or an approved 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 approved design standard, unless approved by the Design Professional.

7.2 Beam Stiffeners: Review the approved design or approved 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).

8.0 Floor and Roof Trusses

8.1 Truss Chord and Web Members and Panel Points: Check the approved design or approved design standard for truss details. Pre-engineered trusses may be designed by others (e.g. Specialty Designer) 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 truss spacing to confirm compliance with the approved design. Also, verify that the drawings contain the approval seal of the Specialty Designer for the truss.

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

8.3 Truss-to-Wall Connections: Check that connections of trusses to the top of the wall conform to the approved design or approved design standard.

8.4 Truss Bracing: Check that truss bracing conforms to the approved design or approved design standard and the truss design drawings.

8.5 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.

8.6 Shear Connector Blocking at Exterior Bearing Walls: Check the approved design or approved 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 approved design standard for specific requirements.

Useful Reference Documents

1. AISI S100, *North American Specification for the Design of Cold-Formed Steel Structural Members*, American Iron and Steel Institute, Washington, DC.
2. AISI S200, *North American Standard for Cold-Formed Steel Framing - General Provisions*, American Iron and Steel Institute, Washington, DC.
3. AISI S201. *North American Standard for Cold-Formed Steel Framing - Product Data*, American Iron and Steel Institute, Washington, DC.
4. AISI S202, *Code of Standard Practice for Cold-Formed Steel Structural Framing*, American Iron and Steel Institute, Washington, DC.
5. AISI S210, *North American Standard for Cold-Formed Steel Framing - Floor and Roof System Design*, American Iron and Steel Institute, Washington, DC.
6. AISI S211, *North American Standard for Cold-Formed Steel Framing - Wall Stud Design*, American Iron and Steel Institute, Washington, DC.
7. AISI S212, *North American Standard for Cold - Formed Steel Framing - Header Design*, American Iron and Steel Institute, Washington, DC.
8. AISI S213, *North American Standard for Cold-Formed Steel Framing - Lateral Design*, American Iron and Steel Institute, Washington, DC.
9. AISI S214, *North American Standard for Cold - Formed Steel Framing − Truss Design*, American Iron and Steel Institute, Washington, DC.
10. AISI S230, *Standard for Cold -Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings*, American Iron and Steel Institute, Washington, DC.
11. ASTM A307, *Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength*, ASTM International, West Conshohocken, PA
12. ASTM A1003/A1003M, *Standard Specification for Sheet Steel, Carbon, Metallic and Non-Metallic Coated for Cold-Formed Framing Members*, ASTM International, West Conshohocken, PA
13. ASTM C1513, *Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections*, ASTM International, West Conshohocken, PA
14. AWS, D1.1, *Structural Welding Code*, American Welding Society, Miami, FL
15. AWS, D1.3, *Structural Welding Code − Sheet Steel*, American Welding Society, Miami, FL
16. ICC-ES, AC 46, *Acceptance Criteria for Steel Studs, Joists, and Track*, International Code Council Evaluation Service, Whittier, CA
17. ICC-ES, AC 118, *Acceptance Criteria for Tapping Screw Fasteners*, International Code Council Evaluation Service, Whittier, CA

Technical Review and updating for Revised Edition:
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