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CFSEI
COLD-FORMED STEEL ENGINEERS INSTITUTE

TECHNICAL NOTE

On Cold-Formed Steel Construction

1201 15th Street, NW, Suite 320 Washington, DC 20005 (202) 785-2022

Common Design Issues for Deflection Track

Summary: When cold-formed steel studs are used on exterior walls between spandrel beams or floor slabs to create the exterior envelope of the building, a deflection track is often required at the top of the wall to allow for the roof or floor above to deflect without transferring axial load to the studs. This Technical Note explores two methods for deflection track usage.

Disclaimer: Designs cited herein are not intended to preclude the use of other materials, assemblies, structures or designs when these other designs and materials demonstrate equivalent performance for the intended use; CFSEI documents are not intended to exclude the use and implementation of any other design or construction technique.

INTRODUCTION

When cold-formed steel studs are used on exterior walls between spandrel beams or floor slabs to create the exterior envelope of the building, a deflection track is often required at the top of the wall to allow for the roof or floor above to deflect without transferring axial load to the studs. Proprietary products such as slotted track or deflection clips may be used. Follow manufacture's published design values and installation recommendations when using these products. However the following two methods are covered in this tech note:

1. Deflection track is constructed with a single, long leg track, a gap is left between the wall stud and the track web, and a row of bracing is placed close to the end of the member to restrain the stud from lateral movement and twisting under lateral loading.

2. Deflection track is constructed with two tracks, the upper "over" track is an oversized track with long legs, and the lower track is a standard track with legs long enough, typically 1" longer than the over track to allow clearance for the screw heads. The lower track is fastened to the studs with low profile screws or other suitable connectors at each flange and a gap is left between the lower and upper track. The tracks are not attached to each other. Bracing is not required for the studs because the lower track is attached to each flange and braces the stud against rotation.

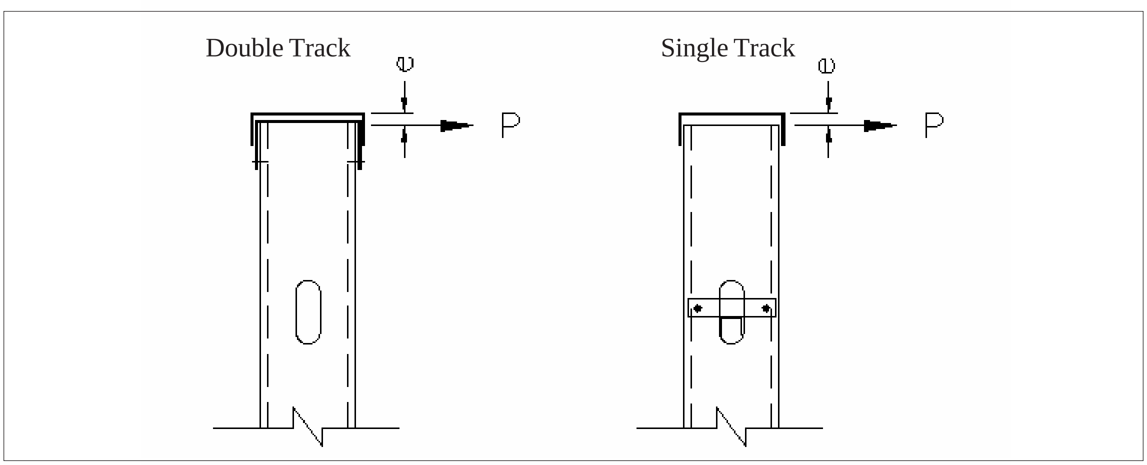

FIGURE 1

COMMON DESIGN ISSUES WITH DEFLECTION TRACK

1. Anchorage - Design the fasteners to structure for direct shear from the stud reaction and for indirect tension due to the eccentricity of the load. See Figure 2.

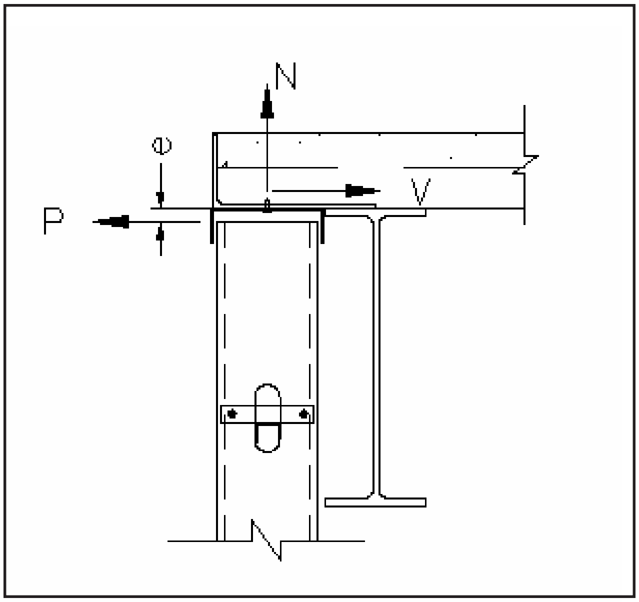

FIGURE 2

2. Issue of overhang of the structure - Limit the outward and upward deflection to 1/8" for serviceability and prevent stud from disengaging. Design the fasteners to the structure for direct shear from the stud reaction and for indirect tension due to the eccentricity of the load and the pivot point of the track. See figure 3.

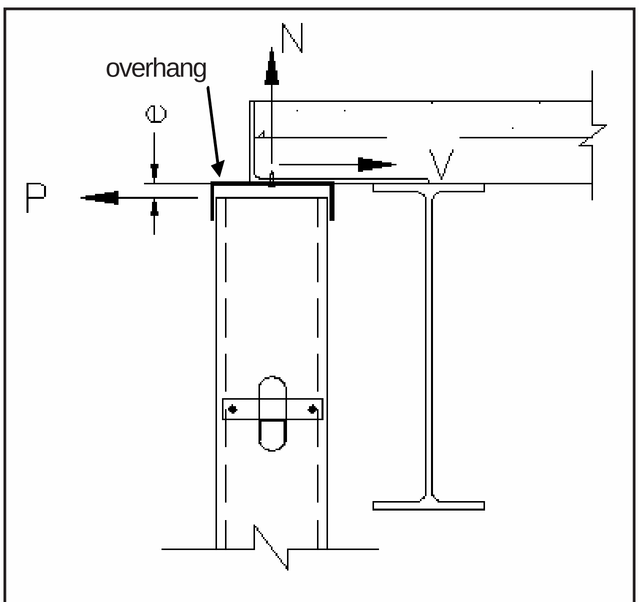

FIGURE 3

3. Detail of Almost Bypass with beam infill. Where wall stud overhangs the primary structure excessively, use infill studs to support the deflection track. See Figure 4.

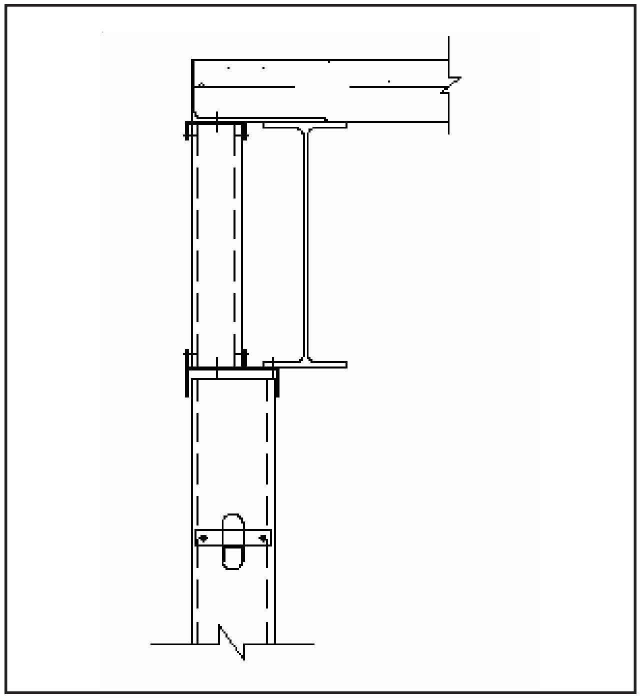

FIGURE 4

4. Reinforcing blocking at jamb locations - Use stud blocks to stiffen the deflection track, see Figure 5. in this case both track legs are resisting the load provided the screws can transfer the load to the other leg. If enough screws are used the capacity may be doubled as compared to deflection track without reinforcement.

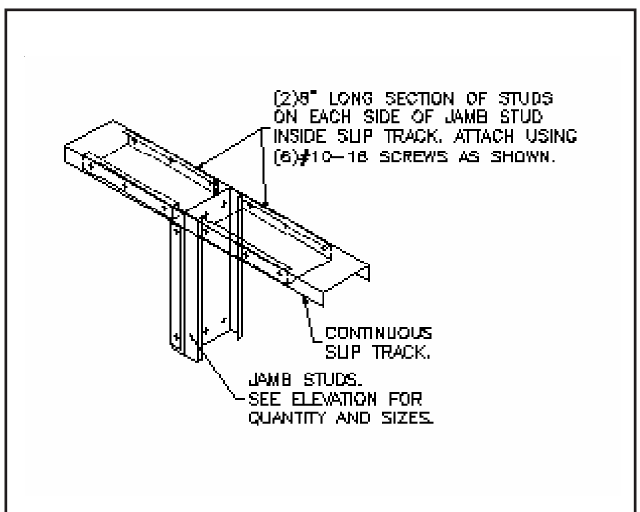

FIGURE 5

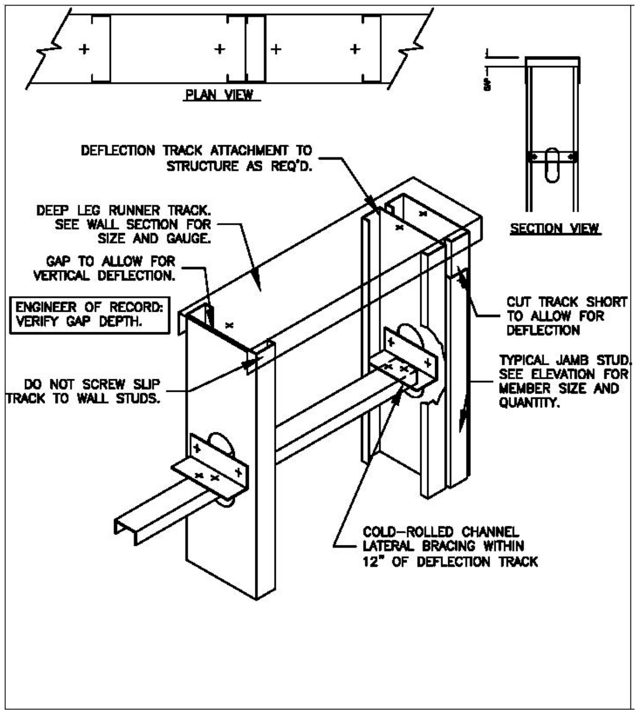

FIGURE 6A: CRC BRACING AT SLIP TRACK

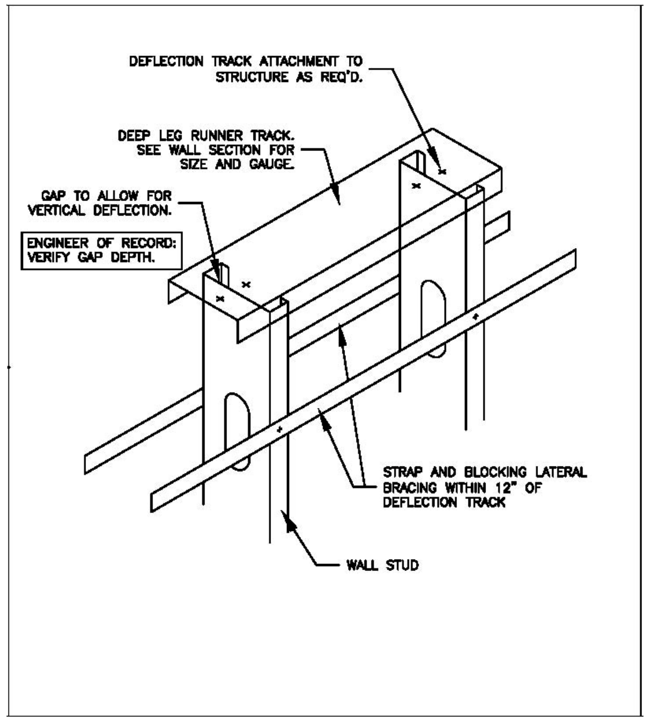

FIGURE 6B: FLAT STRAP BRACING AT SLIP TRACK

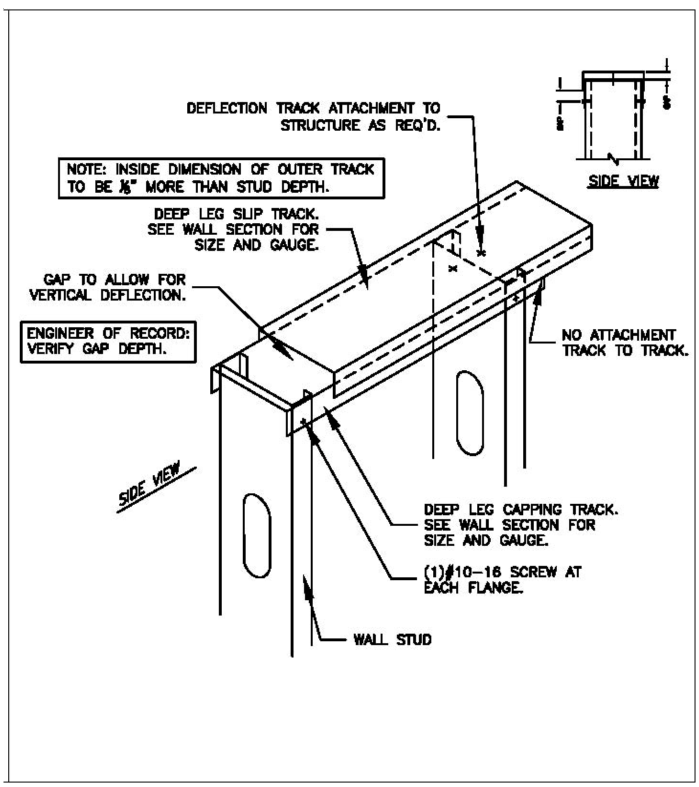

FIGURE 6C: DOUBLE SLIP TRACK

5. Rotation - The wall studs must be restrained against rotation within 18" of the deflection track. For single track design, this is accomplished with the use of mechanical bracing (cold-rolled channel, flat strap, etc.). For double track design, the wall studs are braced by the inside track which is attached to the wall stud flanges. See Figure 6.

6. Proprietary products - Slotted slip track allows the deflection track to be attached directly to the wall stud. Rotational bracing of the wall studs is accomplished by the screw attachment. See Figure 7.

7. Track Splice - Locate first wall stud at least one half the effective track length, w_{dt}, from end of deflection track.

8. Corner Detail - Special attention must be given to the corner detail where the studs are located at the end of the track. Reduce the capacity of the deflection track by at least 50%. See Figure 9.

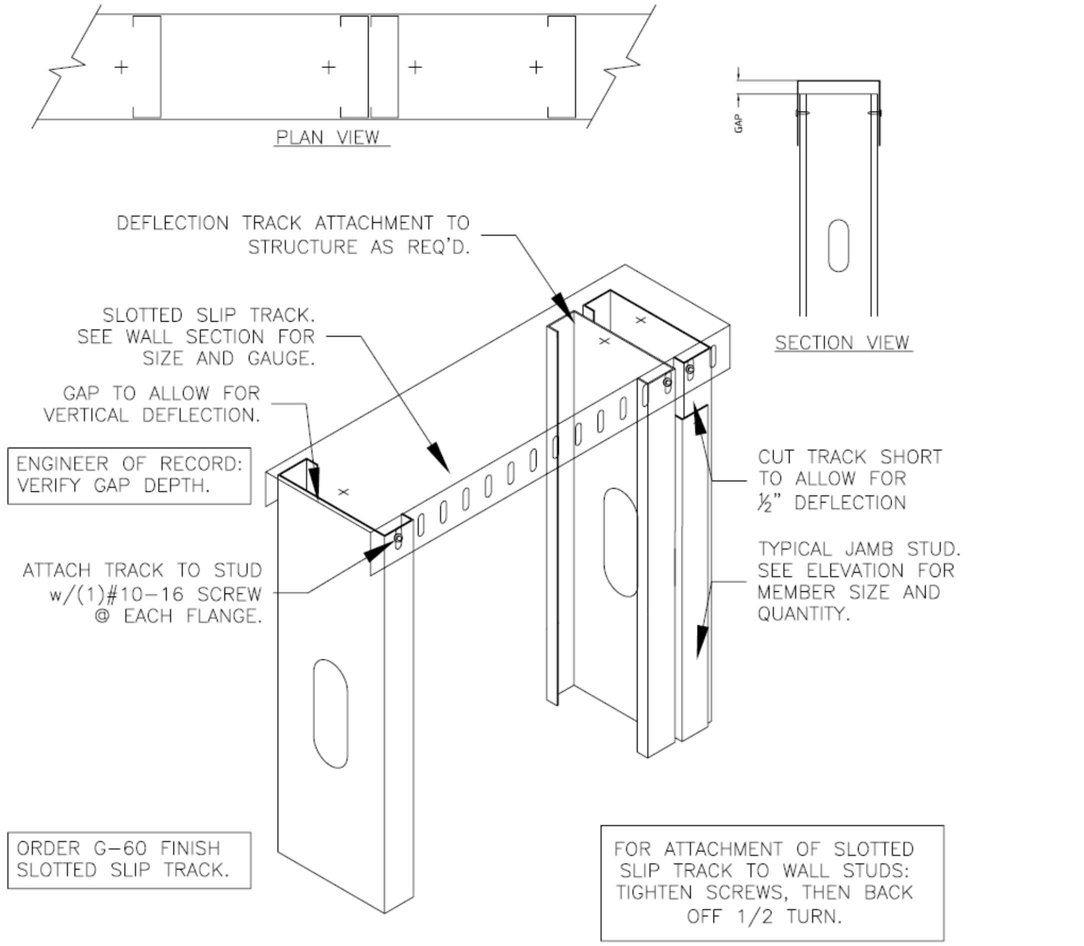

FIGURE 7

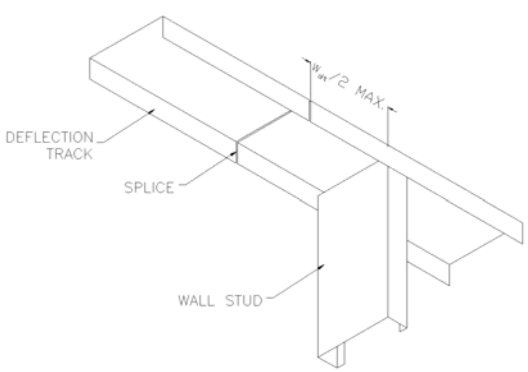

FIGURE 8

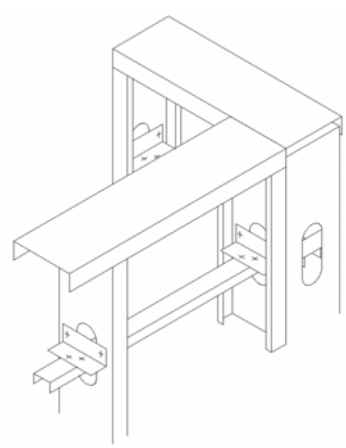

FIGURE 9

REQUIRED GAP & TRACK LEG LENGTH

Studs with a deflection track are generally subjected to lateral or wind loads only. In order to prevent any transfer of axial load between the structure and the stud, a gap is placed between the web of the deflection track and the top of the stud. This gap must allow for construction tolerances, material tolerances, in addition it must provide for upward and downward movement of the structure. Upward movement may occur when the structure experiences uplift pressure, especially in the roof, or from unbalanced loading of the floor. Studs are attached to structural elements which are subjected to live load deflection, typically limited to L/360. For a 30 foot span the vertical movement of the beam could be as much as 1 inch if full design live load is applied. EOR typically provides the required gap in the construction documents.

Calculation of required gap:

Floor Beam Span:	**20 ft**
Live Load Deflection Limit:	**L/360**
Max. Live Load Deflection:	**(20 ft x 12 in/ft) / 360 = 0.67 in**
Required Gap:	**0.67 in**

Calculation of Leg Length:

Required Gap:	**0.67 in**
Min. Leg Length (Single Track or Over Track):	**0.67 in x 2 + 1.0 in = 2.34 in.**

The effective width, w_{dt}, of the leg of the track is calculated differently between single and double track. The deflection track in the single track configuration receives the reaction from the flange of the stud, while the reaction is distributed through the fastened track to the deflection track in the double track assembly.

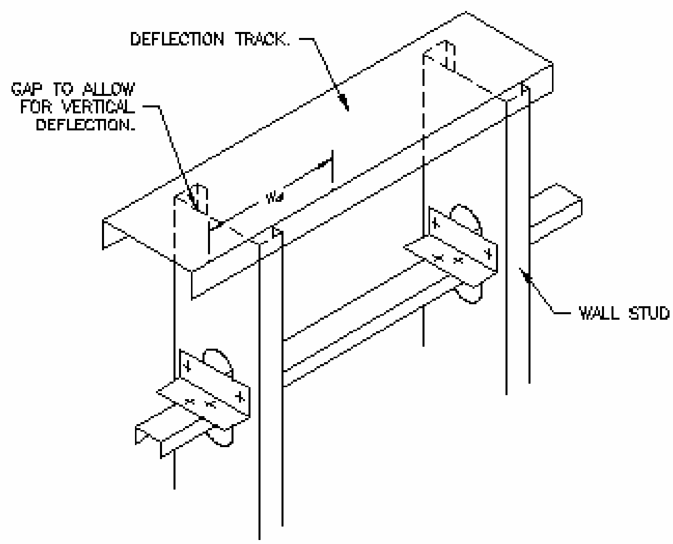

FIGURE 10

SAMPLE CALCULATION

Using AISI Wall Stud Design standard (AISI S211-07), Calculate the nominal strength of a single deflection track subjected to transverse loads.

$$P_{ndt} = \frac{w_{dt} t^2 F_y}{4e} \qquad \text{(Eq. B2.3-1)}$$

Where:
t = track thickness
F_{ut}= track yield strength
e = design gap for deflection
Ω = 2.8 for ASD
Φ = 0.55 for LRFD
F_{ut} = 0.45 for LSD

$w_{dt} = 0.11\,(\alpha)^2\,(e^{0.5} / t^{1.5}) + 5.5\alpha \le S$

α = 1.0 when e, t, and stud spacing are in inches
α = 25.4 when e, t, and stud spacing are in mm

EXAMPLE (SINGLE TRACK)

Wall height = 12’-0”
Stud spacing = 16”
Lateral load = W = 20 psf
½” gap for deflection

Try 600T200-54, 33ksi track

P_{act} = (20)(16/12)(12/2) = 160 lb

$w_{dt} = (0.11)[(0.5)^{0.5}/(0.0566)^{1.5}] + 5.5 = 11.28$ in < 16 in $\therefore$ ok
$P_{ndt} = (0.0566 \text{ in.})^2(45{,}000 \text{ psi})(11.28 \text{ in.}) / [(4)(0.5 \text{ in.})] = 813$ lb

$P_{all} = P_{ndt}/2.8$ = 813 lb / 2.8 = 290 lb > 160 lb $\therefore$ ok

EXAMPLE (DOUBLE TRACK)

Wall height = 12’-0”
Stud spacing = 16”
Lateral load = W = 20 psf
½” gap for deflection

Try 600T200-43, 33ksi track

P_{act} = (20)(16/12)(12/2) = 160 lb

Note: For the double slip track, w_{dt} is taken as the stud spacing, and the plate bending formula is used.

$f_b = 0.6F_y$

$S = (w_{dt} \cdot t^2) / 6$

$M = P_{all} \cdot e \Rightarrow P_{all} = M / e$

$f_b = M / S \Rightarrow M = f_b \cdot S \Rightarrow 0.6 \cdot F_y \cdot w_{dt} \cdot t^2 / 6$

Solve for P_{all} :

$P_{all} = 0.6 \cdot F_y \cdot w_{dt} \cdot t^2 / 6e$

Where:

F_y = 33,000 psi

e = 0.5 inch

w_{dt} = 16 inch

t = 0.0451inch

$P_{all} = 0.6 \cdot (33{,}000\ \text{psi})(16")(0.0451")^2/6(0.5")$

P_{all} = 215 lb > 160 lb ∴ ok

DEFLECTION TRACK TABLES

- Values are for Single Deflection Track
- Values are maximum allowable wall stud reaction, lb

½" Gap
Stud Spacing = 12 in

ksi	43mil	54mil	68mil
33	144	213	287
50	218	323	435

½" Gap
Stud Spacing = 16 in

ksi	43mil	54mil	68mil
33	163	213	287
50	247	323	435

½" Gap
Stud Spacing = 24 in

ksi	43mil	54mil	68mil
33	163	213	287
50	247	323	435

¾" Gap
Stud Spacing = 12 in

ksi	43mil	54mil	68mil
33	96	151	210
50	145	229	318

¾" Gap
Stud Spacing = 16 in

ksi	43mil	54mil	68mil
33	123	158	210
50	187	240	318

1" Gap
Stud Spacing = 12 in

ksi	43mil	54mil	68mil
33	72	113	169
50	109	172	256

1" Gap
Stud Spacing = 16 in

ksi	43mil	54mil	68mil
33	96	129	169
50	145	195	256

1" Gap
Stud Spacing = 24 in

ksi	43mil	54mil	68mil
33	102	129	169
50	154	195	256

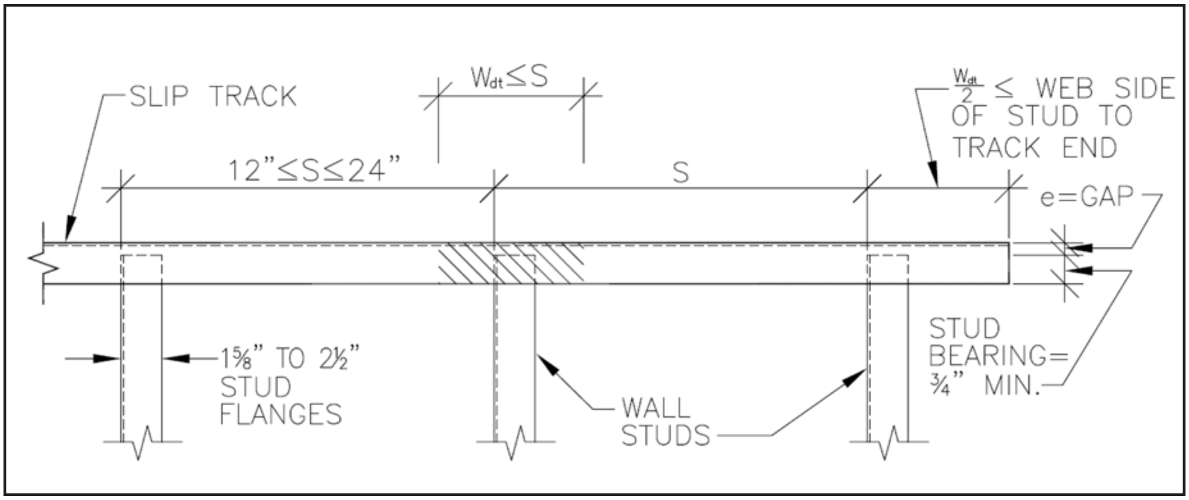

FIGURE 11: ELEVATION OF SLIP TRACK AT STUD BEARING

LIMITATIONS OF DEFLECTION TRACK

The deflection track design guidelines given above are subject to the following limitations:

1. Design thickness is limited to 43 mil to 68 mil material for stud and track material
2. Design yield strength is limited to 33 to 50 ksi for stud and track material
3. Nominal depth is limited to 3.5 in to 6.0 in for stud and track sections
4. Nominal flange width is limited to 1.625 in to 2.5 in for stud sections and 2.0 in to 3.0 in for track sections
5. Stud shall have ¾" min bearing on track
6. Deflection Track values should not exceed the web crippling values for the wall studs

References

1. *North American Standard for Cold-Formed Steel Framing - Wall Stud Design*, AISI S211-07, American Iron and Steel Institute, Washington, DC, 2007.

Primary Author of this Technical Note:
Rahim Zadeh, P.E., Marino\WARE

Contributing Committee: CFSEI Technical Document Committee (Dick Layding,P.E., NUCONSTEEL, chairman)

CFSEI Technical Review Committee: Rob Madsen, P.E., Devco Engineering, Inc., chairman.

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