CENTRIA
EXPERT ANALYSIS

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# Differential Live Load Floor Deflection and the Effect on Insulated Metal Panels

## Overview

One of the most frequent challenges for any insulated metal panel (IMP) wall installation is a support system that translates the inter-story live load (LL) floor deflection into the panel system. Floor deflection is the vertical displacement by bending of a floor support beam and slab due to its own weight and that of the live loads placed upon it. Maximum deflection limits are set by building codes dependent on project or material usage. The most common support system utilized currently in building design is light-gauge metal stud framing spanning from lower to upper slab, placed near the slab edges, with a slip joint—or deflection track—placed at the underside of the upper slab. Another less common system that also translates LL deflection is a spandrel support system used for strip window applications. In this case, all floor deflection must be accommodated at the location of the window head.

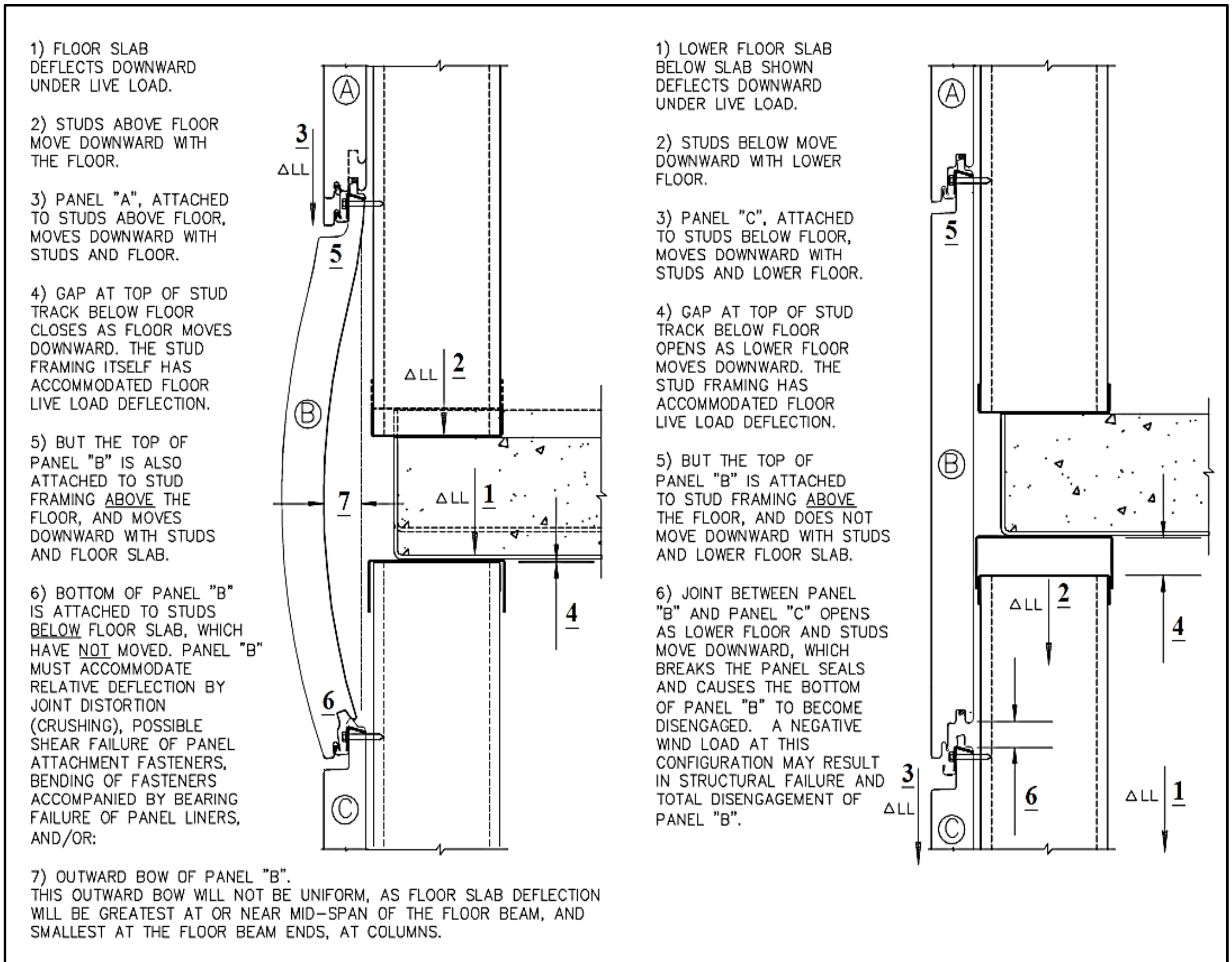
## Design Codes

The International Building Code (IBC) limits LL floor deflection for serviceability to L/360, where L is the distance the floor spans between columns in inches. This deflection magnitude can be quite large. For example, a floor spanning 30' - 0" between columns results in an L/360 deflection of 1".

However, the American Institute for Steel Construction (AISC) Design Guide 3 recommends a maximum deflection between 1/4" and 1/2". Unfortunately, many designers do not follow the AISC Design Guide recommendations. The American Concrete Institute (ACI) 318 standard has a more restrictive LL deflection limit of L/600, with a maximum of 0.30". This more restrictive limit is not typically encountered in IMP projects.

## Acceptable Deflection for Insulated Metal Panels

For horizontal IMPs, the maximum LL deflection limit is typically considered to be +/- 1/4". In actuality, the maximum allowable deflection that closes the panel joint is 1/4" to prevent damage to the panels, but the maximum allowable deflection that opens the panel joint must not exceed 1/8”. Opening deflection greater than 1/8” will break the panel seals and could result in disengagement of the panel joinery and structural failure. Please refer to *Figure 1* for examples of both cases**.**




After Floor Deflection
Floor Above Deflects

After Floor Deflection
Floor Below Deflects

**Figure 1**

**What are the Options?**

**Option 1** - The first option is to work with the architectural designer early in the project design phase to limit LL floor deflection to 1/4” maximum. The AISC Design Guide 3 further states that perimeter beams do not typically see the full design live load due to the lower density of use of floor space near a window, and that it is reasonable to assume a 50% reduction. This would bring the maximum anticipated deflection down to less than 1/4”. If the reduction results in +/- 1/8” maximum live load deflection, then the application would be acceptable for IMPs. If the deflection cannot be reduced to this level, other options must be explored.

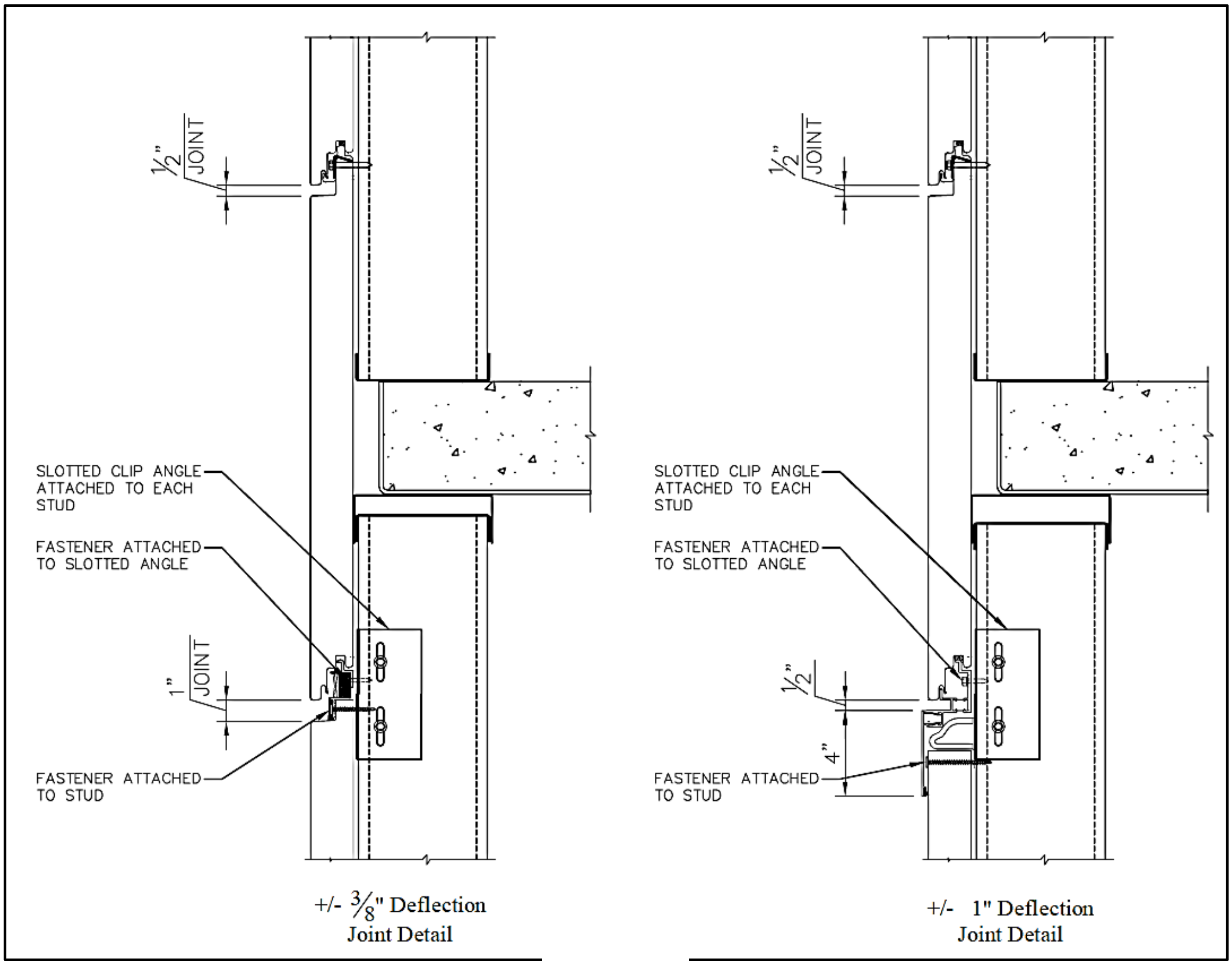



**Figure 2**

**Option 2** - The second option is to introduce deflection joints within the IMP system. The deflection joint will be visible on the exterior of the building and can vary from barely noticeable to significantly noticeable depending upon the amount of LL deflection anticipated. Exterior deflection joints can change the appearance of the elevation undesirably for the architect and add significant material and labor cost to the project. Deflection joints can either be done with flashing or extrusions, with the extrusion option adding the most cost.

Note that the cost to stiffen the spandrel beam is typically much cheaper than adding deflection joints in the IMP system, but by the time cladding is ordered for the building, the steel design has been completed and most likely erected. Therefore, the cost to add deflection joints is typically unforeseen by the project team. Additionally, special width panels may be required to ensure that the deflection joint occurs at the required location, adding even more cost. Please refer to *Figure 2* for examples of deflection joints within the metal panel system.

*Figure 3* illustrates a typical deflection joint above a window head.

**Option 3** - The final option is to design the project with steel framing that bypasses the floor slabs. This can be presented in the form of bypass stud framing or hot-rolled steel tubes (HSS). With both systems, all LL deflection is easily accommodated by slip connections between the floor slab and the framing. Therefore, there is no change to the desired architectural appearance of the elevation and no hidden additional cost to the project.

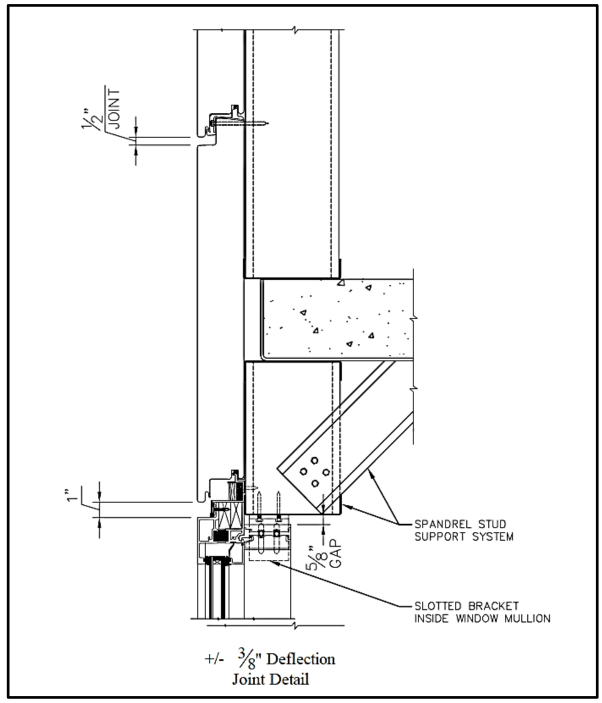



**Figure 3**

A major advantage of bypass HSS construction over stud framing is that it provides seamless support for not only punched windows but also strip windows (strip windows with studs require the spandrel support system). Examples of all three systems are shown in *Figure 4*. Option 3 is undoubtedly the best option for an IMP system.

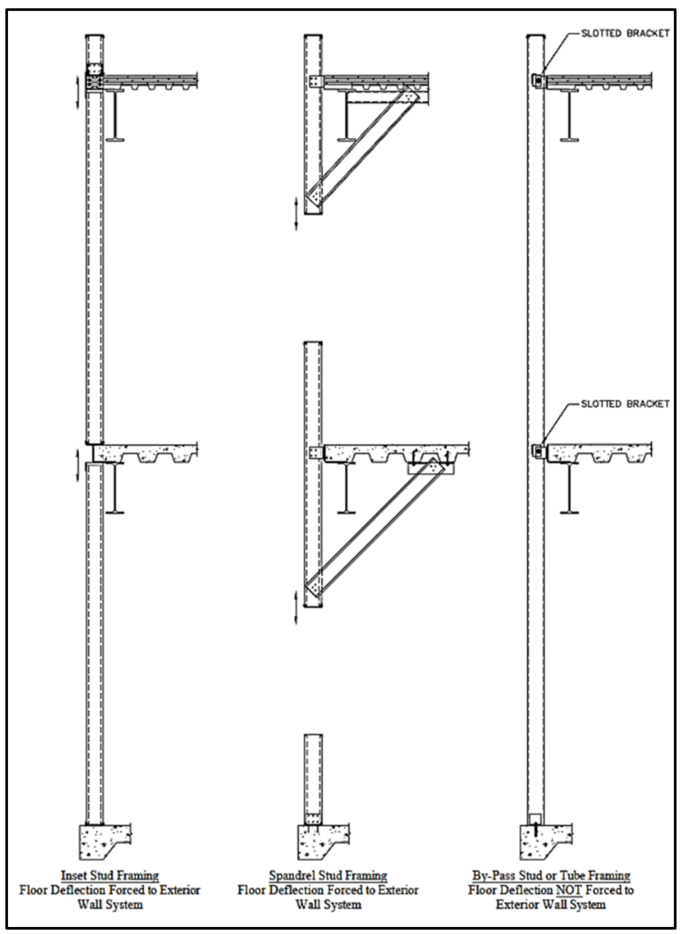



**Figure 4**

It is extremely important to engage with the architectural team early in the design phase of the project to promote and highlight the advantages of a bypass framing system over the stud/deflection track or spandrel system and their inherent deflection issues.

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