All Weather Insulated Panels utilize a semi-rigid polyisocyanurate (polyurethane) foam core with excellent flexibility, resistance to core shear and adhesion properties. When panels are mechanically fastened to the perpendicular supports, they rigidize the assembly and rely on the thermal expansion coefficients of the foam core and exterior steel facing as a unitized composite to withstand movement without structurally compromising the components. The thermal expansion coefficient in steel is also higher than that of the foam core. Therefore, as the exterior and interior facings are exposed to different temperatures at the same time (termed “temperature differential”), the panel composite may bow out of plane with the warmer face becoming convex due to the expansion of the metal. On cooler and freezer buildings, thermal bowing can be even more exaggerated because of the increased temperature differential.

To measure resistance to bending and thermal movement, All Weather panels have been tested for inward/outward deflection for two million continuous cycles with no evidence of adhesive/cohesive delamination or core failure. Assuming five thermal cycles per day and a safety factor of 3.0, this calculates out to 365 years. It is important to recognize that, like all building claddings, IMPs do have limitations, which is why AWIP provides load span tables based on ASTM E72 Transverse Load Testing, solar load guidelines as well as project specific engineering analysis to determine whether a particular application is within the appropriate margins for acceptable panel performance.

AWIP incorporates software programs that have been developed based on the physical characteristics of the product components and industry engineering standards. The principles and design of sandwich panels developed in both Europe and North America have proved to be extremely valuable in pre-determining the performance of insulated metal panel wall and roof assemblies.

Analyses include an evaluation of the following design parameters: panel type, core thickness, steel thickness, panel length, panel color, building orientation, span between structural supports, temperature differential, fastening patterns, wind loads and panel end use. Unchecked, the long term results of excessive thermal bowing will induce aesthetic failure through thermal rippling and potential delamination resulting in blisters and creases as the panels look for a way to relieve stress.

The figure to the left shows an exaggerated image of thermal bow on an insulated metal panel.
Recommended Panel Lengths

As previously discussed, the thermal expansion coefficient of the steel facer is higher than the polyisocyanurate core. As the metal face begins to expand, the adhesive bond between the face and foam restricts the steel from moving and can potentially result in thermal rippling or blistering. To mitigate the potential for face stress caused by thermal expansion, panel lengths must be limited based on core thickness, color and face gauge. Increasing the core thickness can minimize the amount of thermal bow in the panel because of greater bending stiffness in the foam. Also, the use of lighter colors on the exterior face will lower the temperature differential and reduce the stress imposed on the panel. Surface temperatures of paints with cool pigmentation can range between 120ºF to 165ºF.

AWIP’s Solar Load Table (Technical Bulletin #80) recommends maximum panel lengths based on light, medium and dark exterior face colors. If any roof or wall exceeds these lengths, the use of endlaps or stack joints is recommended. If single length wall panels are absolutely needed, a relief cut on the exterior face of the panels will be required immediately after installing. The continuous relief cut can be made at a girt line approximately mid-height and will not structurally compromise the panel.

Framed Openings

Panel creasing and thermal rippling is exacerbated in corners, doors, windows or any openings where panels are further rigidized with extra framing. Interior relief cuts are recommended to be made at the panels that are cut to fit any framed openings. The interior cut is made on the panel adjacent to the header framing (or the closest girt, if not on the same elevation.) This cut should not be farther than 2” from the girt if a typical circular saw is used, and the cuts should not be visible from the floor level since the flange of the girt will cover the cut.

For walls with multiple overhead doors spaced relatively close to one another, a continuous stack joint at the framed opening header elevation is recommended. If single length panels are absolutely needed, an exterior relief cut will be required to relieve the stress caused by over-rigidization.
Supporting Steel

For quality panel installation, it is imperative that the supporting steel is properly aligned before the installation of wall panels. The maximum deviation of steel alignment should be limited to 0” + 3/16” from the control with a 1/8” maximum change in deviation for any member of any 10’-0” run of panel. The figure to the right illustrates an extreme condition where girts are out of plumb which can result in additional stress in the panel.

Furthermore, secondary framing shall run perpendicular to the panel length for proper fastening. When framing runs along the length of panel, the panel is restricted from any thermal bow and can result in panel failure. As such, panels shall not be installed to columns when used with inset girts. If the panel joinery falls on a column, flange clips with Fabloks shall be used to fasten the panels onto each adjacent girt. The same procedure is applicable to corner conditions as well.

Support Spacing/Fastening Patterns

Girt or purlin systems are used to support insulated panel systems which in turn helps to stabilize the secondary framing when fastened together. However, special care must be taken into consideration when designing secondary framing for IMPs. When panels are mechanically fastened to closely spaced framing, they may become over-restrained and thusly exposed to stresses as the exterior facing expands and panels bow outward. Secondary framing should be designed no less than 5’-0” on center. For heavy gauge structural steel that is less forgiving than light-gauge steel, panels should span even farther with the higher pullout values structural steel can offer for attachment. The thicker hot-rolled members would provide less flexibility as insulated metal panels deflect, thereby further restricting panel movement. Ideally, the fastening spacing for heavy gauge structural steel girts should be designed for no less than 7’-0” on center.

If high suction loads are present on a particular project, there is an option of increasing the panel thickness or using back-fastened Fabloks in addition to the clip fastening assembly depending on what is necessary to meet project requirements. When additional framing is necessary for column stability, snow loads or other building design requirements, the fastening patterns for the panels can be staggered at every support. For example, odd-numbered joineries shall be fastened at the first and third girts and even-numbered joineries shall be fastened at the second and fourth girts. Note that this fastening pattern doubles the tributary area for each fastening assembly. Panels can also be fastened in an unstaggered pattern onto alternating girts. Note that the standard fastening assemblies will be designed to resist the full wind loads.

If there are concerns regarding girt or purlin support from the panels, 1’’ Tek fasteners may be fastened through the support flange and into the interior skin of each panel along span of the supports. This will provide extra stability to the supports and still allow the panel to move under stress.
Thermal Blisters

Thermal blisters are round or oblong “bubbles” in the steel facing that typically form from a combination of face delamination and the subsequent release of blowing agent gases from the foam core substrate. After migrating from the foam core into the space behind the blister, the blowing agent can expand under extreme temperatures and create a bubble on the panel face.

In most applications, insulated metal panels are not used as structural supports and only need to perform as a building cladding subjected to standard design loads. Therefore, panels will perform in place with as much as 50% delamination, particularly if they are mechanically fastened through both facings into the supporting structure. Thermal blisters can be relieved by drilling a maximum 1/16” hole through the metal skin at the bottom of the blister to release the expanded blowing agent. It is imperative that the cause of the blistering be determined and corrections made to mitigate future blistering prior to making repairs. Detailed procedures can be obtained from your AWIP representative.

If you have any further questions or concerns regarding panel design, please contact your AWIP representative for more details.