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Specifying Light Gauge Metal Headers

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Specifying metal studs for interior and exterior walls can be simple. However, openings in the walls for doors, windows, and HVAC ducts require headers, jambs, and sills around them. This is where complications arise in that the wall above must be supported to divert the imposed loads around the opening. This is commonly accomplished with built-up headers and multiple jamb studs. These members and their connections are the most difficult challenges in metal-stud framing. Further, longer spans and tighter construction standards are pushing headers and jamb construction in a new direction.

This article discusses some of the current issues associated with the specification and construction of headers and jambs in light-gauge steel stud designs, including:

- the assembly and design of metal stud-framed headers and jambs;
- difficulties associated with the lack of an industry standard and the finish quality of gypsum wallboard surfaces installed over traditional metal stud framing at openings; and
- industry trends and new technologies developed to solve current design limitations.

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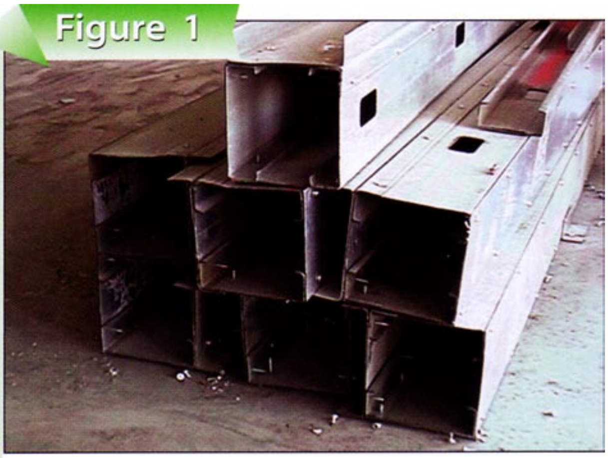
Figure 1



Built-up configurations—combinations of stud and track—are frequently specified for header and jamb conditions requiring higher demands for deflection, spans, wall heights, and loads.

Understanding headers and jambs

Cold-formed steel headers and jambs must be designed to carry the loads imposed on them. Specifically, headers must resist both vertical (dead load) and horizontal (lateral load) forces from wind and seismic events. In interior conditions, dead loads can vary depending on wall type (generally 287 Pa [6 psf]) and lateral loads are usually relatively small (239 Pa [5 psf]). In exterior conditions, dead loads are generally larger, varying from 335 to 1197 Pa (7 to 25 psf), while lateral wind loads are more significant, ranging from 718 to 2633 Pa (15 to 55 psf). In coastal regions subject to direct exposure to high winds, these loads can be even greater. A finish's tolerance for deflection, opening spans, wall heights, and loads must be considered for both interior and exterior studs.

Traditionally, designers and installers were limited in their choices to solve header and jamb conditions. Most often, designers specified a single-track header for very small openings. When this method was not strong enough, the designer specified a combination of studs and tracks, which is known as a built-up configuration (Figure 1). However, using traditional stud and tracks to form a built-up section is very labor-intensive and creates many variables. Additionally, traditional header sections are usually constructed and assembled on the jobsite, consisting of designs ranging from two to five pieces. These can include several different types of connection designs, such as multiple screws and excessive welding.

The most common built-up section is a box header made of two studs and two or three tracks. Each of these tracks and studs is screwed or welded to one another to act as a unit. The connection of these built-up members to the jamb studs is done by installing additional clips or plates or by dog-earring (*i.e.* hand-cutting) the members at their ends. Detailing for these connections varies among architects and engineers. Since the industry has no generally recognized standard detailing headers and their connections, several variations have developed. In many situations, the drawings are not detailed enough to account for all conditions and connections. Installers are then forced to build the headers and connections the way they have in past projects, while trying to integrate non-existent details in the drawings. This mix and match approach can lead to problems. While there are structural provisions in codes for specific evaluation of these connections, little attention is generally paid to these 'nonstructural' portions of the building by the structural engineer.

Frequently, specification for jambs at windows and doors dictate they be double studs that are faced (*i.e.* open 'C' section to open 'C' section) and often welded to one another, creating a hollow section. However, as explained previously, it is often the case the construction does not match the drawings specified. Rather, connections are constructed following the last project the construction crew worked on.

Built-up header and jambs for spans over 0.9 m (3 ft) in length are frequently specified in the following manner:

1. Track 1 is placed on top of the hollow metal door frame (HMF) and securely attached for support. Its job is to be in contact with the HMF and act as a receiving track to connect to the additional components of the built-up assembly.
2. Studs 2 and 3 connect to Track 1 and extend horizontally. It is the track's job to carry the vertical dead load imposed on the header.
3. Track 4 installs legs pointing down on top of Studs 2 and 3. Once combined with Track 1, their purpose is to resist lateral forces, keeping the wall rigid in wind or heavier load conditions.
4. Track 5 installs on top of Track 4 with legs pointing up to receive the cripple studs necessary to maintain the required stud spacing (Figure 2).

Striving for consistency

Many times, designs focus on the headers section and are unclear when it comes to how the designer intends to connect the horizontal header to the vertical king studs. Due to the field fabrication of these connections and built-up members, the resulting construction quality can vary significantly. Structurally, the connection where the header meets the king studs is one of the weakest points in a design. Connections are frequently designed and installed differently, making headers unpredictable from project to project or even within a project. This can lead to damage during high winds or minor movements in the connections, which can cause distress in the finishes.

In an effort to control costs, some contractors will often have the lowest cost and least skilled apprentice precut and assemble header materials. After the header materials (*i.e.* studs and tracks) are cut to size, the quality of the installer's dog-earring on each end is entirely dependent on his or her ability and preference, which frequently results in poor and inconsistent header quality and variations in the header to jamb end connections. Also, it is often the case the headers assembly screw-weld pattern is not clearly detailed, so once again it is up to the individual worker to install the assumed quantity of screws and/or welds to connect the studs and tracks to one another before placing the header into the framed opening. Assembling these sections requires screwing with multiple fasteners, and often times, welding the pieces together to fabricate a single unit (Figures 3 and 4).

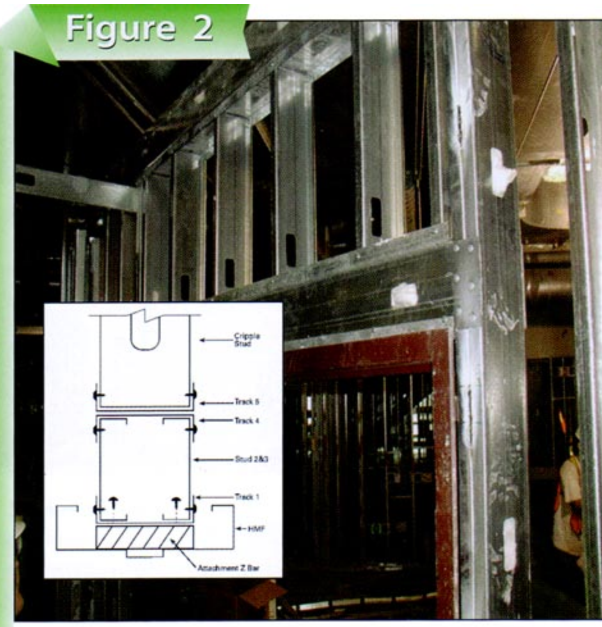
Screwing and welding create their own set of problems with regard to the built-up system's integration with other materials that make up the wall. Metal over metal overlaps create a protrusion, especially where screws are used. Given this, a sheet of interior gypsum board or exterior sheathing will not lie flat against the wall. Instead, the material bows or bulges out at the point where the header is connected to the jamb studs. This can cause additional remedial work or noticeable unevenness in the finishes. Even more challenging is the inspection of these headers, especially at welded connections. This is always a test of document interpretations. Inspections of these conditions is impossible without clear construction documents with which to make comparisons.

Inspections are particularly more difficult to pass in California, where some buildings must comply with the Office of Statewide Health Planning and Development (OSHPD). This body works to ensure the safety of hospital patients and employees and requires healthcare facilities meet higher seismic and safety standards than typical buildings. Inspectors often give failing grades to assemblies in which damage to the substrate has occurred due to the protrusion of the built-up header.

Built-up closed sections, such as box headers and double jamb studs, are more difficult to insulate and run utilities through. With these assemblies, insulation needs to be preinstalled or injected. However, this work is typically performed out of sequence, complicating the project and adding further costs. This usually happens when the insulator is not yet on the jobsite, but framing work on the headers and other metal stud has begun. The insulator is sequenced on to the project after the drywall stage is started and at this time, the metal framing is substantially complete.

Cold-formed steel headers and jambs are also used in shaft wall design. Shaft walls have multiple HVAC openings and other types of penetrations and openings, such as elevator doors. Not only do the members surrounding these openings need to be designed to properly maintain the structural integrity of the shaft wall system, but they must also maintain the fire rating of the shaft wall itself. While J-tracks have been used for this header condition and end shaft studs have been used for the jamb studs, their use is limited to small openings of 0.9 m (3 ft) or less. Boxed or built-up sections used for headers or jambs do not allow for placement of the shaft liner and the ratings will be adversely affected. These issues further complicate the design process.

Figure 2



Multiple connections are required between the track and the hollow metal door frames (HMFs) in a built-up configuration.

Building codes

Nationally recognized building codes address opening supports and header requirements by specifying minimum design loads and providing recommendations for deflection tolerances. They include:

- 1997 *Uniform Building Code (UBC)*;
- 2000 *International Building Code (IBC)*; and
- 2003 *IBC*.

These building codes reference national design standards for the calculation of the cold-formed member and their connection components and allow the engineer of record to justify how the design meets these requirements. They do not include standards indicating the level of detail required on construction documents for nonstructural walls. They also do not include typical details for such walls and specific framed wall openings and connections. As new materials and construction methods emerge, architects and specifiers should look to light-gauge metal experts and the engineer of record to ensure these minimum requirements are met.

Figure 3

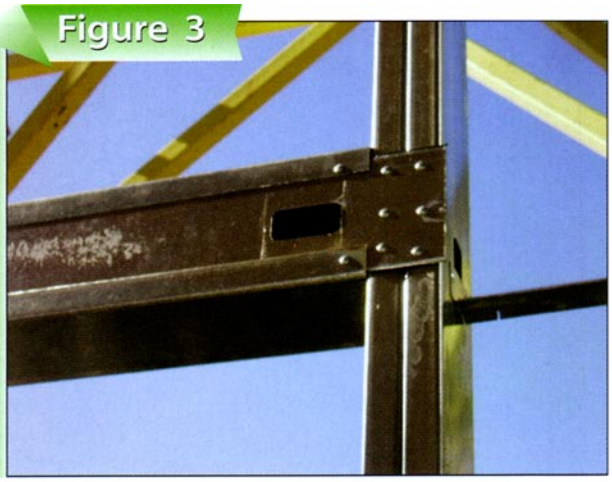
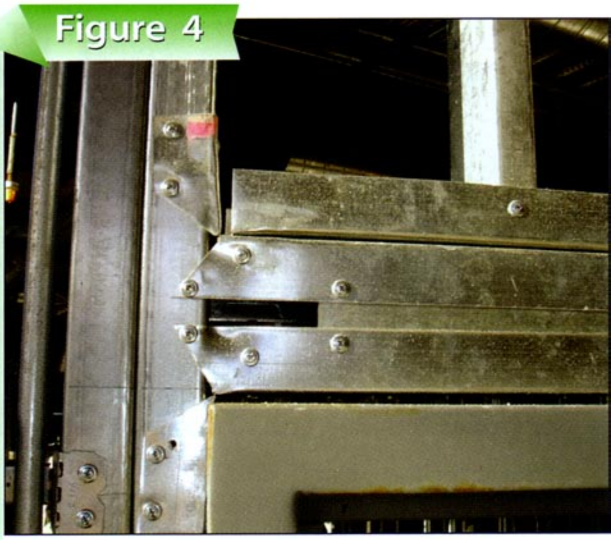


Figure 4



Studs and tracks are commonly hand-cut to size. They are dog-earred on each end, fastened with multiple screws, and often welded, depending on the skill and preference of the installer.

Specification sections

When referencing *MasterFormat*™ *2004 (MFO4)*, cold-formed steel framing—including components used in header and jamb assemblies and their installation—is detailed in section 09 22 16–*Non-Structural Metal Framing* and section 05 04 00–*Cold-formed Metal Framing*. It is also covered by the following standards:

1. ASTM International A 653/A 653M, *Standard Specification for Steel Sheet, Zinc-coated (Galvanized), or Zinc-iron Alloy-coated (Galvannealed) by the Hot-dip Process*;
2. ASTM A 1003/A 1003M, *Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-coated for Cold-formed Framing Members*; and
3. ASTM C 645, *Standard Specification for Nonstructural Steel Framing Members*.

However, there is no specification section written to particularly identify header standards, header sections, jambs, and/or components, given they have not yet been developed beyond minimum standards set for general conditions. This is also true for header connection details to jamb studs, including installation, which in the opinion of this author, is critical.

Specifications for cold-formed framed walls can proceed in three distinct directions. First, they can select materials and indicate specific details identified in the architectural or structural drawings, requiring the specifier to consider all loading and geometry considerations. In an effort to save cost, the design time of nonstructural openings is limited, resulting in specifications that are routinely conservative and cumbersome. Specifiers typically use old specification details used on numerous designs, which are not project-specific. This approach has two associated problems. The specific project may contain situations not addressed by the design and may be too conservative, creating added project costs. On the other hand, overly complicated designs can also lead to a lack of consistency in the installed assembly and a decrease in the quality of the finished product.

Second, specifications can place the responsibility for the design of the cold-formed steel framing with a specialty engineer. This allows specifications to be provided for materials, along with construction tolerances and a performance requirement that can include design loads and deflection tolerances. This approach allows for designs that are more likely tailored to the specific project and are possibly more economical than typical details.

Third, the specifier can combine these two approaches, allowing for substitution of specified designs with assemblies meeting a specific performance requirement. This approach means construction can follow the typical details, but allows for specialty designers to request substitutions when cost savings are significant and justifiable.

Choosing one of these methods is dependent on the particular project, the specifier's level of knowledge in cold-formed steel design, concerns about construction budgets, and project size.

A practical field example

In a recent project, a specialty steel-framing contractor installed built-up box headers that were welded together before being placed in the opening. The jambs were also welded double studs placed around the opening. (This kind of pre-assembly of welded members is common, given that welding is easier on the ground compared to when materials are installed.) Next, to properly attach the HMF to the metal-stud-framed opening, it was necessary to drill access holes in the welded box sections and make attachments through the holes into the HMF attachment clips (Figures 5 and 6).

In an attempt to solve this Inspection problem, inspectors stopped the construction process around the openings. While this significantly delayed the project, Inspectors Insisted no more pre-welded assemblies could be installed. Instead, the components had to be Installed one piece at a time and connections Inspected individually during the Installation process. Once all the attachments and other trades work was completed and Inspected, the headers were then welded In place.

The contractor now faced extra fire protection for the welding, burnt-out door frames, and a significant loss of production across all trades. The ripple effect was enormous, with electricians and insulators unable to proceed. This example Illustrates that even when clearly detailed, built-up sections can experience complications, resulting In significant cost overruns. It also highlights the fact inspectors find it difficult to verify whether the attachment to the HMF is tight or fully made—poor attachments result in long-term building maintenance issues at critical door access locations. To solve these problems, this author recommends looking to new technologies developed in the metal-stud framing Industry.

Construction trends and new technology

The trend in the industry is to standardize headers, jambs, and connections. This standardization should solve numerous issues related to variation and quality. This author recommends using a single member that can act as both a header and receiving track for the studs above the opening, along with a single member for the jamb that is strong enough to resist the imposed load and deflection criteria. The connection to the jamb should also be standardized to avoid field decisions and metal to metal overlaps.

New technologies are making this standardization easier, particularly for headers. A one-piece header is a good choice for most applications, while a two-piece header is an option for spans over 2.1 m (7 ft), depending on the particular loads. Certain proprietary systems offer one- and two-piece headers in numerous standard stud widths and various material dimensions. These systems are available with a standard internal clip, which allows for the connection of the header to the jamb without product buildup. The clip is fabricated from 345-Mpa (50-ksi) steel.

Additionally, the header-and-clip system minimizes variability and quality issues associated with the interior or exterior built-up header assemblies. These one-piece headers do not require excessive screwing and eliminate welding. The screws connecting the header to the vertical king studs are placed in recessed channels, which are roll-formed into the product so they install flat and do not impact the drywall substrate and other trades work (Figure 7). This approach reduces time spent on labor by eliminating field fabrication of built-up sections and custom clips or tabs.

Figure 5

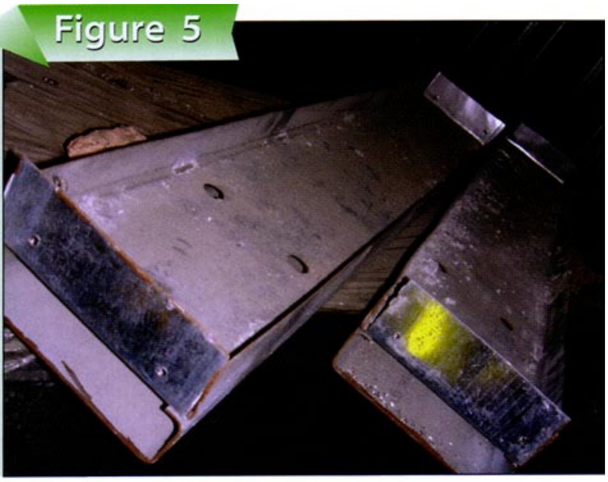
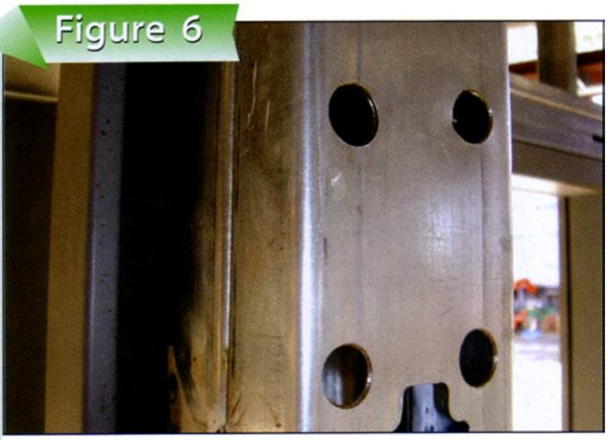


Figure 6



The above photos show how access holes are drilled in the welded box sections to attach the hollow metal frame into the meta l-stud framed opening.

Traditional double-jamb studs welded to form a closed section can be problematic, given the quality of field-welded, cold-formed steel can sometimes be an issue, particularly in lighter gauges. These studs can also be expensive—two 'C' stud jambs (welded sections) cost $8 to $10 per linear foot. Welding of galvanized steel also has its issues with toxic fumes created as a result of the extreme heat on the galvanizing coating.

This author recommends achieving the properties required of a jamb stud in a single-piece member, particularly, a single-jamb stud with a wider flange member measuring up to 76 mm (3 in.) depending on spans and loading conditions. These members are structurally adequate, easy to install, not subject to field-weld or connection quality issues, and open at the back, allowing for insulation and metal door attachments. The substitution of these single, large jambs in place of equivalent double-jambs should also be originally specified or specifically allowed, provided supporting documentation and performance specifications are met.

This new technology of one- and two-piece headers and one-piece jambs is advantageous in the following ways:

Figure 7

The screws that connect the header to the vertical king stud are placed in recessed channels that are roll-formed into the product. The finished surface is then aligned with adjacent studs so there is no overlap of material.

- their shape is engineered to deliver superior strength with fewer pieces;
- they can allow for installation of insulation during the normal course of work;
- they can allow for easier attachment of heavy metal door assemblies that require back screwing;
- the connection clips are usually less obtrusive and can result in less bulge in the finishes;
- they can offer a higher level or certainty in obtaining the required quality for the project, particularly at the connection;
- they can be safer to handle and require less cutting and no welding, making for easy and consistent inspections; and
- field decisions are kept to a minimum.

Manufacturers are also introducing products in an effort to minimize field fabrication and buildup, serving a dual purpose of increasing quality and reliability as well as decreasing construction labor costs. Many times in the construction industry, new products are not allowed or are held to higher allowance or approval standards simply because they are new; design professionals can be unwilling to take the time or gamble on a new product for fear of making a mistake. These products should be either originally specified in construction documents or specifically allowed by substitution, provided both the supporting documentation and performance specifications are met. As more specifiers are educated about the merits of these new products, particularly one- and two-piece headers, there should be an increase in the industry's ability to provide much-needed improvement in the finished product.

Additional Information

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One-piece header
Seismic control
Two-piece header

Abstract

Built-up headers and multiple jamb studs are commonly used to support and divert imposed loads around windows and doors. An understanding of the specification and construction of headers and jambs is required to handle these loads, including the assembly and design of these components and some of the difficulties surrounding the lack of an industry standard.