METAL CONSTRUCTION ASSOCIATION

Metal Roof Installation Manual

Chapter 2: Metal Roofing: A Family of Products / History of Metal Roofing

METAL CONSTRUCTION ASSOCIATION
8735 W. Higgins Road, Suite 300, Chicago, IL 60631
847.375.4718 | mca@metalconstruction.org | www.metalconstruction.org

BUILD LEGACIES METAL

Chapter 2: Metal Roofing: A Family of Products / History of Metal Roofing

Chapter Contents

2. METAL ROOFING:

A FAMILY OF PRODUCTS / HISTORY OF METAL ROOFING

When installing a metal roof, it is important to realize that a system of individual components is being installed that are related to each other, and that depend on the proper installation of each part in order for the system to perform correctly. Understanding this "family of products" and how they are related will make any installation job easier, safer, and less confusing.

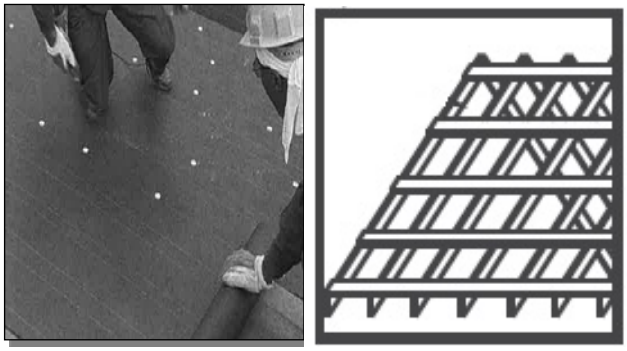
Metal roofing has always been considered a premium roofing material. A brief look at how metal roofing developed over the centuries will help the installer understand why and how various roof styles, types of panels, materials, and seam methods were developed. Each was developed to solve a roofing problem. Some were developed to meet unique roofing situations.

2.1 Metal Roofing : A Family of Products

A typical metal roof system is composed of five primary components an installer needs to consider in any application. They are:

- **Substructure**
- **Roof panels & trim**
- **Fasteners**
- **Common roof accessories**
- **Support structure**

The **substructure** is the foundation, or base, to which the top roof panel is attached. Think of it as the first thing that is found when the roof's top layer is pulled back. The two main types of substrates are called solid deck and open framing (Figure 2-1). Decking material may be either wood or metal, and some substrates may have rigid insulation.



Solid Deck Substrate Open framing Substrate
Figure 2-1 Types of Substrates

Roof panels and trim make up the top layer of the roof and are directly exposed to the weather and the environment. These products can be made from:

- Natural metals
  - o Aluminum
  - o Copper
  - o Zinc
- Alloys
  - o Aluminum/Zinc
  - o Stainless Steel
- Metallic coated materials
  - o Galvanized
  - o Galvalume®

They may be in the form of sheets, panels, or smaller individual pieces, much like traditional asphalt shingles, wood, slate, or tile facsimiles. The sizes and shapes of metal panels and trim pieces may vary widely, but are light in weight, and usually easy to install. (Figure 2-2) Most panel styles and varieties are available painted or unpainted.

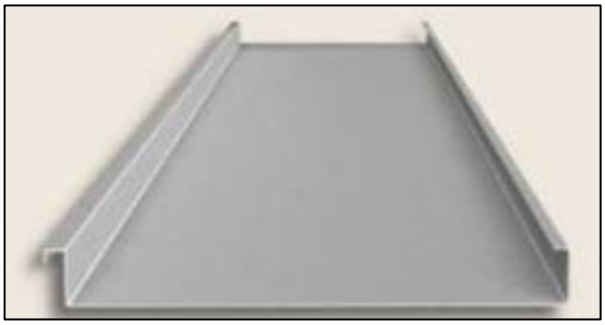


Figure 2-2
A Standing Seam Roof Panel

Installation of a metal roof requires the use of a variety of styles and types of fasteners and or clips. These are the components responsible for keeping the roof on the structure. Examples are shown in Figure 2-3a and Figure 2-3b. The exact style and size of the fastener will depend on the roof panel to be installed, as well as design requirements of the roof. A roof installed in a high wind zone will require a different fastener and spacing than one installed in a milder environment. Other considerations, such as snow and ice loading, and building codes, may also change the type and amount of fasteners and clips required for any installation.

Figure 2-3a
Typical Fasteners

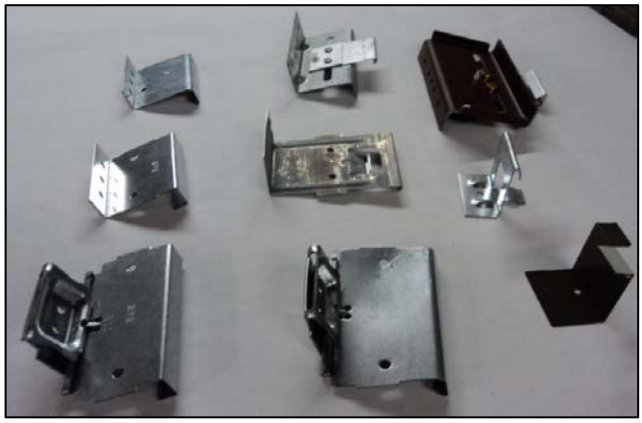


Figure 2-3b
Various Clip Examples

Common roof accessories will be a part of every installation. Every installer needs to be familiar with such common accessory installations as vents, curbs, and pipe penetrations. Depending on the job or location, the installer will also need to be familiar with installation of accessories like skylights, snow guards, and solar panel mounting. Be aware that some of these accessories will require fasteners that may not be a part of a standard roof installation.

The **support structure** (Figure 2-4) for the roof is responsible for holding the weight of the installed roof, including the substructure and any insulation or accessories. This support system must also take into consideration additional roof loads from wind, snow, ice, roof-installed equipment, and any foot traffic the roof will experience, and transfer those loads to the structure. The support structure usually is a framing system of wood, metal, stone, or concrete.

Figure 2-4
Support Structure

Each member of this "family" must be selected and installed properly in order for the roof to provide the protection, performance, and life expectancy for which it was designed.

Each of these components will be addressed and discussed in more detail, and from an installer's perspective, throughout this manual.

2.2 History of Metal Roofing

2.2.1 Earliest Usages

More than 2,000 years ago, smiths hammered out small roof plates of metal. Throughout its history, into the present day,

metal roofing has always been considered a premium roofing system, often reserved for the most important of buildings and centers of worship. In a few extreme cases, metal roofs have even been made out of gold! The long life of metal roofs is well known and documented. There are metal roofs hundreds of years old that are performing well. The earliest metal roofs were built in the Middle East around 675 A.D. or even earlier. They were especially suited to the domed and rounded roof styles of the area. (See Figure 2-5)

Figure 2-5
The Dome of the Rock, Finished In 691, Now Has a Gold-Leafed Aluminum Roof

2.2.2 European Influences

When the roofing craft migrated from the Middle East to Europe during the Crusades, metal roofing changed. Metal roof profiles adapted to the styles of architecture and climate which prevailed in Europe. Steep roof areas and tiered roofs would shed snow and ice, damaging the seams used at the time. A strip of wood was inserted between the panels and their upright joints. A new seam style was created - the batten seam. The addition of a separate joining component, the batten cover, locked into the two uprights and covered the joint. (See Figure 2-6)

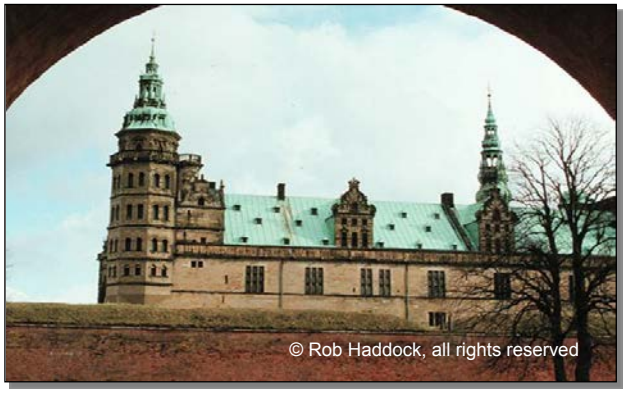


Figure 2-6
Metal Roof Showing European Influence

2.2.3 Modern Production and Growth

For centuries, these styles were fabricated at the point of installation (on site) with the simplest of hand tools. The metal was soft and easily formed. Metal roofing remained in this state until the industrial revolution arrived. This brought major changes to the methods, tools, and materials of metal roofing.

Improvements in mining and refining techniques, innovations in fabrication tools and equipment, and the development of new materials allowed new styles of metal roofing to emerge.

2.2.4 Fabrication Methods

2.2.4.1 Hand Tools and Soldering

Hand tools have always been, and still are, a critical part of proper metal roof installation (See Figure 2-7). The first tools, though, were simplistic and crude. Mallets, malletting anvils, tongs, hand and foot brakes were standard tools. Simple pan formers appeared later.

Figure 2-7
Early Roofing Hand Tools

The earliest seam joints were over-lapping flaps which were folded over and hammered flat to the roof, thus the term flat seam. Later, as soldering techniques were developed, these seams were soldered to provide a sealed surface impervious to the weather.

2.2.4.2 Brake Forming

While the growth of steel sheet goods grew in the mid-1800s, the invention of the "leaf-brake" allowed longer, straighter bends. These bends were more accurate and could be formed much quicker than with hand tools. This made any metal roof style more affordable by pre-bending panels in a production environment using less skilled workers. Panels now 8-10 feet in length became available. Installation was easier, saving money on installation costs and labor.

Common seams for these panels were of the standing seam type which kept the seam elevated and further away from the draining water.

Two world wars, production methods, and modern technology brought changes to manufacturing that would dramatically change metal roofing.

2.2.4.3 Corrugating, Roll Forming, and Press Brakes

Steel manufacturers found that they could take a very thin sheet of steel, and press lengthwise ridges into it by passing it beneath a "corrugating drum." Modern roll forming equipment, as shown in Figure 2-8, adds ribs and ridges to flat material. These ridges add strength to the panels. The panels could now span an open distance and did not require a solid deck surface beneath each panel. The panels now served as structural members as well as a roof surface. These corrugated panels now made metal roofing a very economical choice in roofing. Metal corrugated roofs became "the roof of choice" in many applications.

Corrugated roofing was often installed using nails fastened to the "peak," or "high point" of the corrugations. Later, fasteners with gaskets were developed. This allowed fasteners to be installed in the lower corrugations, or "valleys," of the panel.

This same concept took a giant leap forward after World War II when roll-forming technology was developed. Instead of rolling sheets of metal, long coils were rolled and formed as a continuous process instead of one sheet at a time.

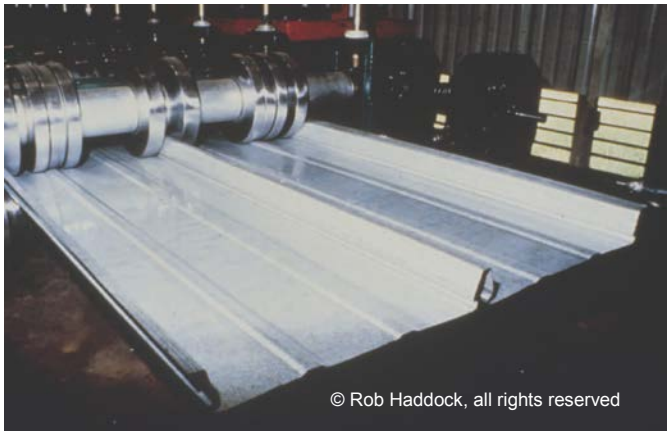


Figure 2-8
Roll Forming Equipment

Panels could now be made to very precise dimensions. Many styles of finished profiles could easily be produced, and the length of panels was only limited by handling and transportation restrictions. This process reduced manufacturing costs dramatically. Today's roll-forming equipment can operate at speeds up to 600 feet per minute, automatically measure, then cut panels to virtually any length with extreme accuracy.

As panel lengths increased, expensive and problematic end-to-end joints were reduced. This greatly simplified installation and reduced costs, but another problem began to appear. Roof failures due to the thermal effects on such long panels became common. The attachment of such long panels had to change in order to accommodate these effects. Attachment methods will be discussed in detail later in this manual. (See Chapter 14, *Fasteners*.) Most roll-formed panel seams are of the standing seam type.

Roll-forming equipment has found its way from the factory to the job site. Today's metal roof installer may find roll-formers "on-site" in order to quickly make material specific to an individual job. (See Figure 2-9.)

Figure 2-9
Mobile Roll Former Used "On-Site."

Press-forming of sheet metal uses a piece of equipment commonly called a press brake. This process makes individual metal shingles, tiles, or textured shapes that are not characterized by long panels with parallel lines. Press forming may be used as a standalone process or in addition to roll forming.

Press-formed metal panels are often made to resemble their traditional counterparts, such as asphalt shingles, wood shakes, slate, or ceramic tiles. They offer the advantage of lighter weight and simplified installation. Their long life rivals that of actual slate or tile, while maintenance issues are reduced.

Notes: