

ICC Evaluation Service, Inc.
www.icc-es.org

Business/Regional Office ■ 5360 Workman Mill Road, Whittier, California 90601 ■ (562) 699-0543
Regional Office ■ 900 Montclair Road, Suite A, Birmingham, Alabama 35213 ■ (205) 599-9800
Regional Office ■ 4051 West Flossmoor Road, Country Club Hills, Illinois 60478 ■ (708) 799-2305

DIVISION: 05—METALS
Section: 05120—Structural Steel

REPORT HOLDER:

SIDEPLATE SYSTEMS, INC.
23332 MILL CREEK DRIVE, SUITE 205
LAGUNA HILLS, CALIFORNIA 92653
(800) 475-2077
www.sideplate.com
solutions@sideplate.com

EVALUATION SUBJECT:

SIDEPLATE® STEEL FRAME CONNECTION TECHNOLOGY

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2006 *International Building Code*® (IBC)
- 1997 *Uniform Building Code*™ (UBC)

Properties evaluated:

Structural design

2.0 USES

SidePlate® Steel Frame Connections are used for beam-to-column moment connections in steel moment frame designs.

3.0 DESCRIPTION

3.1 General:

SidePlate® Steel Frame Connection Technology provides beam-to-column moment connections for use in Special Moment Frame (SMF) and Intermediate Moment Frame (IMF) systems. This connection system satisfies all applicable requirements under the IBC and the UBC, and ANSI/AISC 341-05, including Section 9, Section 10, and Appendix P. The system also meets the prequalification requirements under Sections 3.1 and 3.4 of the ICC-ES Acceptance Criteria for Steel Moment Frame Connection Systems (AC129), for both new and retrofit construction applications. The connection system is constructed of all welded fabrication, and features a physical separation, or “gap”, between the face of the column flange and the end of the beam, by means of parallel full-depth side plates which sandwich and connect the beam(s) and the column together. Top and bottom beam flange cover plates are used, as necessary, to bridge any difference between flange widths of the beam(s) and of the column. Vertical and horizontal shear plates, as applicable, are provided at the beam and column webs, respectively. Illustrative details are provided in Figure 1 and 2.

3.2 Materials:

3.2.1 Structural Shapes: Structural steel shapes include wide flange shapes conforming to ASTM A 6/A 6M-04a, tube shapes conforming to ASTM A 500-03a, and built-up I-shape or box sections conforming to Chapter 22 of the IBC and UBC.

3.2.2 Plates: The steel plates must be fabricated from structural steel that complies with ASTM A 36/A 36M-04 or ASTM A 572/A 572M-04, Grade 50, including supplementary requirements.

3.2.3 Welds: All welds shall be produced using E70 electrodes. Weld filler metal and associated welding processes for all welds shall comply with one of the following:

- E71T-8, E70T-6, or E70TG-K2 for flux-cored arc welding (FCAW)
- E7XT-9 for flux-cored arc welding with gas shielding (FCAW-G)
- E7018 stick electrodes for shielded metal arc welding (SMAW)
- F7A2-EXXX for submerged arc welding (SAW)
- E70S-X, E70C-XM or E70C-XC for Gas Metal Arc Welding (GMAW), except for the short circuit transfer process.

All weld filler metal shall comply with Charpy V-Notch (CVN) toughness requirements set forth in Section 7.3, Appendix W and Appendix X of AISC 341 .

4.0 DESIGN AND INSTALLATION

4.1 Structural Design:

The structural design procedures shall be in accordance with Chapters 16 and 22 of the IBC or UBC as Load and Resistance Factor or Allowable Stress Design. In addition, compliance with the American Welding Society Structural Welding Code—Steel (ANSI/AWS D1.1:2004), Section 2, is required. The design shall also take into account Sections 4.1.1 through 4.1.6 of this report.

4.1.1 Plastic Hinge Location: For calculation purposes, the plastic hinge location in the beam or girder shall be located at least one-third of the beam or girder depth beyond the end of the side plate.

4.1.2 Protected Zone: The protected zone at the end of each beam extends from the end of the sideplates to the plastic hinge location to a point one-half the beam depth beyond the plastic hinge location.

4.1.3 Plastic Moment Capacity: Plastic moment capacity at the plastic hinge location, which includes the effects of strain hardening, shall be calculated as follows:

$$M_{pb}^* = 1.1 R_y F_{yb} Z_b$$

where:

- M_{pb}^* = Plastic Moment Capacity (lb-in. or N-m).
 R_y = Adjustment coefficient for material over-strength, per Table I-6-1 of ANSI/AISC 341-05.
 F_{yb} = Specified minimum yield strength of the beam (psi or Pa).
 Z_b = Plastic modulus of the beam section (in.³ or m³).

4.1.4 Shear at Plastic Hinge: The shear at the plastic hinge shall be determined by calculation, applying statics that consider gravity loads acting on the beam and the plastic moment capacity at the hinge.

4.1.5 Strength Demands at the Critical Sections: Strength demands at the critical load transfer locations through the SidePlate[®] Steel Frame beam-to-column connection and column are determined by superimposing M_{pb}^* at the known hinge location, and then ramping up the moment demand at each critical section.

4.1.6 Strong-column, Weak-beam Condition Analysis: The strong-column, weak-beam condition shall be satisfied by applying the following equation:

$$\sum Z_c (F_{yc} - P_u/A_g) / \sum M_c > 1.0$$

where:

- F_{yc} = The minimum specified yield strength of the column at the connection (psi or Pa).
 P_u/A_g = Ratio of column axial compressive strength to gross area of the column (psi or Pa).
 $\sum M_c$ = The sum of the moments in the column at a distance of $1/4$ the column depth from the top and bottom edge of the side plate, based on the occurrence of M_{pb}^* in each beam framing into connection (lb.-in. or N-m).
 $\sum Z_c$ = The sum of the plastic modulus of the column section above and below the connection (in.³ or m³).

4.1.7 Column Panel Zone Shear Strength: The column panel zone shear strengths need not be calculated for the SidePlate[®] moment connection system, since SidePlate[®] connection technology design inherently provides three panel zones (i.e., two side plates plus the column web). Therefore, the configuration of the SidePlate[®] connection system satisfies the requirements for checking panel zone strength, found in Section 9.3 (Part I) of ANSI/AISC 341-05.

4.1.8 Section Properties: Section properties of the SidePlate[®] connection system shall be determined and used in the frame analysis.

4.2 Fabrication:

All components of the SidePlate[®] connection system shall be fabricated by an approved fabricator. The approved fabricator shall comply with Section 1704.2.2 of the IBC or Section 1701.7 of the UBC. When approved by the registered design professional and the code official, field fabrication may be permitted with special inspections complying with Section 1704 of the IBC or Section 1701.6 of the UBC. Welding must be in accordance with Section 7.3 and Appendix W of AISC 341. Weld runoff tabs shall not be used for fillet and flare bevel welds. The start and stop of fillet and flare bevel welds shall be accomplished by stepped stringer passes, to provide a sloped weld-end profile.

A Welding Procedure Specification (WPS), prepared in accordance with Section 4 of AWS D1.1:2004 or Section 1704.3.1, Table 1704.3 and Section 1708.4 of the IBC, or Section 1701.5.5 of the UBC, shall be developed for every welding position, welding process, electrode manufacturer, filler metal trade name for the electrode type selected; and for all essential variable changes in the Procedure Qualification Record (PQR) that exceed allowable tolerances. Each WPS shall be qualified by a documented PQR in accordance with Section 4 of AWS D1.1:2004. Alternatively, a prequalified WPS may be used, provided the WPS complies with all the conditions of prequalification articulated in Section 3, AWS D1.1:2004, for prequalified fillet and CJP welds.

4.3 Erection:

Erection shall be in conformance with the Code of Standard Practice for Steel Buildings and Bridges, Section 7, published by the American Institute of Steel Construction, effective March 18, 2005, and shall be consistent with the requirements noted in Chapter 22 of the IBC or of the UBC for Load and Resistance Factor Design or Allowable Stress Design. For new construction of the SidePlate[®] system, shop-fabricated column trees shall be field-erected and joined to drop-in link beams (as necessary) that are spliced at each end to beam stubs extending from the column trees, using either (1) a welded web and flange full-penetration butt joint splice; (2) an end plate bolted splice; or (3) a bolted web with either fillet-welded or bolted flange splice plates.

The design shall consider the anticipated connection demand, which may vary depending on design criteria based on seismic or wind. The selection is subject to approval by the code official. For retrofit construction of the SidePlate[®] system to upgrade existing traditional beam-to-column moment connection systems, each side plate shall be configured with an initial opening to permit field-welding access, while the cut-out pieces of plate are saved for use as closure plates to close the access window after welding is completed. The existing full-penetration welds that join beam flanges to column flange shall be removed. The existing shear tab connecting the web of the beam(s) to the column may be left in place. Existing continuity plates, if any, may be left in place to act as horizontal shear plates.

4.4 Quality Assurance:

A plan for quality assurance conforming to Sections 1705 and 1706 of the IBC shall be included in the structural design prepared by a registered design professional.

Special inspection for steel construction shall conform to Sections 1704.2, 1704.3 and 1707.2 of the IBC, or UBC Sections 1701.5.5 and 1703, and Part 1, Section 18 and Appendix Q of ANSI/AISC 341-05, and shall be included in the quality assurance plan. Special inspection shall verify compliance of steel with specifications, steel identification, qualification of welders, use of appropriate welding materials, storage conditions for welding materials, welded joint preparations, conformance of welding procedures with applicable AWS D1.1:2004 requirements, and fabrication tolerances. In Seismic Design Categories C, D, E and F (IBC) or Zones 3 and 4 (UBC), visual inspection and nondestructive testing (NDT) in accordance with Section 1708.4 of the IBC, Section 1703 of the UBC, or Section 4.8.2 of AWS D1.1:2004 shall be performed. A visual inspection and testing program shall be established by the registered design professional and shall include the following items, at a minimum:

- Visual inspection of the welds between the full-depth side plates and column flange tips.
- Ultrasonic testing of complete penetration butt joint welds (as applicable) contained in the splice between link beam

and column tree beam stub. Testing rates for individual welders may be reduced per Section 1703 of the UBC, as permitted by Section 1708.4 of the IBC.

- c. Qualification of NDT personnel, and compliance with AWS D1.1:2004 Section 6.14.6 and ASTM E 164-97, as appropriate.

5.0 CONDITIONS OF USE

The SidePlate® Steel Frame Connection Technology described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 Connection design shall be in accordance with this report and the applicable code, and shall be prepared by a registered design professional of SidePlate Systems, Inc.
- 5.2 Structural design drawings and specifications, shop drawings, and erection drawings must comply with Section 5 of AISC 341.
- 5.3 Fabrication shall comply with Section 4.1 of this report and the “SidePlate® Notes” (as specified by SidePlate Systems, Inc., on the construction documents), and shall either be done by a fabricator approved by the building official, as set forth in Section 1704.2.2 of the IBC or Section 1701.7 of the UBC, or shall be under special inspection as set forth in Section 1704 of the IBC or Section 1701.6 of the UBC.
- 5.4 Erection shall be in accordance with Section 4.2 of this report and the “SidePlate® Notes” (as specified by SidePlate Systems, Inc., on the construction documents).
- 5.5 Quality assurance shall be provided in accordance with Section 4.4 of this report.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Steel Moment Frame Connection Systems (AC129), dated March 1, 2004 (editorially revised February 2008).

7.0 IDENTIFICATION

On each sheet of shop detail drawings that contains SidePlate® technical information showing, in any way, the SidePlate® connection concept, a “Notice of Proprietary Information” shall be affixed before release of such information for its intended use. Such notice shall be provided to the contractor’s fabrication subcontractor by SidePlate Systems, Inc., in a format suitable to the needs of the fabrication subcontractor’s detailer.

Before shipping the column tree assembly for new construction, or the loose side plates with cut-out pieces for retrofit construction, the fabricator shall paint the word “SidePlate®” on the outside face of selected side plates, in the color white, using a stencil provided by SidePlate Systems, Inc. The stenciled word shall be located in a portion of the side plate that precludes its being obstructed by peripheral hardware or framing. The stencil locations shall be shown on the shop drawings of affected piece marks, and may be limited to only four steel frame lines in the building, one of each of the four being the nearest to the north, south, east and west faces of the building. The stencil locations shall be coordinated with SidePlate Systems, Inc., and will typically be spaced at every other floor and every other column within the moment frame. The side plate selected for stenciling at any designated connection location shall face the exterior of the building.

An adhesive-backed SidePlate® patent label, provided by SidePlate Systems, Inc., shall be applied on the outside face of one of the two side plates of each moment connection, near the bottom edge of the plate.

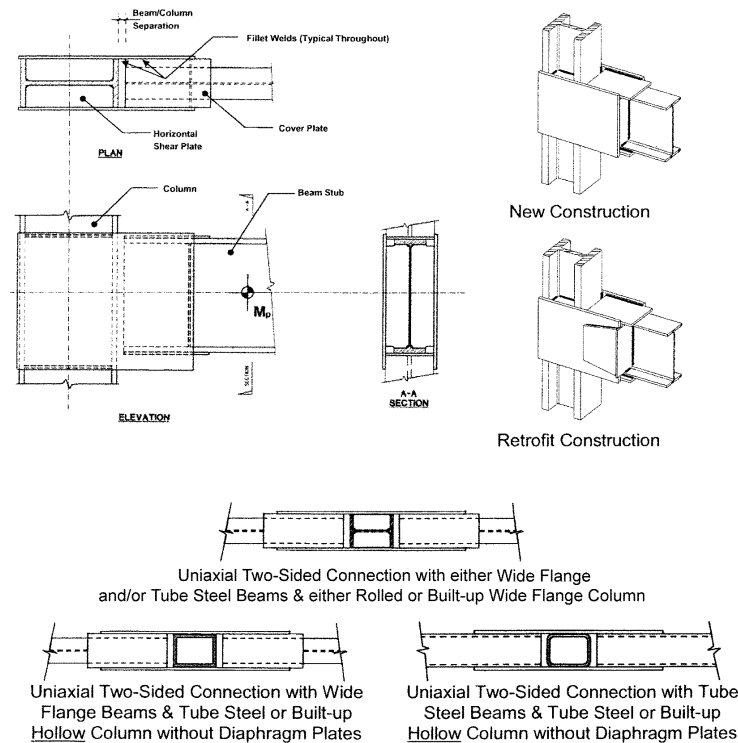
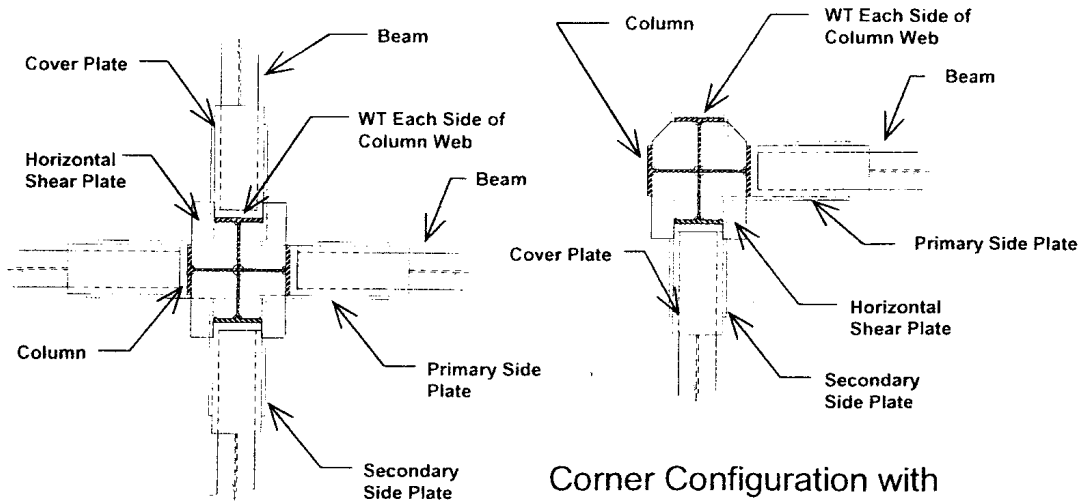
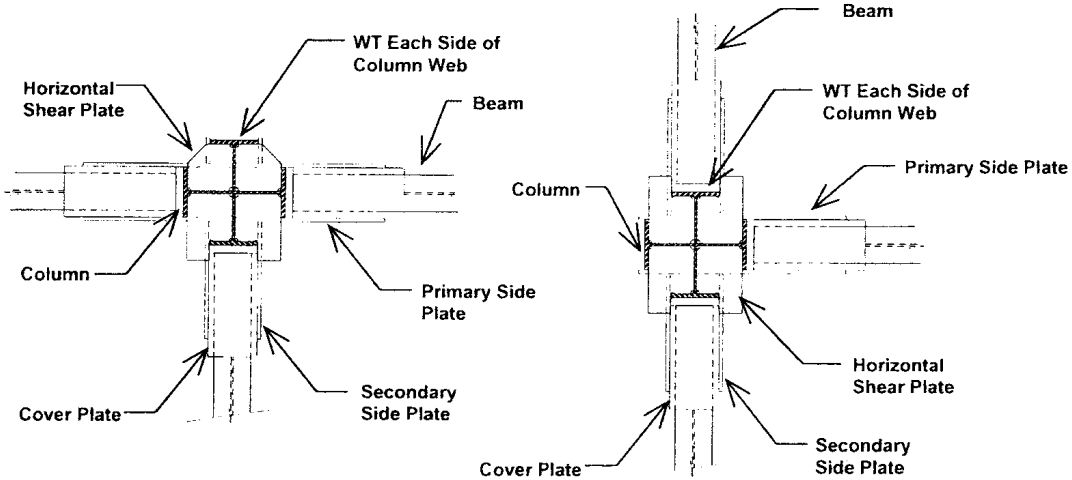


FIGURE 1—SIDEPLATE® BASIC UNIAXIAL CONFIGURATION



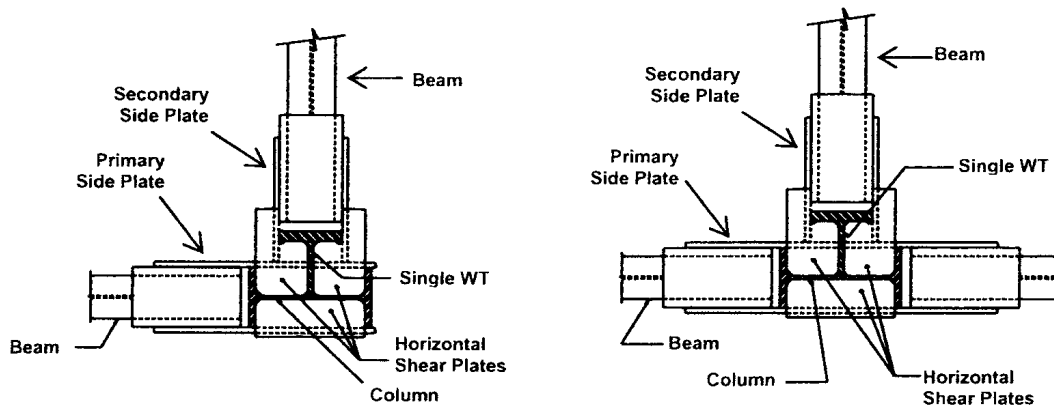
Full Dual Strong Axes Configuration

Corner Configuration with Double WT



"T" Configuration with Double WT (primary)

"T" Configuration with Double WT (secondary)



Corner Configuration with Single WT

"T" Configuration with Single WT

FIGURE 2—SIDEPLATE® BIAXIAL DUAL STRONG AXIS CONFIGURATIONS