# TECH NOTE

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# Limiting Heights for Nonstructural Standard and EQ Wall Studs

***SUMMARY:*** This Technical Note addresses cold-formed steel studs in nonstructural interior wall systems, often referred to as drywall partitions. The intent is limited to discussion of criteria necessary to understand and determine maximum allowable or "limiting" heights including applicable standards as referenced in the 2018 International Building Code (IBC) for steel framing materials, fasteners, bridging or bracing, and deflection. Examples are provided at the end of the paper to demonstrate selection of studs based on limiting height.

## Cold-Formed Steel Framing

Cold-formed steel framing is made from strips of structural quality sheet steel that are fed through roll forming machines that progressively shape the steel into C-shaped sections. The cold-forming process can also be used to produce a variety of other shapes, including "U", "Z", and even hat-shaped sections. Cold-formed steel framing members can be formed from a wide range of material thicknesses to meet the requirements of nearly all structural and nonstructural applications. This Technical Note focuses on **nonstructural** applications of cold-formed steel studs, specifically for use in interior partitions in buildings.

Nonstructural walls are walls that do not exceed the loads in Figure 1 and are not exterior walls. Although most interior partitions in a non-combustible building are considered nonstructural, a uniform lateral live load, typically 5 psf, is required by code. This lateral loading will impact the required stud size and spacing as the wall gets taller. See the section on *Bridging and Bracing* for further discussion on lateral loads.

## General Design Considerations

Steel framing, fasteners, and other elements of a wall should be designed or selected using products that have properties consistent with appropriate codes and standards. Once an appropriate type of steel and coating is selected, a nonstructural wall must be designed to not exceed its maximum allowable or "limiting" height, based on product specifications or code-required allowable deflection for a given finish and code-specified loads. Additional requirements may be part of the project specifications.

The following sections address the most important variables and requirements that should be considered for most nonstructural wall applications. Special loads or unusual applications may require additional consideration by a design professional.

## Applicable Standards for Nonstructural Cold-Formed Steel

Determining which requirements are important for design of nonstructural cold-formed steel walls requires an assessment of the legally-adopted building code. Except where noted otherwise, in this Technical Note the applicable requirements are based on the 2018 International Building Code (IBC) and the standards adopted by reference in that same edition of the IBC.

Table 2506.2 of the 2018 IBC references AISI S220 *(North American Standard for Cold Formed Steel Framing- Nonstructural Members)* as the governing standards for nonstructural cold-formed steel framing members used for interior construction. However, within the AISI S220 reference standard are numerous secondary reference standards that also govern nonstructural walls. For example, AISI S220 defers to ASTM C754, *Standard Specification for Installation of Steel Framing Members to Achieve Screw Attached Gypsum Panel Products,* for the installation of studs.

Among other topics, the AISI S220 standard covers the type of steel permissible for nonstructural stud manufacturing, corrosion protection (coatings), member design, product identification, installation, and connections. AISI S220 specifically requires the steel used in cold-formed steel to comply with one of the steels in ASTM A1003/A1003M *(Standard Specification for Sheet Steel, Carbon, Metallic and Non-Metallic Coated for Cold-Formed Framing Members)*.

By reference, AISI S220 requires coatings complying with ASTM A653/A653M *(Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process).* Coatings must be a minimum of G40 or provide an equivalent corrosion resistance.

AISI S220 also describes the minimum dimensions of critical parts of studs (such as flange dimensions) and defines manufacturing tolerances.

The reader should note that this Technical Note focuses on the major standards criteria necessary for evaluation of limiting height requirements for nonstructural walls. Manufacturers and designers should be aware that there are additional requirements related to cold-formed steel design in the standards referenced in this document, as well as in AISI S100 *(North American Specification for the Design of Cold-Formed Steel Structural Members)* and state or local code amendments. To simplify compliance, products from manufacturers who participate in the Steel Framing Industry Association (SFIA) code compliance program *(Code Compliance Certification Program for Structural and Nonstructural Framing Members)* meet the applicable referenced standards related to stud manufacturing and the base steel and coating materials. The SFIA compliance program verifies the product through unannounced random semi-annual inspections by an independent third party that include destructive testing of the products.

## Alternative Products

The drive for higher efficiency and technology improvements has enabled the development of a new generation of nonstructural studs that are lighter and thinner than standard studs. These new studs use higher strength steels and stiffening elements that enable equivalent (EQ) performance to the standard studs they are meant to replace. With over ten years in the market, EQ studs now represent 90 percent of the nonstructural steel studs produced in the United States and are recognized by the industry's Code Compliance Certification Program administered by SFIA.

As an alternative material, design, or method of construction, EQ studs are approved under Section 104.11 of the IBC. EQ studs are typically certified through third-party testing in accordance with ICC-ES AC 86, *Cold-Formed Steel Members-Interior Nonloadbearing Wall Assemblies.* In fact, many manufacturers of standard studs use limiting height tables developed by testing under AC-86 as an alternative design method. Limiting heights tables under AC 86 are developed using calculated performance based on test data.

## Fasteners

Screw design for nonstructural stud connections is governed by Section E4 of AISI S100. The screws themselves for steel-to-steel connections must comply with ASTM C1513 (Standard Specification for Self Tapping Screws for Cold-Formed Steel Framing Connections).

For attachment of gypsum board to steel, screws can meet either ASTM C 1513 or ASTM C1002 *(Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs).*

There are a number of screw types and lengths that enable proper attachment of various brands and thicknesses of finish materials to the steel studs. Properly driven screws will not break the face of the wall board paper and will be sufficiently recessed to be concealed by joint compound and not interfere with any finish material.

Although EQ studs are made with thinner materials, the studs use steel with higher yield strengths and consequently may have greater pullout and shear values. EQ studs meet fastener requirements in Appendix 1 of AISI S220.

## Bridging and Bracing

All CFS framing must be properly braced to meet strength requirements and provide stability to the entire assembly. Nonstructural interior walls framed with cold-formed steel studs are often framed with cladding (gypsum wall board, etc.) on one or both sides. With cladding on one side only, the unsheathed flange needs to be braced to resist torsional rotation of the framing member when the wall is subjected to a lateral load. The model codes and standards require, as a minimum, a 5 psf interior lateral live load.

In most cases the 5 psf lateral live load will be the controlling design load, except when higher loads are required by contract specifications. In high seismic areas the 5 psf load may be exceeded where heavy cladding materials are attached to the wall. An engineered solution is required with other special applications or loads that fall outside of the limits in Section A1 of AISI S220 as shown in Figure 1.

If bracing is used as an alternative to sheathing, one practice is to install cold-rolled channel at 4-foot on center through the web punch-outs to stiffen and stabilize the wall. The cold-rolled channel installed through the punch-outs is effective in providing unsheathed flange bracing if there is a positive attachment of the cold rolled channel to the webs of 6" and narrower studs. Several proprietary products are also options to be installed in the punch-outs.

As an alternative to bracing being placed in the punch-outs, other framing such as track, studs, channels, strapping, or proprietary bracing products may be used on the face of stud flanges, or on one flange for partitions cladded on one side only with blocking.

For chase walls where there are constraints for the use of cold rolled channels and the unsheathed flanges are inaccessible, a qualified engineer should evaluate and design a system that will meet the performance requirements.

Manufacturers tables and their specific design notes should be consulted for bracing design and installation.

## Deflection

Deflection, not yield strength, is typically the primary factor that affects the selection of framing members and their limiting height. When specifying deflection, "L" refers to the length of the member, or span, in inches. Therefore, a 10' or 120" span at L/120 would be allowed to deflect no more than 120"/120 or 1.0". A stiff enough member must be selected such that this deflection allowance is met when the maximum design loads are applied. If the same member was designed to L/240, then it could only deflect 120"/240 or 0.5" when maximum design loads are applied.

The IBC specifies deflection limits for interior walls of L/120 for flexible finishes. For brittle finishes, except plaster and stucco, it requires L/240, while for stucco and plaster the limit is L/360. Deflection limits more restrictive than code may be required in the contract documents or specifications.

**Limitations for Nonstructural Walls**, *Figure 1 (as required in AISI Standard S220)*

- Members limited to a transverse (out-of-plane) load no greater than 10 lb/ft.$^2$ (0.50kPa in Canada)
- (15 lbs/ft.$^2$ for pressurized air plenums, ceilings, and elevator shaft enclosures).
- Members limited to an axial load of no greater than 100 lbs/ft. (excluding sheathing materials).
- Members limited to a superimposed axial load no greater than 200 lbs.

## Stud Selection Based on Limiting Heights

To select the appropriate framing for interior partitions, information about wall height, stud type, stud spacing, finish materials' deflection requirements, lateral load and any special loading conditions must be evaluated.

There are two types of design applications available for nonstructural walls. Some rely on the capacity of the studs only (non-composite) and others are based on the contribution of gypsum board and/or other sheathings (composite). Composite tables are based on testing of assemblies with sheathings in place. Users cannot assume that a fully-sheathed wall is a composite assembly just due to the presence of sheathing. The composite assembly must be based on the tested assembly, as noted in the manufacturers tables. It is important to note that a wall designed using limiting heights from composite tables must be constructed consistent with the assembly as it was tested.

There are various sources of limiting heights tables. ASTM C754 contains composite nonstructural prescriptive tables for selected studs. SFIA's *Technical Guide for Cold-Formed Steel Framing* contains limiting heights tables for a variety of composite and non-composite wall applications. The guide can be downloaded at www.cfsteel.org/sfia-technical-publications. In addition, most manufacturers publish wall height tables for their standard and/or EQ products which will differ from product to product including some for construction that is not fully clad or non-composite.

Studs can be selected by comparing the required height from the plans or specifications to the limiting height in published tables, based on the deflection limit, yield strength (33, 50 ksi or higher for EQ) and stud spacing. For example, in the following table taken out of the SFIA Technical Guide, a 362S125-30 mil stud at 16 inches on center spacing with 33 ksi yield strength would allow a wall height of 15'-5" assuming a 5psf lateral load and a deflection limit of L/240.

| Interior Nonstructural Non-Composite, Fully Braced | | | | | |
|---|---|---|---|---|---|
| 5 psf* | | | | | |
| Stud Member | Spacing in. oc | Fy, ksi | L/120 | L/240 | L/360 |
| 362S125-30 | 16 | 33 | 17'-0" | 15-'5" | 13'-5" |

* This SFIA tables for 7.5 psf and 10 psf are not shown here.

Section B of AISI S220 addresses calculation or test-based design procedures for non-composite walls and a test-based procedure for composite assemblies. Although the procedures from AISI S220 would be too complex to include in this Technical Note, the following examples demonstrate the application of stud selection by the limiting heights method.

## DESIGN EXAMPLES

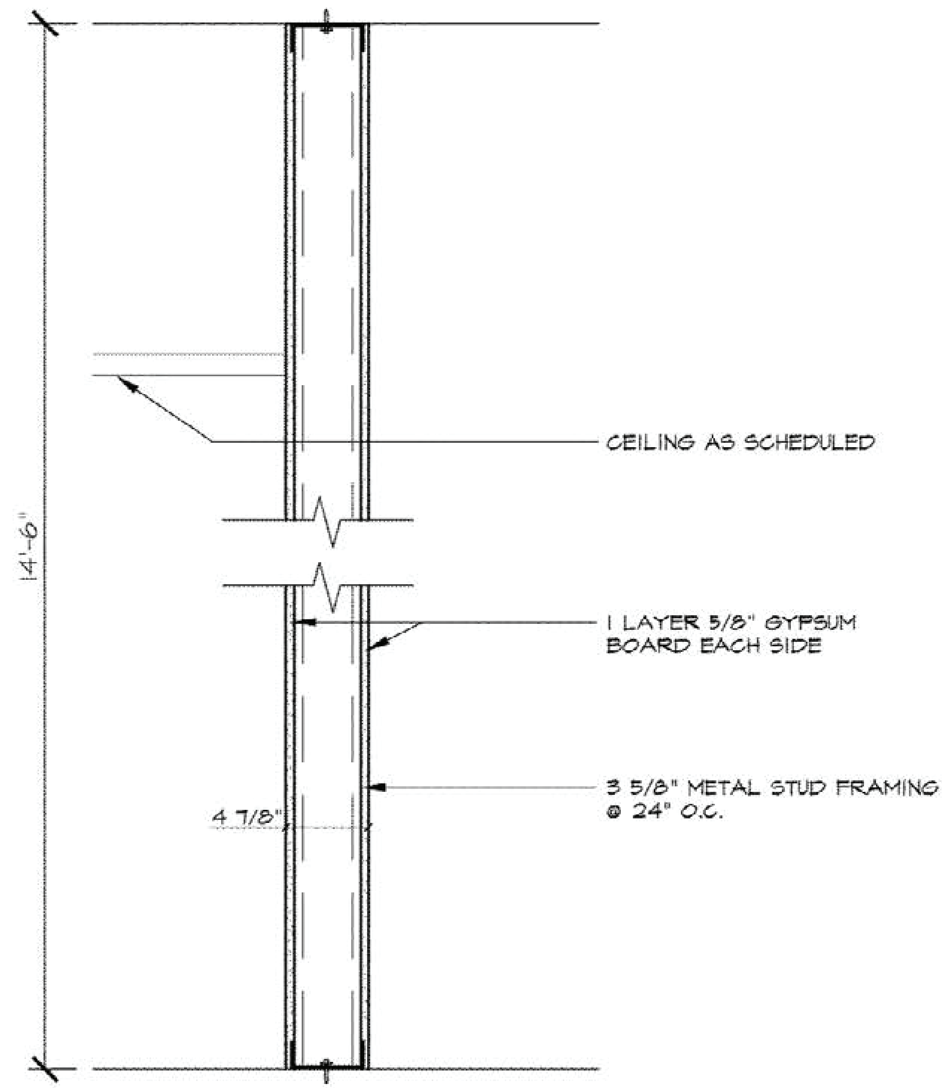
The purpose of the following examples is to demonstrate the importance of verifying conformance with composite and bracing requirements when using limiting heights tables in the selection of interior nonstructural cold formed steel studs. Example 1 shows the limiting heights for studs that can be considered fully composite. Examples 2 and 3 show limiting heights for the same stud sizes at the same loading conditions as Example 1 for different limiting heights but both with non-composite studs that are fully braced. Example 4 shows further reduced limiting heights for the same non-composite studs that are braced only at 4'-0" on center. The deflection limit in each example is L/240 to match both gypsum board manufacturer recommendations as well as the most common architectural requirement.

The limiting heights for studs used in the examples are from the SFIA Technical Guide and/or manufacturers tables. Studs from manufacturers tables are only used to demonstrate the design and are not an endorsement of any specific product.

Note that the designs demonstrate that there are many typical interior partition cases that do NOT qualify as composite construction. Great care should be taken to properly size or select the correct stud framing members.

**Interior Drywall Partition Example 1 - Fully Composite:**

Comparisons between three different drywall studs: NS 33 mil (0.0346” design thickness); NS 30 mil (0.0312” design thickness); and a proprietary ‘EQ’ 20 stud (0.0200” design thickness, multiple-stiffened with high yield).

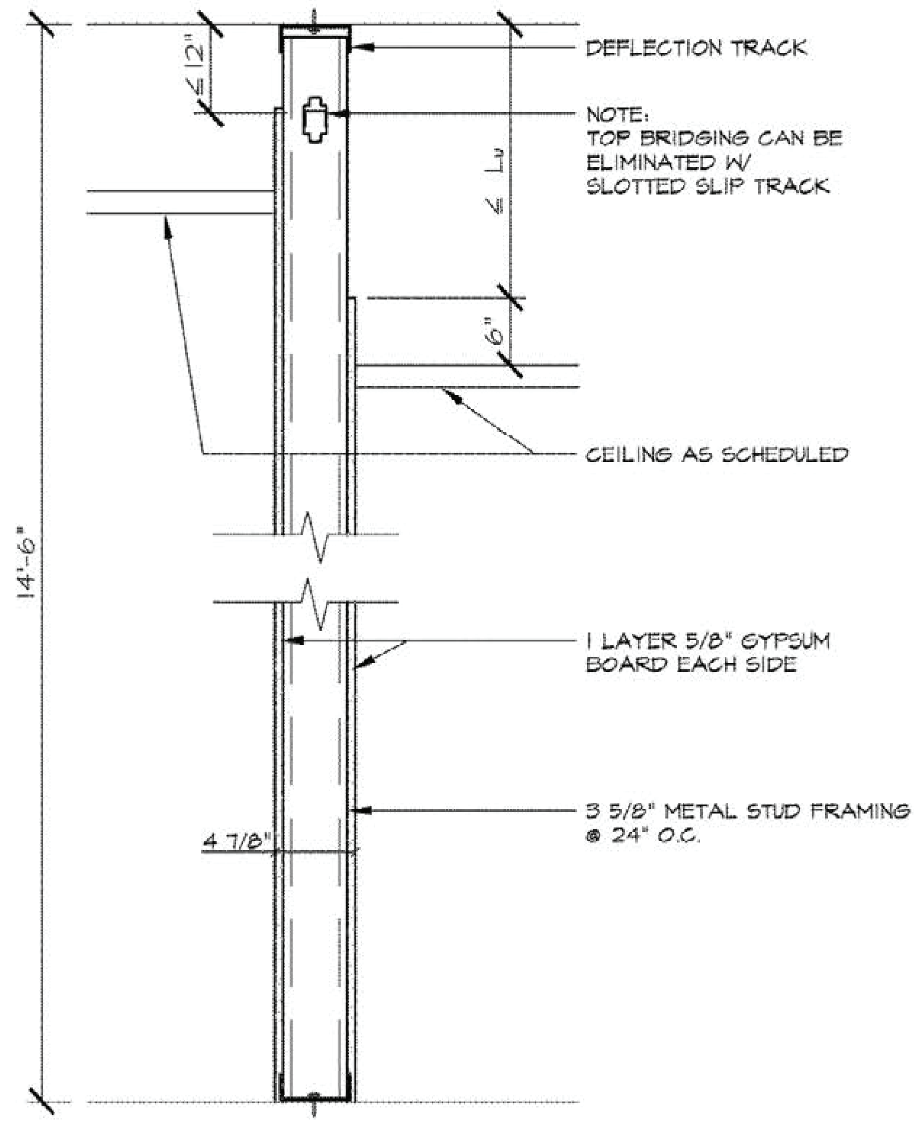



**3-5/8” studs @ 24”o.c., 14’-6” total wall height**

| | |
|---|---|
| 5 psf lateral load | Check at deflection limit of L/240 |
| Composite? | ***YES*** (Clad full height, gypsum board oriented vertically, both sides, fully braced) |

| Stud Size | | Deflection L/240 | OK? |
|---|---|---|---|
| 362 S 125 - 33 | **Limiting Heights** *(ft. - in.)* | 15 - 3 | ***YES*** |
| 362 S 125 - 30 | | 14 - 6 | ***YES*** |
| 362 S 125 - 20EQ | | 14 - 8 | ***YES*** |

**Interior Drywall Partition Example 2 - Non-Composite, Fully Braced:**
Comparisons between three different drywall studs: NS 33 mil (0.0346" design thickness); NS 30 mil (0.0312" design thickness); and a proprietary 'EQ' 20 stud (0.0200" design thickness, multiple-stiffened with high yield).

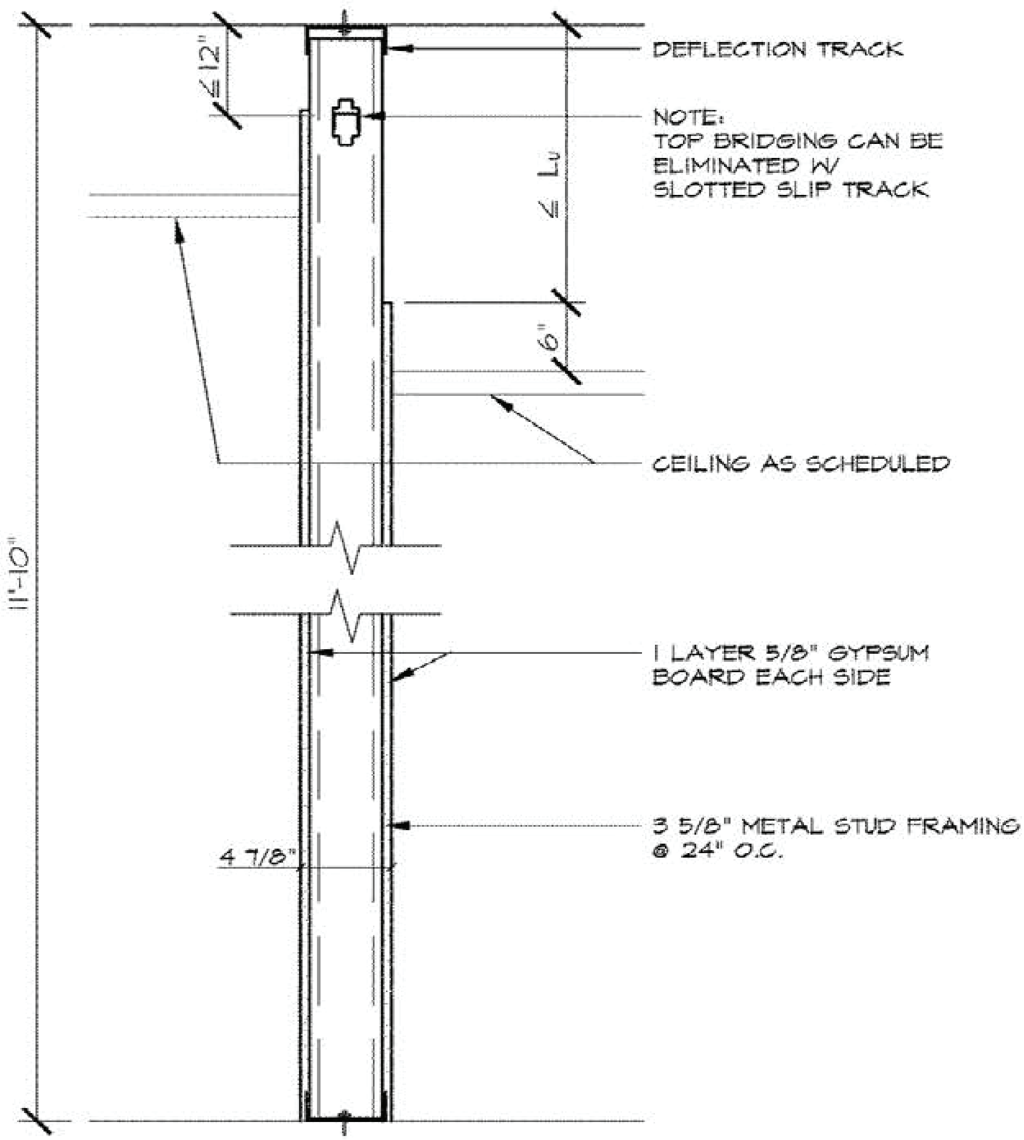



**3-5/8" studs @ 24"o.c., 14'-6" total wall height**

| | |
|---|---|
| 5 psf lateral load | Check at deflection limit of L/240 |
| Composite? | ***NO*** (NOT Clad full height, both sides – must add bracing if height above cladding > $L_u$ as specified by the manufacturers fully-braced height table) |

| **Stud Size** | | **Deflection L/240** | **OK?** |
|---|---|---|---|
| 362 S 125 - 33 | **Limiting Heights** *(ft. - in.)* | 13' - 11" | ***NO*** |
| 362 S 125 - 30 | | 13' - 5" | ***NO*** |
| 362 S 125 - 20EQ | | 11'-10" | ***NO*** |

**Interior Drywall Partition Example 3 - Non-Composite, Fully Braced:**
Comparisons between three different drywall studs: NS 33 mil (0.0346” design thickness); NS 30 mil (0.0312” design thickness); and a proprietary ‘EQ’ 20 stud (0.0200” design thickness, multiple-stiffened with high yield).



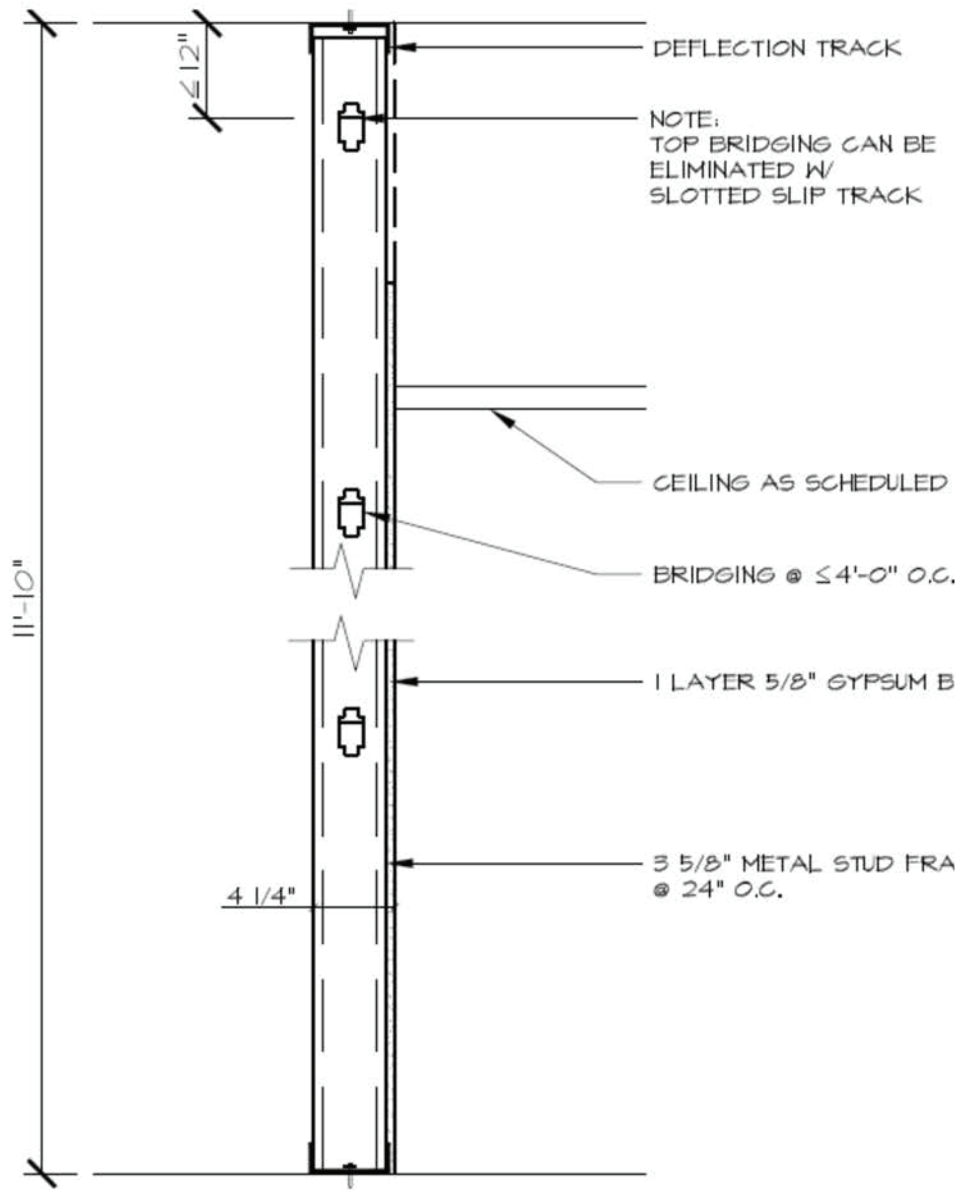

**3-5/8” studs @ 24”o.c., 11’-10” total wall height**

5 psf lateral load — Check at deflection limit of L/240

Composite? — ***NO*** (NOT Clad full height, both sides – must add bracing if height above cladding > $L_u$ as specified by the manufacturers fully-braced height table)

| Stud Size | | Deflection L/240 | OK? |
|---|---|---|---|
| 362 S 125 - 33 | **Limiting Heights** *(ft. - in.)* | 13' - 11" | ***NO*** |
| 362 S 125 - 30 | | 13' - 5" | ***NO*** |
| 362 S 125 - 20EQ | | 11'-10" | ***NO*** |

**Drywall Partition Example 4 - Non-Composite, Braced @ 48” o.c.:**
Comparisons between three different drywall studs: NS 33 mil (0.0346” design thickness); NS 30 mil (0.0312” design thickness); and a proprietary ‘EQ’ 20 stud (0.0200” design thickness, multiple-stiffened with high yield).




**3-5/8” studs @ 24”o.c., 11’-10” total wall height**

5 psf lateral load — Check at deflection limit of L/240

Composite? — ***NO*** (Unclad entirely one side – must add bracing @ 48”o.c. max)

| Stud Size | | Deflection L/240 | OK? |
|---|---|---|---|
| 362 S 125 - 33 | **Limiting Heights** *(ft. - in.)* | 13' - 11" | ***YES*** |
| 362 S 125 - 30 | | 13' - 5" | ***YES*** |
| 362 S 125 - 20EQ | | 11'-10" | ***YES*** |