METAL CONSTRUCTION ASSOCIATION

Metal Roof Installation Manual

Chapter 5: Panel Attributes/Profiles

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Chapter Contents

5. Panel Attributes / Profiles

After installing several roofs and gaining a wider experience in the field of metal roofing, there will be some common panel attributes and profiles an installer encounters on a regular basis. Understanding these attributes and profiles will make the installer's work much easier.

This chapter examines the common panel widths, ribs, gauges, and side-joint configurations that an installer is most likely to encounter working in the field.

5.1 Widths

How a panel is manufactured and installed, including the environment surrounding the installed panel, are factors that determine the width of a panel.

Before looking at these factors individually, be aware that most panels are given two different width dimensions. There is an overall width which is the actual, or formed, edge-to-edge size of the panel. The other width dimension is given as the coverage, or exposure, width. This is the width of the panel exposed to the environment. It can be thought of as the width of the panel actually seen after it is installed. It will be the smaller of the two width dimensions. The difference between the two widths is determined by the method used to install the panel and how the panel was designed. These are shown in Figures 5-1a and Figure 5-1b.

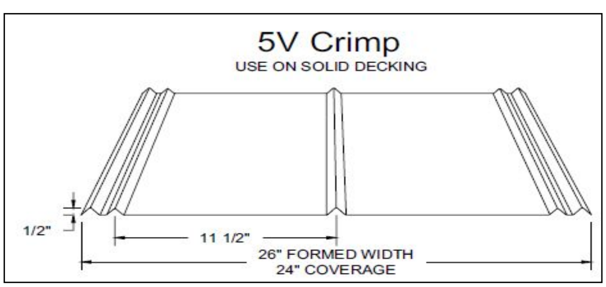

Figure 5-1a
Formed vs. Coverage Width

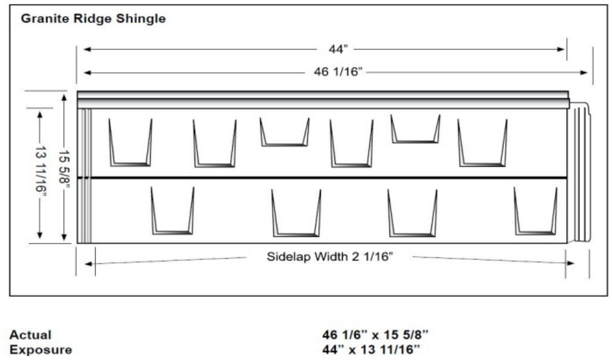

Figure 5-1b
Actual vs. Exposure Widths

Manufacturing Processes

Improvements in manufacturing enable panels to be made in virtually any length and significantly wider widths. Early panel dimensions were limited by the hand-tools used and by limitations of on-site brakes and formers.

Figure 5-2
Hand and On-Site Tools Limit Panel Size

Modern roll-forming equipment and the availability of larger coils of sheet metal allow larger panels to be produced. This reduces the number of panels, seams, and joints needed on a job. Longer panels lower installation costs, such as labor and materials. Fewer seams, joints, and panels also reduce the opportunities for leaks.

Figure 5-3
Large Coils of Sheet Metal Allow
Larger Roof Panels to be Produced

Orientation of the Installed Panel

A panel's installed orientation, vertical or horizontal, will be a factor in the panel's width and how it is measured. Vertical panels (Figure 5-4, left) can have widths from 12" or less for individual standing seam panels to over 36" for a ribbed structural-style panel. For vertical panels, length is the dimension of the panel "ridge-to-eave", while width is the "rake-to-rake" dimension of the panel material. These panels will normally have some style of rib along the entire length of the panel for joining to the next panel or covering the seam. Ribs are discussed in more detail in the next section, 5.2.

Vertical Horizontal
Figure 5-4
Panel Orientation

The "width" of a horizontally-installed panel may be designated differently because of its orientation after installation (Figure 5-4). The width of a horizontally installed panel may actually be shown as the "ridge-to-eave" dimension of the panel, while the panel length is shown as the "rake-to–rake" dimension. A common width for long, horizontally-installed panels is 12", but when a horizontally-installed metal roof panel is formed to look like other roof materials, the individual panel width can vary greatly. Modular panels representing clay tiles are 14" to 16" wide, while those looking like wood shakes may be wider, and those representing individual tiles or shingles may be much narrower, less than 12" wide.

In either case of vertical or horizontal panels, the width is considered the shorter of the two dimensions, and length as the longer.

5.2 Ribs

The main purpose of adding ribs to a panel is to strengthen it. The earliest ribs were added in the form of evenly spaced wave shapes called corrugating. These ribs were applied to the entire length and width of the panel, and made it very strong.

Manufacturing improvements, especially the roll-forming of sheet metal, enable various rib shapes, sizes, and spacing to be added.

In addition to strengthening the panel, ribs are added in order to cover panel seams, and to divert ice, snow, and water runoff. Adding ribs reduces the risk of leakage, especially between panels. Ribs of specific sizes and shapes can add to the attractiveness of a finished roof profile while providing additional ventilation as shown in Figure 5-5.

Most ribs run the entire length of a panel, although some profiles add horizontal ribs. Metal roof panel ribs are further defined by their shape, height, and spacing.

Figure 5-5
Ribbed Panels Add to a Building's Attractiveness

5.2.1 Rib Shape

Vertical and trapezoidal ribs are the two most common shapes used on metal roof panels.

Vertical ribs are normally 90° bends along the entire length of a panel with additional, smaller bends at the top edge for sealing or interlocking with other panels. The joint may be sealed using hand or mechanical seaming tools, separate interlocking pieces, or interlocks and "snap-fit" to the next installed panel or trim piece. (Figure 5-6)

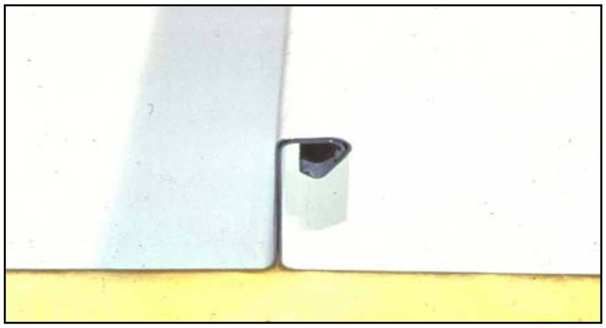

Figure 5-6
Typical Vertical Rib

Trapezoidal ribs are named after the geometric shape of the rib formed into the panel, as seen in Figure 5-7. When installed, trapezoidal ribs create open channels which provide ventilation under the finished roof, removing any moisture which may find its way beneath the roof panel.

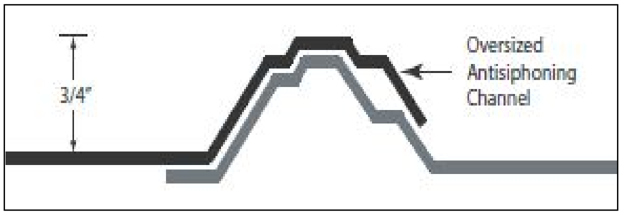

Figure 5-7
Typical Trapezoidal Rib with Overlap Seam

A benefit of both trapezoidal panels and corrugated panels, which was mentioned earlier, is that they are nestable. One panel actually fits, or "nests" inside the others. This is shown in Figure 5-8.

These panels are easily stacked for shipping and storing. They are also convenient to manufacture and install, making them less expensive than some other panel styles.

Figure 5-8
Nested Panels

The nature of nested panel profiles both simplifies and complicates installation. On very long roofs which require more than one panel to reach from ridge to eave, the end-to-end joint is easily accomplished with what is called a "nested end lap" and is circled below in Figure 5-9.

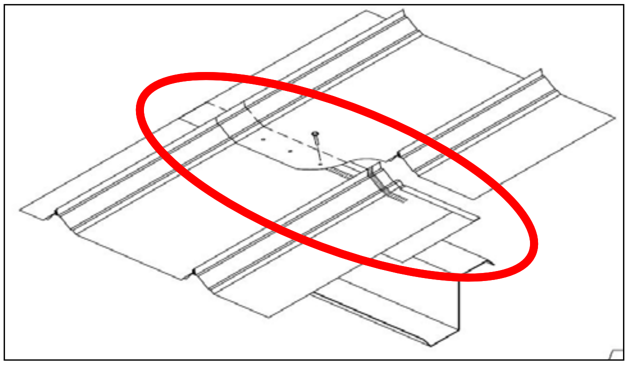

Figure 5-9
Nested End Lap

On the other hand, most ribbed and nested panels are more difficult to flash at hips, valleys, and other diagonal terminations because of the open areas beneath the ribs. Panels of this style are often installed using exposed fasteners which are unacceptable in some applications. Always follow the manufacturer's installation instructions for the specific style panel being installed.

Sometimes, a variation of these seams is used that incorporates a vertical rib formed on top of a trapezoidal rib. A big advantage of this seam is that the potential for leakage is reduced because the seam is further elevated above the drainage plain of the panel. This seam is shown in Figure 5-10 and is called a trapezoidal standing seam.

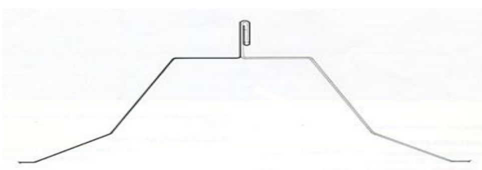

Figure 5-10
Example of a Trapezoidal Rib with Vertical Rib Seam Top

Smaller ribs across the pan of the panel have other names. Some are called pencil ribs. (Figure 5-11) These are small half-round, crescent-shaped ribs resembling pencils.

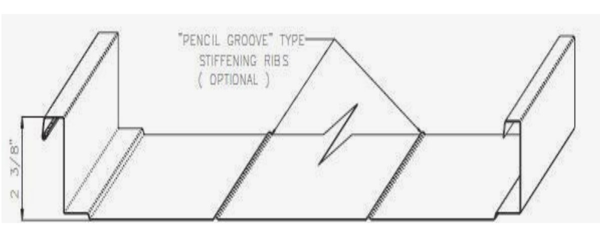

Figure 5-11
Vertical Rib Panel with Pencil Ribs

The shape of a rib is selected in order to match certain specifications. Specifications like panel strength, ventilation, environmental requirements or curbside appearance are all factors in a panel's rib shape. These same factors affect the next two rib characteristics: rib height, and rib spacing.

5.2.2 Rib Height

Rib heights vary, even within the same roof panel, for a variety of reasons. The tallest ribs are usually located at the edges along the length of the panel. The taller ribs cover any fasteners or clips used to secure the underlying panel to the substrate, as well as to provide protection from the environment since the panel beneath it also has a taller rib on its edge which needs covered.

When other ribs are added, they are usually referred to as intermediate ribs, minor ribs, pencil ribs, or similar names. These ribs, as seen in Figure 5-12, are usually not as tall, but serve to strengthen and stiffen the panel, direct runoff, and add design appeal.

Figure 5-12
Intermediate Ribbed Panel

5.2.3 Rib Spacing

Rib spacing, especially of the intermediate or minor ribs, depends on the overall width of the panel and design requirements. Ribs may be spaced evenly across the panel or in specific patterns. Some ribs may be a different shape and/or size, and appear to divide the panel in equal sections.

All ribs add to the material that is necessary to make a panel, which means added cost, but the benefits of the ribs are many. Installation is made easier because the ribs provide a convenient location to install fasteners and clips which are then covered and protected by the next panel. Panel stiffness, strength, and roof appearance are also improved. A variety of ribbed design profiles is shown in Figure 5-13.

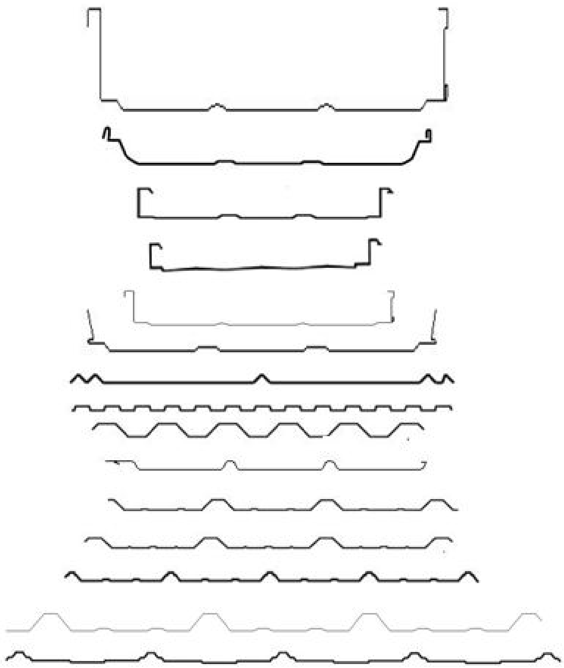

Figure 5-13

Examples Showing the Variety of Rib Shapes, Heights, and Spacing Available on Today's Metal Roof Panels

5.3 Gauge

Gauge refers to the thickness of the material used to make the panel. Sheet metal thickness is traditionally measured in terms of its gauge. Gauges are given as numbers. Common sheet metal gauge numbers range from 3 to 36 - the smaller the number, the thicker the material. A metal's gauge is also referenced to a nominal measured thickness normally stated in thousandths (.001) of an inch. For example, a 24 gauge uncoated steel panel would measure a nominal 0.0239" thick. Aluminum, however, is normally referred to by its decimal thickness and not its gauge.

A general guideline is that the thicker lower gauge material is considered the better quality panel. An installer will notice that the thicker material will handle, bend, cut, drill, and shape differently than the thinner material. However, the thicker material is usually more difficult to work.

Anyone working with metal roofing, and the variety of materials used for metal roofing, must be aware that the same gauge number does not mean the same material thickness when the materials are different. Referencing Table 5-1, 24 gauge aluminum measures a nominal 0.020" thick, while 24 gauge uncoated steel nominally measures 0.024" thick, and stainless steel, 0.025". A more complete version of this table may be found in Chapter 3.

Nominal Sheet Thickness (Inches)			
Gauge No	Uncoated Steel	Aluminum	Stainless Steel
10	0.1345	0.1019	0.1406
11	0.1196	0.0907	0.1250
12	0.1046	0.0808	0.1094
13	0.0897	0.0720	0.0937
14	0.0747	0.0641	0.0781
15	0.0673	0.0571	0.0703
16	0.0598	0.0508	0.0625
17	0.0538	0.0453	0.0562
18	0.0478	0.0403	0.0500
19	0.0418	0.0359	0.0437
20	0.0359	0.032	0.0375
21	0.0329	0.0285	0.0344
22	0.0299	0.0253	0.0312
23	0.0269	0.0226	0.0281
24	0.0239	0.0201	0.0250
25	0.0209	0.0179	0.0219
26	0.0179	0.0159	0.0187
27	0.0164	0.0142	0.0172
28	0.0149	0.0126	0.0156
29	0.0135	0.0113	0.0141
30	0.0120	0.0100	0.0125

Table 5-1
Gauge Table (in inches)

5.4 Side-Joint Configuration

The side-joint configurations on metal roof panels provide the most variety of any panel attribute. The majority of ribbed panels are joined side-to-side using a nested side-lap joint, some form of simple overlapping of the rib area, similar to that shown in Figure 5-14.

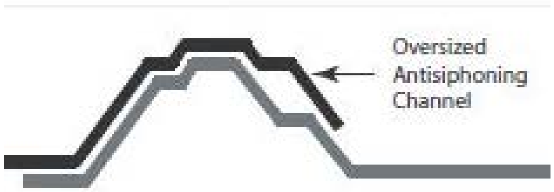

Figure 5-14
Nested Side Lap Joint

In the early days of metal roofing, side-to-side joining was accomplished by bending and folding the panel edges in the field. Depending on the number of folds, a single-lock or double-lock standing seam was formed. The difference between these two seams is shown in Figure 5-15.

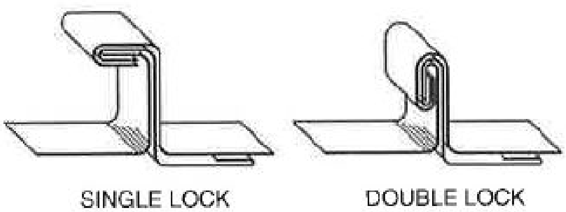

Figure 5-15
Field Formed Seams

Today's panels use several additional installation methods. Some panels are designed to interlock and just snap together. The snap-joint may be designed to cover previously installed fasteners or clamps, or require additional external fasteners to be installed, strengthening the roof system. Similar designs may snap together, but require a separate "cap" that snaps or slides into place, similar to a batten-type joint. A selection of common seam profiles is shown in Figure 5-16. Always refer to, and follow, the manufacturer's installation instructions when working with any panel.

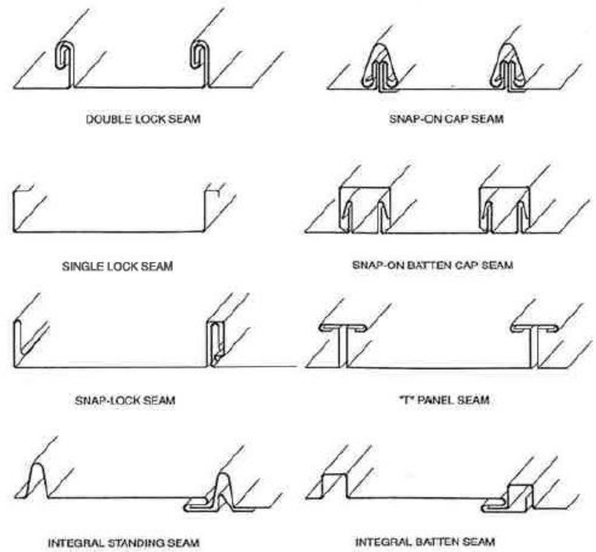

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Figure 5-16
Common Seam Profiles

Other panels are still installed using folded seams, both single-lock and double-lock styles. The seams are field-folded, but most utilize electric seaming machines similar to the machine shown below in Figure 5-17 to roll the seam. When properly adjusted, the seamer provides a more consistent, tighter seam than a hand-formed seam.

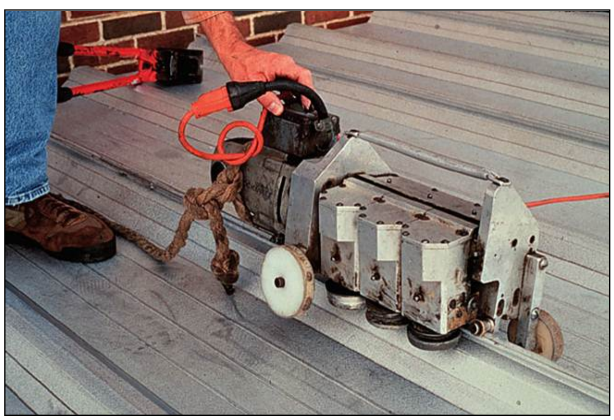

Figure 5-17
Power Seamer of Panel Joints

A few installations are still performed using hand-forming (Figure 5-18) just as it was done centuries ago. This method is very slow, costly, and seldom used, except in historic restoration applications, small repairs, and areas inaccessible by a mechanical seamer.

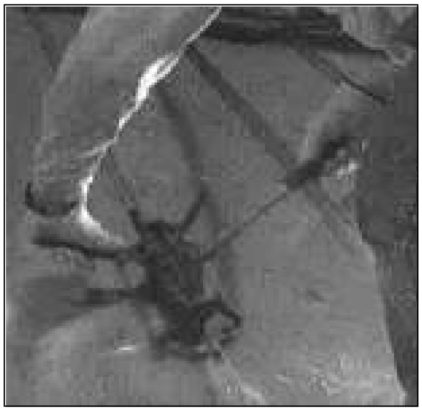

Figure 5-18
Hand Forming Panel Seams

Another side-joint configuration may be used when installing smaller unitized panels. Metal roof panels, fabricated to represent traditional shingles, shakes, and tiles, often use "fins" or flanges on several sides to interlock with panels already installed alongside, above, and below the panel being installed. Fasteners are installed along one side of the panel and covered by another panel as the installation progresses. These lap joints are clearly shown in Figures 5-19 and 5-20.

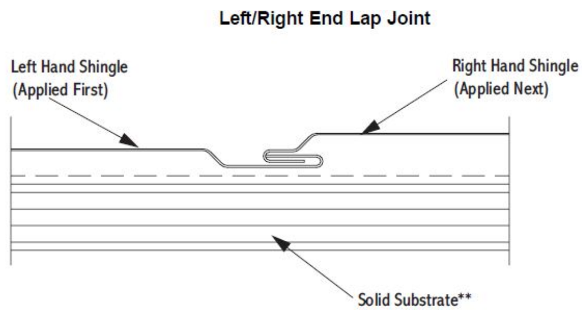

Figure 5-19
Side Lap Joint for Unitized Panels

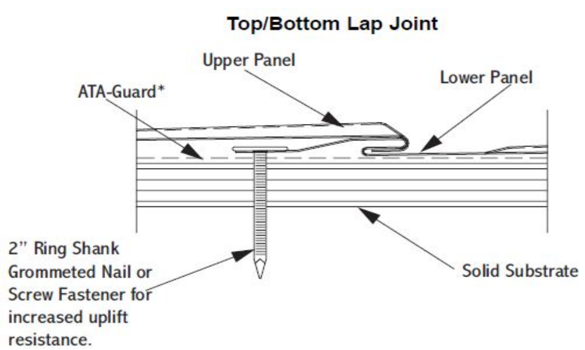

Figure 5-20
Lap Joint with Fasteners For Unitized Panels

Notes: