CFSEI
COLD-FORMED STEEL ENGINEERS INSTITUTE

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TECHNICAL NOTE

On Cold-Formed Steel Construction

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HOW COLD-FORMED STEEL IS USED IN BUILDING CONSTRUCTION

Summary: Cold-formed steel (CFS) framing is used in numerous applications across the building industry. The purpose of this Technical Note is to provide a general overview of common CFS shapes and various applications in which they are used.

INTRODUCTION

Cold-formed steel framing is cold-rolled at room temperature from hot-rolled coils that are typically less than 1/8" thick (see Figure 1) to form structural members. By contrast, hot-rolled steel is produced at significantly higher temperatures and formed into many different structural shapes, including coil to be used in the production of CFS. When CFS is used in framing applications, it is also commonly referred to as cold-formed metal framing (CFMF), light-gauge steel, or light metal framing (LMF). Building designers (architects and engineers of record) often show CFS in a variety of different types of projects, and almost always delegate the design of CFS framing to a Specialty Structural Engineer. For additional information on cold-formed steel production, see "Beginner Tech Note B001-20 – How Cold-Formed Steel Framing is Produced."

The most common shapes used in building construction are Z-shapes, C-Shapes, furring channels, and angles, as well as metal deck profiles. Each of these members can be used in a variety of applications.

Figure 1 - Steel Coils
Courtesy of American Iron and Steel Institute

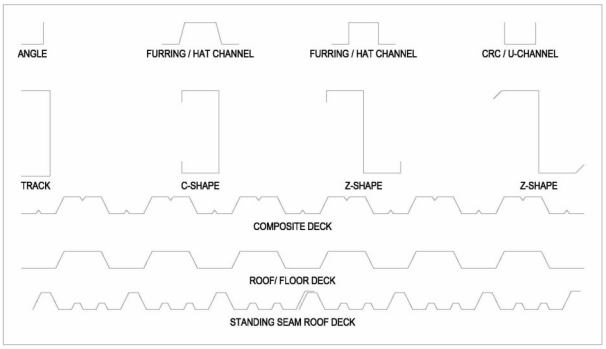

Figure 2 - Common CFS Shapes
Courtesy of ADTEK Engineers, Inc.

METAL BUILDING SYSTEMS

The most common uses for Z-shapes are in the metal building industry. Metal building systems, commonly referred to as pre-engineered metal buildings (PEMB), also utilize C-shapes and custom shapes known as eave purlins. The Z-shapes are typically used as girts in walls and purlins in roofs between large structural steel rigid frames. PEMBs are used in numerous applications and offer the ability for quicker building erection. Typically, exterior finishes consisting of metal panels installed on PEMBs allow greater deflection limits so frames can be spaced farther apart with the CFS spanning larger distances. These features make metal buildings ideal for industrial and manufacturing buildings, municipal buildings such as firehouses, open structures like churches and gymnasiums, and add-ons to existing buildings.

In addition to Z-shapes and C-shapes, metal buildings use cold-formed steel for roofing. Metal building roofing systems are commonly constructed using standing seam roof panels and through-fastened roof panels, which typically come in a variety of profiles.

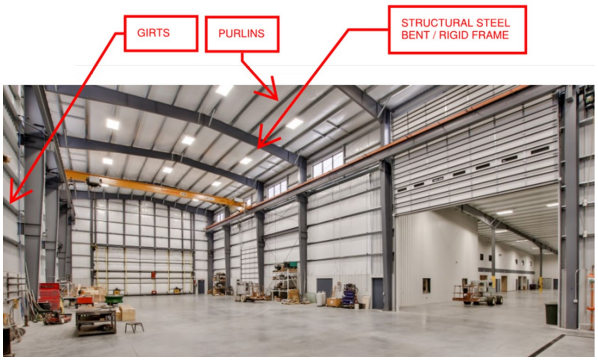

Figure 3 – Metal Building
Courtesy of Metal Building Manufacturers Association

BUILDING ENVELOPES – EXTERIOR WALLS, SOFFITS, FASCIA, AND CEILINGS

CFS is used in many other types of buildings as well, ranging from small single-story buildings and renovations all the way up to high-rise buildings and skyscrapers. It can be used for many types of commercial, industrial, specialty, and residential construction.

In exterior applications, CFS is commonly used in curtain wall construction. In this application, the superstructure is typically composed of hot-rolled steel and/or concrete beams and columns, and CFS is used to frame the exterior walls. Framing used in exterior applications are still within the building envelope but are subjected to components and cladding wind loading. This type of framing is also referred to as non-load bearing wall framing.

Curtain wall framing is typically supported in one of two ways. Framing either spans from the top of one floor slab to the bottom of the upper slab or roof and is supported with deflection track, or framing can bypass floor levels with support via vertical slide clips. Oftentimes, it is important to provide movement at these connections so that an axial load is not introduced to the framing when live loads are applied. In high -seismic regions, lateral drift must also be accounted for.

Figure 4 – Standing Seam Metal Roof
Courtesy of ADTEK Engineers, Inc.

Figure 5 - CFS Wall Framing w/ Deflection Track & Parapet Framing—Courtesy of ADTEK Engineers, Inc.

Figure 6 - By-Pass CFS Wall Framing
courtesy of ADTEK Engineers, Inc.

Figure 7 - Load Bearing CFS Framing
Courtesy of ADTEK Engineers, Inc.

CFS framing can be used to support gravity loads applied to the structure. Exterior load bearing framing still must resist wind loads, but must also resist roof dead, wind, snow, and live loads, and floor dead and live loads. This framing is designed without slip connections such that axial loads will be applied to framing.

In addition to resisting components and cladding wind loads and various gravity loads, CFS can be used as part of the lateral force-resisting system. Typical systems include strapped braced wall, wood structural panel, steel sheet sheathing, gypsum board panels, or numerous proprietary products to be used as shear walls. Lateral load is transferred through these systems to hold-downs which transfer load to the building foundation.

CFS framing is used in several other exterior conditions. C-shapes are commonly used to build exterior soffits. The versatility of CFS makes it ideal to build the complex shapes of exterior soffits envisioned by architects. C-shapes can also be used as roof rafters or exterior ceiling joists.

Figure 8 - Load Bearing Framing w/ CFS Floor Joists
Courtesy of ADTEK Engineers, Inc.

Figure 9 - CFS Soffit Framing
Courtesy of ADTEK Engineers, Inc.

INTERIOR FRAMING

CFS is used in a variety of ways in the interior of structures. C-shapes are commonly used to frame partition walls. These are interior walls that can typically be altered within the shell of the building. They do not support gravity load from the building, and support very little lateral load (i.e., the walls are not part of the building's primary gravity or lateral force-resisting system). Additionally, non-structural framing is often used to frame ceilings, bulkheads, and soffits inside the building.

Structural cold-formed steel framing is used when non-structural framing is not feasible. For non-load bearing conditions, these situations exist in buildings with very tall partition walls. Interior structural framing is used similarly to exterior framing, with the exception being that it only supports minor lateral pressures. Structural framing can also be used to support floor or ceiling systems. For more information on the differences between structural and non-structural framing, see "Beginner Tech Note B009-20 – Non-Structural vs. Structural Framing."

TRUSS FRAMING

Cold-formed steel members are commonly used as truss members. These trusses are made using either C-shapes or from a truss manufacturer's proprietary shapes. Chord and web members are either welded or screwed together in the field or in a truss plant, where they are built and then shipped to the project site. CFS trusses are used for both roof framing and floor framing.

Figure 10 - CFS Roof Trusses - Courtesy TrusSteel

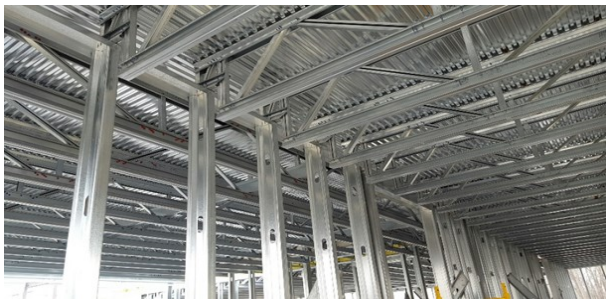

Figure 11 - Metal Deck on CFS Floor Trusses Load Bearing Wall – Courtesy TrusSteel

METAL DECK

Metal deck is also considered cold-formed steel, as it is manufactured (roll-formed) in the same way. It is commonly used as part of a building's floor and roof systems. Metal deck can be used with concrete floor systems either compositely or non-compositely. It is also used as a roofing substructure, supporting roofing materials or concrete roofs.

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