TECHNICAL BULLETIN: 03/01/2017

Profile/Furring Requirements

AFCC Profile Requirements:

- Material must be installed in accordance with the AFCC installation instructions
- A structural Engineer typically determines the fastening/fixing specification of the profiles and attachment of the panels
  - Must support *3.2lbs/ft^2* dead load
  - Must support the design wind loads for the geographic location
- If steel is used, profiles must be a minimum of *16-gauge*
- Depending on location/climate, a minimum of *G90* or greater hot-dipped galvanized coating is recommended.
- If aluminum is used, profiles must be a minimum thickness of *2 mm*
- Profile fasteners must allow for thermal expansion/contraction of the metal
- Profiles must be straight, plumb, level, and aligned correctly on the building
- Profiles for affixing panels must provide a *25-30 mm* ($1\text{-}1\frac{1}{4}$ *in*) airspace
  - Buildings from 60-150 *ft* tall must have *30 mm* airspace
  - Special provisions are required for above 150 *ft* buildings
- If a single profile is used at a vertical joint, the profile width must be greater than or equal to *120 mm* ($4\frac{3}{4}$ *in*)
- Interior center profile width must be greater than or equal to *40 mm* ($1\frac{1}{2}$ *in*)
- Two "Hat" or "Z" profiles greater to or equal to *40 mm* in width can replace one wide profile at a vertical joint
- Steel profiles must be less than or equal to *12 ft* in length
- Aluminum profiles must be less than or equal to *10 ft* in length
- Spacing between vertical profiles must be greater than or equal to *20 mm* ($\frac{3}{4}$ *in*)
  - A joint between vertical profiles must always coincide with a joint between panels

More detailed profile requirements are outlined in the AFCC Aluminum and Steel Profile Installation Instruction Brochures

Please contact American Fiber Cement Corporation at *303-972-5107* with any questions.

16 Gauge/2mm Thickness Requirements:

Steel and Aluminum profiles have a minimum required thickness to maintain a high rivet pullout strength and system rigidity. Using thinner profiles will negatively affect both these elements of the ventilated rain screen.

A direct switch out from 16-gauge to 18-gauge steel is a poor choice for the following reasons. To use 18-gauge steel, the system would have to be re-engineered to get around not meeting the required rivet pullout strength and profile rigidity. Re-engineering this system would require the expense of an engineer. The re-engineered system would also result in making the system more expensive compared to using 16-gauge steel. A cost analysis of a ventilated rain screen system with 18-gauge vs. 16-gauge steel is shown on page 3.

Rivet Pullout Strength:

Decreasing the profile thickness from 16-gauge to 18 gauge will significantly lower the rivet pullout strength of the profile. Going from 16-gauge to 18-gauge reduces the thickness of the profile by approximately 20% but the rivet pull out strength is nearly 50% lower. This lower pullout strength requires the use of more rivets per profile. In needing more rivets, more holes must be drilled in the profiles as well as the panels.

With a thinner profile, the quality control of drilling holes is also lowered. When drilling a pilot hole in a lighter gauge metal, the drill bit is more likely to move up, down, left, or right. This can create a slightly larger than desired hole. Even a slightly larger hole can significantly reduce the rivet pullout strength. This will require the use of even more rivets, more pilot holes in the profile, and more panel holes.

System Rigidity:

In having thinner profiles, the bending strength is also reduced. To obtain the same system rigidity as 16-gauge steel or 2mm aluminum, thinner profiles must use more fasteners per lineal foot of attachment to the wall. If the system incorporates horizontal and vertical profiles, more fasteners must be added on the horizontal profile to the stud as well as the vertical profile to the horizontal profile.

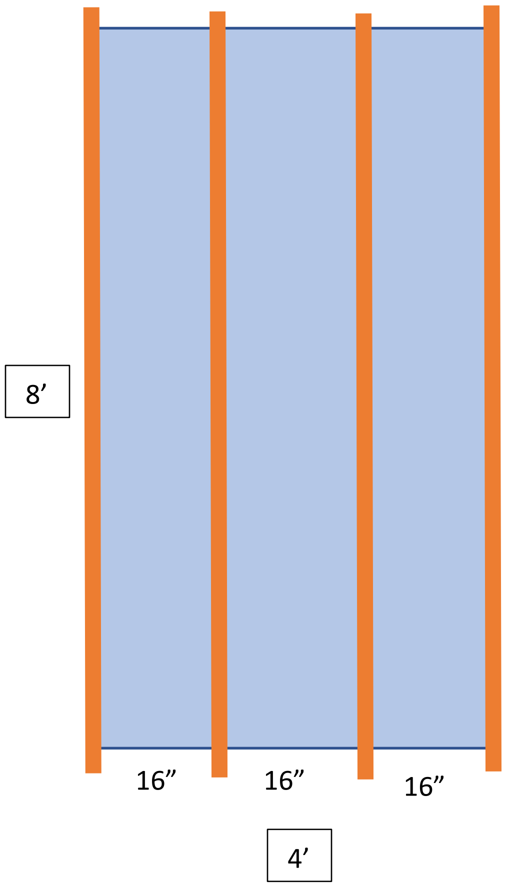
This process will require purchasing more fasteners and drilling more pilot holes.

Summary:

When using a thinner profile in a ventilated rain screen system, the combination of both a lower rivet pullout strength and system rigidity will create higher material and labor fees. These higher fees will always outweigh the slightly lower cost achieved in purchasing a thinner metal profile. Additional engineering design fees will also apply. The result of using 16-gauge steel or 2mm aluminum will always yield a lower cost when incorporating all of the factors.

*For these reasons, Knight Wall or any other 18-gauge steel cannot be used with AFCC's Fiber Cement Panels.

Cost Analysis (18-gauge vs. 16 gauge):



For this analysis, a single 4’ x 8’ sheet will be used. There are four profiles, shown in orange, spaced 16” on center. These are z-profiles fastened back into the studs.

The cost of the following portions of the system will be analyzed when using both 16 and 18-gauge steel:

- Profiles
- Rivets
- Fasteners
- System Summation

This analysis is being performed to attain two systems with equivalent performance from each gauge steel.

Profiles:

The cost of steel profiles can significantly fluctuate based on order quantity. The cost of 16 versus 18-gauge tend to differ by $0.08-0.12/ft. for varying quantity orders. The specific z-profiles are 1 ½ - 1 – 1 ½. The following prices will be used for analysis:

18-gauge: $0.58/ft.

16-gauge: $0.68/ft.

There are 32 lineal feet of z-profiles per 4’ x 8’ sheet (Four 8’ pieces).

Price Calculations:

18-gauge: $\frac{\$0.58}{ft} * 32ft = \$18.56$

16-gauge: $\frac{\$0.68}{ft} * 32ft = \$21.78$

Δ = - $3.22 for 18-gauge

Rivets:

The rivet pullout strength of 18-gauge steel is nearly half the value of 16-gauge, but it will be assumed that it is only 33% worse for this analysis. Each painted rivet costs $1.00. Using 16 gauge, the rivets will be spaced 15” apart and 3” from the top and bottom. Therefore, there will be 6 rivets per 8’ of profile.

Rivet Calculations:

16-gauge: $6\ rivets * 4 = 24\ rivets/panel$

18-gauge: $24 * 133\% = 32\ rivets/panel$

Price Calculations:

18-gauge: $\frac{\$1.00}{rivet} * 32\ rivets = \$32.00$

16-gauge: $\frac{\$1.00}{rivet} * 32\ rivets = \$24.00$

Δ = + $8.00 for 18-gauge

*There will also be an additional labor fee for attaching additional rivets and corresponding hole drilling when using 18-guage steel.

Fasteners:

When calculating the number of required fasteners, the bending strength of the steel must be analyzed using the following equation:

$$\sigma = \frac{3FL}{2bd^2}$$

Where:

$\sigma = bending\ stress$

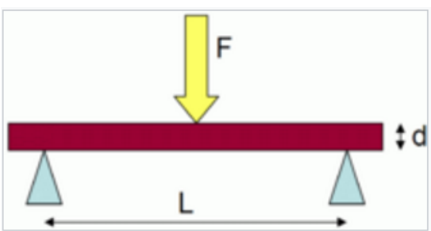
$F = force\ (based\ on\ wind\ load)$

$L =\ length\ (fastner\ spacing)$

$b = profile\ width$

$d = profile\ thickness$

The force and profile width are held constant for both 18 and 16-gauge steel. If the bending stress is to be the same when using 18-gauge steel, the fastener spacing (*L*) must be reduced.



Beam under 3-point bending

This image resembles the bending strength equation shown above. The beam is a profile of thickness *d* and with a fastener spacing of length *L*.

By combining all the variables that are held constant (σ, F, b) into a single constant (A), the resulting equation can be changed to:

$$L = Ad^2$$

Fastener Spacing Calculations:

(*Assume 18-gauge = 0.05 in & 16-gauge = 0.0625in*)

18-gauge: $L = A(0.05in)^2 = 0.0025A$

16-gauge: $L = A(0.0625in)^2 = 0.0039A$

$$\frac{18gauge}{16gauge} = \frac{0.0025A}{0.0039A} = 0.64$$

The fastener spacing calculation concludes that 18-gauge steel requires a smaller distance between fasteners. This means that more fasteners and clearance holes are required. 36% more fasteners will be required. A z cross section is more complex and has more strength than a simple beam, so it will be assumed that only 25% more fasteners will be required. It will be assumed that 16-gauge steel requires 6 fasteners per 8 feet of profile.

Fastener calculations:

16-gauge: $\frac{6fasteners}{8ft} * 32ft = 24\ fastners$

18-gauge: $24\ fastners * 125\% = 30\ fasterners$

It will be assumed that fasteners are priced at \$0.20 each.

Price Calculations:

18-gauge: $\frac{\$0.20}{fastner} * 30\ fastners = \$6.00$

16-gauge: $\frac{\$0.20}{fastner} * 24\ fastners = \$4.80$

Δ = + \$1.20 for 18-gauge

*There will also be an additional labor fee for attaching additional fasteners and corresponding hole drilling when using 18-guage steel.

System Summation:

18-gauge: $Total\ Price$: \$56.56

16-gauge: $Total\ Price$: \$50.58

Δ = + \$5.98 for 18-gauge

*Additional labor not included

Conclusions:

A direct trade-out from 16-gauge to 18-gauge steel cannot be performed because the system will not have equivalent performance. Although 18-gauge steel is cheaper, using it over 16-gauge steel will require more rivets, fasteners, and labor fees for hole drilling as well as fastening the extra screws and rivets. The net result is a more expensive system as shown from this example. Any of the assumptions in the example may be altered but, the net total will always be lower for 16-gauge steel.