Innovations in Cold-Formed Steel Framing

By Don Allen, P.E.

STRUCTURE® magazine has reported several advancements in cold-formed steel framing (CFSF), including the new standards from the American Iron and Steel Institute and the recently developed *Code of Standard Practice for Cold-Formed Steel Structural Framing*. However, during the past ten years, the amount of innovation in the products and accessories for CFSF has grown at an exponential pace.

Special connectors for lateral systems have been developed: sheathing, holdowns, boundary elements, and strap anchorage devices, such as the one shown here.

It all started with clips and connectors. In 1990, there were basically two bypass slide clips for curtain wall framing. Both of them were hard to install and did not work that well for the function they were to perform. Several contractors started developing their own clips and connectors, and some of them took their ideas to manufacturers. By 1995, there were more than a dozen different types of clips for the bypass slip condition, and more being developed for head-of-wall slip connection. At the same time, specialty tracks were being developed for this head-of-wall connection, permitting vertical movement of the structure without loading the CFSF members. As contractors saw the need for new connectors, companies tested and developed their ideas. Now there are several connectors made especially for cold-formed steel, and three manufacturers have separate catalogs just for connectors for steel framing products.

At the same time, manufacturers realized that taking a lipped channel stud member, making it deeper and wider, and using it as a floor joist, was not always the most efficient use of steel. The relatively small holes in the joists did not permit passage of ductwork or services, and the member capacity could be increased only by making thicker, deeper, or wider flanged members. Manufacturers soon developed floor systems with additional material at the flange, to increase moment capacity and provided larger, stiffened holes in the web, to permit the passage of utilities. The key to these holes providing more opening space in the web without sacrificing shear strength is the rolled stiffening lip around each hole. This lip is formed during the roll forming process, and the combination of the hole and the stiffening lip prevents buckling waves from forming at or immediately adjacent to the hole.

Similar techniques have been applied to wall stud framing. Steel is not only very good at carrying loads – it also does a great job of conducting heat. This is great for steel cookware; but not so good for an insulated wall cavity. Stud manufacturers in Scandinavia had been putting slits in their studs and tracks for years, reducing the area of steel in the web of the stud for thermal transfer. Using stiffened holes, just like in the floor joists, has become the solution for at least one stud manufacturer. Another uses an innovative clinching technique to roll the stud flange back onto the web, creating a triangular "tube" along each flange of the stud. This not only increases strength, but permits more of the web to be removed to reduce heat transfer. The tubular shape adds axial capacity as well. Another manufacturer uses material that has been "dimpled" from both sides before forming the members into studs and track. This not only increases structural performance by creating a greater "effective thickness," but also reduces sound transmission and improves performance in fire tests, according to the manufacturer's data.

Proprietary systems and devices are now available for stronger, rapid and economical bracing of load bearing framing members

With the growth of the mid-rise market, increased axial capacity has become a bigger issue, especially for the framing on the lower floors of a multi-story project. Rather than just using thicker, deeper studs, manufacturers are adding more bends, ribs, and stiffeners in their profiles, to create stronger members from less steel. Also, bracing systems to carry the increased brace loads (estimated to be 2% of axial load) have been developed: not only to have more capacity, but also to make the systems easier and more cost-effective to install.

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Since 1990, there has been a proliferation of clips and connectors for bypass framing: both slip- and fixed-connections.

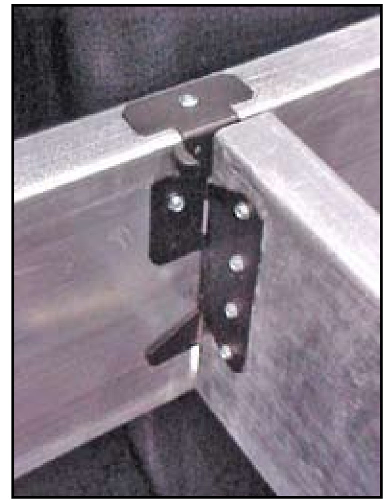
Several manufacturers have floor joist systems with large, stiffened (lipped) holes, which facilitate the installation of MEP services. Other components of these systems include rim tracks with tabs for connections and stiffening, and engineered tracks that can span moderate wall openings without headers.

Around openings in these bearing walls, bigger members designed specifically for jamb locations provide larger stiffened returns on the flanges, allowing members to be attached from both sides (rather than having just one solid face and one open face.) The complex stiffeners permit added axial and bending capacity, and the framers are able to use fewer of these jumbo studs as jambs, heads, and sills. Pre-insulated and built-up headers have also been developed, as well as full-sized insulated wall panels, that fully separate the interior and exterior steel framing members with a solid foam core.

Perhaps the most labor intensive component of a cold-formed steel framed bearing wall structure is the shearwall. Several shear panels have been developed that work well in narrow shearwalls, and other systems have been developed that make the attachment of structural sheathing faster and simpler. These methods include pneumatically driven pins, collated specially-designed screws, and even adhesives, specially formulated to adhere to steel in typical jobsite conditions. One new product consists of a sheet of steel laminated to gypsum or other sheathing, so that the shear panel can be applied at the same time as the finish layer of board (either interior or exterior.)

One of the biggest innovations that may interest engineers is the development of software and manufacturing machinery coupled with the design software. Not quite true Building Information Modeling, these design and manufacturing packages create drawings based on input construction planes, roof slopes, wall, floor, and opening locations, and a host of other input factors. Once the schematic model is completed, loads may be applied and tracked through the structure, as specific members, components, and systems are designed. Some of these computer aided design packages include material takeoff, and direct links to manufacturing machinery making the components of a truss or panel. One system is so sophisticated that as electrical lighting and switches are added to the drawing, the manufacturing software will note where holes in the stud will need to be punched to accommodate the wiring. All of this is coordinated with the structural design, before the first piece is ever manufactured.

Multi-story load bearing structure using perforated joists. Photo Courtesy of Marino\Ware, Inc.



Speciality joist hanger developed exclusively for CFSF

With all of this innovation, the structural engineer may wonder what is the use of this recently announced industry standardization, as well as the series of publications from AISI based on these standardized products. Take heart; most of the framing currently manufactured, used, and installed is still of the standard shape and format of the framing members listed in AISI publications, and matching the span and load tables from the Steel Stud Manufacturers Association (available at **www.ssma.com**.) But engineers should be prepared for submittals and engineered calculations from contractors and manufactures, based on one or more of these new products and systems.▪

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