Photo courtesy of All Weather Insulated Panels

This $100-million, LEED Silver certified Great Park Ice & FivePoint Arena is the largest ice facility in California and one of the largest in the United States, and it features an IMP roof.

The Advantages of an IMP Roof

A closer look at the thermal performance and sustainability qualities offered by insulated metal panels

Sponsored by Metal Construction Association's Insulated Metal Panel Alliance

There is a common misconception in the design and construction industry that insulated metal panels, often referred to as IMPs, are only suited to provide a solution for an exterior wall in the building envelope. This unfortunate misunderstanding unnecessarily limits designers to roof systems such as traditional built-up and single-membrane roofs with limited service life spans, or traditional metal roofs with independent thermal and moisture barriers that must be detailed and installed as separate materials and might suffer from installation mistakes that compromise the thermal performance or moisture management.

The truth is that IMPs can provide a high-performance roofing solution that offers exceptional thermal performance, unparalleled ease-of-installation, and gives the designer freedom to create building profiles rich in character. IMPs also meet or exceed multiple sustainable design criteria that contribute toward a project earning green building certifications or simply support the design and construction of healthier and more environmentally conscious buildings.

This course will explore the use of insulated metal panels as a roofing solution. Features of the panels, including their material construction, will be discussed as will the wide range of benefits that these products can offer a project. Multiple case studies will be profiled throughout showcasing how architects around the United States have successfully applied this IMP roofing system.

CONTINUING EDUCATION

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Learning Objectives

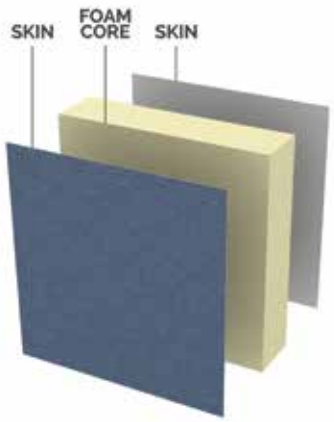
After reading this article, you should be able to:

1. Explain the level of thermal performance that can be designed into an insulated metal panel (IMP) roof system, supporting the creation of a highly efficient building envelope.
2. Describe the qualities that insulated metal panels possess that allow them to provide continuous insulation to the building envelope, satisfying building codes.
3. Provide examples of how insulated metal panels provide the continuous air and vapor barriers in the roof or exterior wall system, managing the movement of air and moisture in the building enclosure.
4. Identify the several ways that the selection of insulated metal panels support sustainable design criteria.

To receive AIA credit, you are required to read the entire article and pass the test. Click here to take the test.

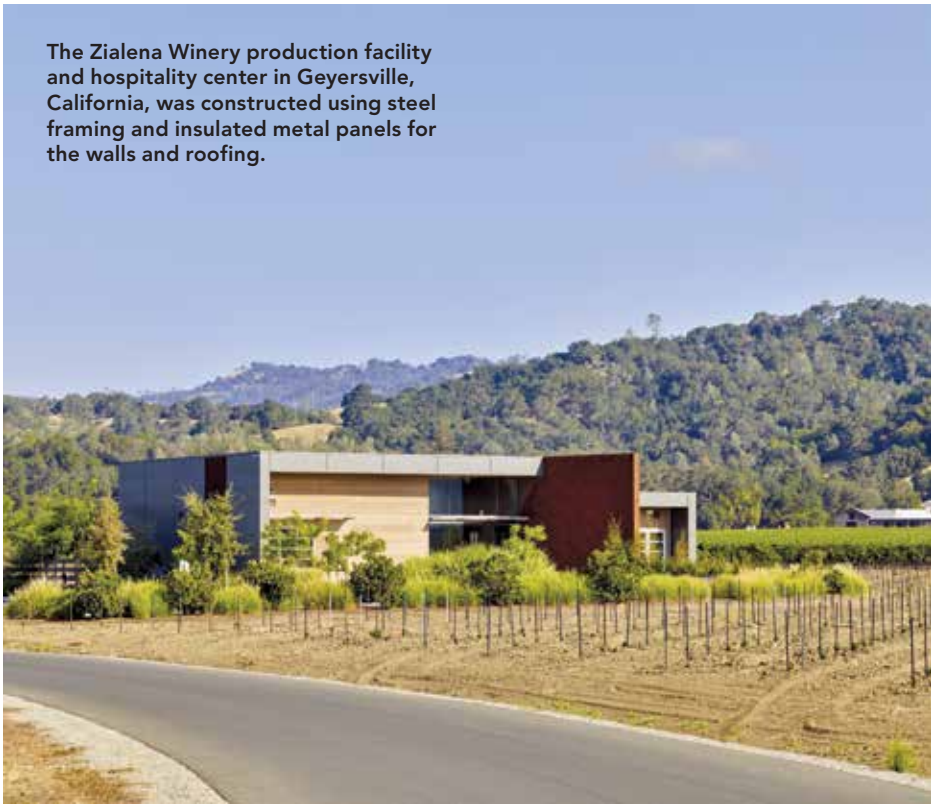
MCA COURSE #1221

Image courtesy of Metal Construction Association



IMPs are lightweight sandwich panels comprised of exterior and interior metal skins that have an insulating foam core.

Photo courtesy of Metl-Span



The Zialena Winery production facility and hospitality center in Geyersville, California, was constructed using steel framing and insulated metal panels for the walls and roofing.

INTRODUCING INSULATED METAL PANEL (IMP) ROOFING

IMPs are lightweight sandwich panels comprised of exterior and interior metal skins that have an insulating foam core. The metal substrates most often used for the faces of painted IMPs are G90 galvanized steel or AZ50 aluminum-zinc coated steel, while unpainted roof panels are typically AZ55 aluminum-zinc. Many panels can also be manufactured from stainless steel or aluminum.

The interior-facing surface is typically finished with a nominal standard polyester coating in a light-reflective and easy-to-maintain color. The foam is injected or poured in place between the two metal sheets, where it expands, cures, and bonds to the metal skins in a matter of seconds. The insulation completely fills the cavity, allowing the solution to offer incredible thermal performance.

The combination of the two metal skins, the interior layer of insulation, and the embedded side joint sealant creates an assembly that serves as a water-control layer, air-control layer, and vapor control with a durable, UV-resistant exterior surface. The insulation provides the thermal control layer, and the interior metal face, in conjunction with the sealant, provide an air-control layer, and a vapor-control layer.

The location of these control layers makes an IMP assembly something of a perfect roof. The water-, air-, and vapor-control layers are all located on the exterior of the structure, with thermal control located inboard along with a duplicate air- and vapor-control layer. Because of their construction, IMPs can be used in all climate zones—cold, hot, humid, dry, mixed, or marine.

As a roofing solution, IMPs provide exceptional insulating properties, superior spanning capability, accelerated installation times, and recycled content. These systems can be installed on both low- and steep-slope roofs, allowing for use in most commercial and residential projects. IMP roofs beat competing roofing systems on weather-tightness and achieve a Class A rating for external fire. They can also be integrated with other wall and roof systems while maintaining proper control-layer continuity.

These panels can be designed to satisfy a variety of performance specifications, including insulation values, span lengths, and load/span capabilities. Their ability to be customized enables architects to find an IMP solution that is the right fit for any project.

HISTORY OF IMPS

IMPs first emerged as a building product in the 1960s. While predominantly used as an exterior wall assembly, these panels were, even then, used as a roofing solution. Throughout the last 60 years, the materials and production methods have advanced considerably. IMP manufacturers were originally responsible for creating the individual components—the metal panels and the insulation—as well as assembling them. Today, there are major chemical companies invested in improving and producing foam core insulation with increasing levels of thermal performance and fire resistance. This has allowed IMP manufacturers to focus on improving the construction of the overall assembly. This divide-and-conquer approach has resulted in tremendous innovation within the IMP industry.

Continues at ce.architecturalrecord.com

WALL PANELS AND ROOFING PANEL PROFILES

Beyond performance improvements, IMPs are available in a wide variety of colors, widths, profiles, and finishes. For exterior wall applications, panel profiles are often described as ribbed, fluted, planked, or flat. These panels can have texture, be embossed, or feature a sprayed-on aggregate that creates a faux stone appearance. Panels can be applied vertically or horizontally, depending upon the joinery.

Roof panels also offer different types of joinery and profiles. There are two basic categories of roof panel profiles: standing seam profiles and through-fastened profiles. Each offers its own blend of benefits. Let's take a closer look at how these profiles are different and the advantages that they offer on a project.

Roof panels with a standing seam profile are mechanically seamed together during installation. This delivers incredible weathertightness. Standing seam panels are also notable because there are no exposed fasteners within the envelope boundaries. The fasteners that connect the panel to the roof framing are covered when the next panel is joined to it.

Several IMP manufacturers offer distinctive profiles, giving architects several aesthetic options from which to choose. A traditional joinery is a standing seam panel with a 2-inch straight leg. Some manufacturers offer panels with a T-shaped joinery. There are also roof panels that feature a trapezoidal joinery. These panels have a 2-inch leg and a trapezoidal lower half, creating a panel installation with greater dimension across the face of the roof.

Through-fastened profiles refer to panels where the fasteners are exposed or visible. While these solutions may not provide the flawless aesthetic created by the standing seam panels, through-fastened panel systems can be installed quicker than the standing seam variety because they do not require that the installer mechanically seam the panels together.

FEATURES AND BENEFITS

It is very common to use IMP roof panels in Europe. They are not used as roofing solutions as much in the United States, but that is changing as architects here become more aware of the benefits of an IMP solution and as the building and energy codes evolve to require greater levels of thermal performance and continuous insulation. Also, IMPs support many sustainable design criteria and so they are often selected on projects that are either pursuing green building certifications or where the owners want the buildings designed to be green conscious.

Photo courtesy of All Weather Insulated Metal Panels

The roof on the Theorum Winery offers the look of traditional standing-seam roof for a stylish appearance as well as the high R-value, energy efficiency, and outstanding fire rating that come with IMPs.

CASE STUDY: ZIALENA WINERY

Zialena Winery sits on a 120-acre property in Geyersville, California, that has been in the family since the early 1900s, when Giuseppe Mazzoni emigrated from Italy to become a grape farmer and winemaker. Recently, a new production facility and hospitality center were constructed on the site, overseen by Giuseppe's great-grandchildren.

The 10,000-square-foot production building was constructed using steel framing. IMPs were used for the exterior walls and roofing. The IMP roofing panels (10,669 square feet) were 5 inches thick with a 22-gauge exterior in a charcoal gray color. The 2,200-square-foot hospitality center was finished to match the production facility. The exterior wall panels selected were charcoal gray, white, and terra cotta colors.

Conventional multi-component building envelopes address the weather barriers with multiple product sources and installation steps, leading to complex wall assemblies and lengthy construction schedules. IMPs provide the same performance elements in a single, easy-to-install component. The end result is a more efficient building envelope that impacts everything from interior trade coordination to the bottom line. The product provides thermal efficiency and all-weather control. The highly efficient insulation delivers an added advantage by minimizing building energy usage and installation labor costs. The product's unique foam core allows the insulation R-value to increase as the core temperature of the panel decreases. Durable interior panels are easy to keep clean, which is important in a facility where beverages are produced.

"We started with a steel frame system and, to reduce cost, selected insulated metal panels that provide finished interior and exterior walls as well as insulation all in one," says Dave Siegert of Osborn Architects in Santa Rosa, California. "Aesthetically, we were after a modern texture which we achieved with this sleek finished product."

Impressive Thermal Performance

Energy codes are increasingly requiring that building envelopes be designed to deliver higher levels of thermal performance. This means that building envelopes must do a better job of minimizing the movement of thermal energy across the assembly in the form of thermal gains in the summer or thermal losses in the winter.

The metric used to describe a material's ability to resist heat flow is the R-value. IMP foam cores are is typically tested at 1-inch thickness. The higher the R-value of a material indicates that the material is better at resisting the flow of heat and is a better insulator.

IMPs have a foam core that can provide a thermal performance of R-7 per inch or greater. This R-value is impressive when you look at the typical thermal resistance of other types of insulation. Mineral fiber and cellular glass have a typical R-value of R-3 to 3.5 per inch. Expanded polystyrene typically offers R-4 per inch. Extruded polystyrene another popular insulation solution has an R-value of R-5. Many IMPs are manufactured with a type of polyurethane insulation that can achieve R-values of R-7 or more per inch.

Energy codes today can require the commercial envelope to contain enough insulation to achieve R-values in the 40s. This better-performing insulation can be used to create panels that achieve R-values of up to 45 in dramatically thinner solutions than could be produced with mineral wool or extruded polystyrene. Generally speaking, as the thickness of an IMP wall system increases from 1 to 6 inches, the R-values increase from 7 to 48. The R-value of roof systems also ranges from R-10 to R-48, as the thickness of the panels ranges from 1.5 to 6 inches.

Beyond increasing requisite R-values, the thermal performance of the building envelope can be improved by eliminating any thermal bridges. A thermal bridge refers to a solid connection of higher thermal conductivity between the warm side and the cool side of an assembly that allows heat to flow freely between the sections where the insulation is present.

Research into the science behind the thermal performance of a building has revealed that the effect of thermal bridging plays an important role, even in well-insulated enclosures. The R-value often does not include the impact of specific thermal bridges, so the industry is moving toward designing building enclosures with fewer thermal bridges, and the major motivators behind this movement are the model code bodies.

Photo courtesy of ATAS International, Inc.

IMPs on the walls and roof of this barn-style building provide superior insulating properties, and their outstanding spanning capabilities and one-pass installation makes them quick to install, saving costs compared to other wall assemblies.

Inherent Continuous Insulation

Code language is being modified to emphasize how important it is to avoid thermal bridges and the energy inefficiencies they create in the building envelope by requiring continuous insulation. Continuous insulation, or c.i., is defined by ANSI/ASHRAE/IES Standard 90.1-2019, Energy Efficiency Standard for Buildings Except Low-Rise Residential Buildings (ASHRAE 90.1) as, "Insulation that is uncompressed and continuous across all structural members without thermal bridges other than fasteners and service openings." It is designed to minimize thermal bridging, primarily of wood- and steel-framed structures, and it can be installed on interior, exterior, or is integral to any opaque surface of the building envelope.

ASHRAE 90.1 shows a clear trend for requiring continuous insulation, specifically in climate zones 5-8. Properly installed, continuous insulation reduces thermal bridging, increases the effective R-value of the wall system, helps control condensation, and air/water infiltration.

IMPs have no compression of insulation and no thermal bridging. The joint geometry of IMP systems addresses thermal bridging in a more robust manner than typical site-built assemblies for walls and roofs, a design asset for maintaining thermal performance.

Sustainability Qualities—subhead level 1

Code compliance and efficiency is one thing. Sustainability is another. The concept of sustainability goes deeper and demands more. Products that support sustainable design must do more than make interiors more efficient. They must simultaneously either improve, or at the very least not damage, the quality of the interior environment and the health of its occupants and minimize their environmental footprint. For that reason, green building programs consider criteria like the recycled content or recyclability of a product. They evaluate whether a solution off-gases chemicals that could be toxic to humans or deplete the ozone layer. IMPs support many of the sustainable criteria beyond improving the thermal efficiency of the project.

Recycled Content

Green building programs incentivize the use of products or materials with recycled content to increase the overall demand for building products that incorporate recycled content, reducing impacts on the Earth that result from the extraction and processing of virgin materials.

Photo courtesy of ATAS International, Inc.

The IMP roofing on Nebraska Correctional Center for Women in Lincoln, Nebraska, provides a low-maintenance, highly energy-efficient solution for the facility.

Recycled content is technically the content of a product or material that has been made from pre- and post-consumer material. Pre-consumer material is diverted waste from manufacturing. Post-consumer material is waste that is redirected from landfills after a consumer has used it and put to use in other forms.

The steel faces in an IMP contain a minimum total recycled content of 30 percent or more. The post-consumer recycled content is approximately 23 percent and pre-consumer recycled content is approximately 7.3 percent.

100 Percent Recyclable

An interest in whether a product is recyclable goes hand-in-hand with an interest in whether it contains recycled material. In both cases, waste is diverted from landfills and reused. A product is recyclable if it can be recycled.

The steel facings and foam core in insulated metal panels are virtually 100 percent recyclable at the end of their service life.

No Volatile Organic Compounds

Volatile organic compounds (VOCs) are gases emitted by products or chemicals that may have short- and long-term adverse health effects. According to the EPA, VOCs are emitted by an array of products numbering in the thousands. Examples include paints and lacquers, cleaning supplies, pesticides, building materials and furnishings, office equipment such as copiers, correction fluids and carbonless copy paper, and more.

IMPs and their accessories do not produce measurable VOCs. The paint is factory applied and baked on, and the sealants are generally more than 95 percent solid (non-skinning butyl) or moisture-cured polyurethanes. This means they can be incorporated into the building envelope and roof without negatively impacting the indoor air quality.

Zero Ozone Depletion Potential

Ozone depletion potential (ODP) measures the potential for a single molecule of refrigerant to destroy the ozone layer. Ozone-depleting substances are used in refrigeration, air conditioning, building insulation, and firefighting equipment in buildings. Unfortunately, according to the U.S. Green Building Council (USGBC), the newer ozone-friendly alternatives are potent greenhouse gases that are a threat to climate change. This creates the quandary where the solution to ozone protection is becoming a problem for climate change. The solution is to select zero-OPD and low-GWP alternatives. Global Warming Potential (GWP) is a value that quantifies the direct effect of global warming of a compound or gas. According to the USGBC, the direct effects of global warming are measured by comparing them to CO_2, which has a GWP of 1.0.

Most IMPs have zero ODP, and there are no limits by the EPA or Environment Canada for its use today or in the future. Furthermore, many manufacturers offer foams using low-GWP options.

Low Global Warming Potential

Blowing agents are gases that expand foam insulation to its rigid shape. They are used to manufacture a few different types of insulation, including extruded polystyrene rigid panels and spray polyurethane. Previously, the blowing agents used in insulation were potent greenhouse gases and, as such, had a high level of global warming potential. Some blowing agents in common use years ago had a GWP in the range of 5,000. Several low-GWP alternatives have become available over the past few years.

The insulation used inside IMPs meets current EPA blowing agent requirements for the reduction of Global Warming Potential.

Net Zero Energy Targets

A net-zero energy building (NZEB) is a residential or commercial building with greatly reduced energy needs that supplements with on-site energy generation to the point that external energy use averages out to zero over the course of a year. IMPs contribute significantly toward net-zero energy targets by yielding as much as a 30 percent reduction in a building's energy use.

Design Flexibility

IMPs also offer designers an incredible level of flexibility in designing building envelopes and roofs. There are a wide variety of standard and custom colors available. Special print patterns can mimic the look of stone or weathered metal, and many manufacturers offer cool roof pigments for added building energy performance.

High Strength-to-Weight Ratio

IMPs are very strong structurally due to the composite action between the flat metal facings and the foam core. The metal skin acts like the flange of a beam, resisting bending stresses. The foam core acts like the web of a beam, resisting the shear stresses. The result is that IMPs have a high strength-to-weight ratio.

Photo courtesy of Centria

The need for a sleek, high-tech look combined with the aggressive timing made metal an ideal choice for the Boeing building in Charleston, South Carolina. IMPs were chosen for their aesthetic and inherent performance qualities.

This high strength-to-weight ratio gives IMPs excellent spanning capability between supports. For example, for a 2-inch panel, most wind load requirements in the 20 to 30 psf range can be met with 7- to 10-foot span conditions. Snow loads up to 30 psf can be met with this same span.

It should be noted that the thickness of the core, the panel profile, connection details, and the gauge of the metal facings all contribute toward determining the actual span capability of any specific panel. Manufacturers normally publish the span capabilities of their panels in load span tables. Many also have ICC-ES reports available for download. Architects can incorporate this increased span capability into the roof plan.

Structural load capacity should be verified by representative structural tests for positive as well as negative wind loads as shown in testing, such as ASTM E72: Standard Test Methods of Conducting Strength Tests of Panels for Building Construction and ASTM E330: Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference. The maximum allowable deflection limits are set by building codes. They can be found in Table 1604.3 of the 2018 International Building Code (IBC 2018). The local building code should be referenced for the applicable limiting criteria. The effects of snow load and long-term loads on roof panels should be considered as appropriate in the structural analysis.

Compliance with the structural provisions of the code can be shown in two ways. The IMP manufacturer will provide calculations sealed by a professional engineer verifying that all factors affecting the

Photo courtesy of Metl-Span

CASE STUDY: SKS BOTTLE & PACKAGING

On the SKS Bottle & Packaging building, the IMPs exceeded the eave lines to create a parapet of varying heights to break up the "boxy" look of the building.

SKS Bottle & Packaging needed a new, larger facility—and quickly. IMPs were selected to create the code-compliant building envelope for the new 140,000-square-foot office and warehouse facility because of the speed with which they could be installed and the flexibility they offered to the design.

"It was an aggressive 268 days from building permit to certificate of completion," explains Todd Coffin, the project coordinator for general contractor Munter Enterprises. "The land was cleared in the fall, foundations started in November into December, followed by steel erection in a bitterly cold January. Other than a couple key open wall areas that were needed for access of equipment, cement trucks, and management of materials, we had the building essentially enclosed by May."

While the timeline was tight, the design team still wanted to create a building that had some character. As John A. Paone, RA, project architect at Paone Architecture in Saratoga Springs, explains, "When you are constructing a warehouse you generally have massive wall areas to address—and unless you have an unlimited budget, you can't afford to spend too much money on product systems that are both energy efficient and aesthetically pleasing. Insulated metal panels simply address both of these elements and work as well for the warehouse area as they do for the office sections. The colors and textures make it easy to dress up the facade so the building doesn't look like just another box warehouse. The insulated metal panels give you some design freedom."

The team at Paone Architecture used IMPs to break up the boxy form of the facility by exceeding the eave lines and creating a parapet of varying heights. In some places, the IMPs reach 35 feet high; in others, they are stepped down to 32 feet high. Overhangs above and below the glazing in the facade create dimension and visual interest.

Two colors were selected for the building facade—charcoal gray and tundra—and beaded metal soffit panels were installed on the overhangs to prevent oil canning. Water drains from the building's 31-foot-high flat roof into an internal gutter system.

Paone has gotten quite comfortable taking advantage of the many benefits offered by insulated metal panels. "It's the one stop shop," he says. "You only have to visit the wall once during installation. In one pass, the 'skin' you are installing is a finished product that can easily meet energy codes—which are continually getting stricter. And with the variety of colors, finishes, and textures it's easy to achieve a great look."

CASE STUDY: ROOFING SOLUTION FOR KVCC FOOD INNOVATION CENTER

Photo courtesy of Centria

The insulated metal roofing panels on the Kalamazoo Valley Community College Food Innovation Building in Kalamazoo, Michigan, were installed to create the building's overall silhouette with the added bonus of thermal and moisture efficiency.

When Kalamazoo Valley Community College (KVCC) received 13.5 acres of land in downtown Kalamazoo, Michigan, donated by Bronson Healthcare Group, the idea emerged to use the space to advance urban revitalization and promote community health, workforce development, and sustainability. The Healthy Living Campus included three buildings, one of which would be dedicated to food innovation and sustainable food education.

The Food Innovation Building was constructed in response to the rising popularity and interest in food-growing simulations. It promotes technological advances in food growth and wellness with hands-on greenhouse work and research. The building houses four distinct training areas: a food education space, an indoor growing space, outdoor growing area, and processing area.

Construction of the facility was executed in collaboration with the City of Kalamazoo, Bronson Healthcare Group, the Department of Environmental Equality, and the U.S. Environmental Protection Agency (EPA), so the architect TowerPinkster was required to specify building materials that provided state-of-the-art sustainability features and thermal performance.

IMPs were selected to enclose the exterior walls and roof of this project. The inherent insulation, air barrier, and vapor barrier equip the building envelope with ample thermal performance and moisture protection. The exterior wall panels were installed horizontally and offer pressure equalization along the length of the horizontal joinery, providing unmatched weather resistance. On the roof, the strong steel skins of the panels increase span capability and cut costs on the support steel necessary for the structure.

Simple, fast installation is another benefit realized on the KVCC Food Innovation project. The lightweight and simplistic design of the IMP system allowed construction to conclude before December's heavy snowfall.

CASE STUDY: DAIRY FARMERS OF AMERICA MILK POWDER PLANT

The Dairy Farmers of America (DFA) milk powder plant in Garden City, Kansas, is a cold storage facility that was designed to achieve impressive sustainability goals. In fact, it was named the 2018 Sustainable Plant of the Year by Food Engineering magazine. The use of IMPs in the building envelope was critical to achieving both of these important design objectives.

The DFA receives four million pounds of raw milk each day and turns it into 500,000 pounds of dry milk powder. At 267,000 square feet, it is the largest facility of its kind in the world and it operates 24 hours a day, seven days a week. Designed and built by Shambaugh & Son, the facility features more than 344,000 square feet of insulated metal panels.

The IMPs provide the R-values necessary to meet the demanding thermal performance requirements of a cold storage project. The interior finish on the panels is a white siliconized modified polyester, which is compliant with the U.S. Department of Agriculture (USDA).

In terms of sustainability, the design of the plant emphasized reducing, reusing, and recycling wherever possible. The plant's wastewater treatment facility utilizes all the water extracted from the milk during processing, so it can be used to clean tanks and used by the city as a non-potable water source. The IMPs also supported sustainable design objectives by offering an exterior wall solution that incorporates recycled content and is 100 percent recyclable at the end of their service life.

Photo courtesy of Kingspan

The insulated metal panels on the Dairy Farmers of America facility in Garden City, Kansas, help provide the highest R-value for controlled environment and cold storage needs.

load-carrying capacity of the panels have been analyzed and verified by testing, and that the structural capacity of the panels meets the project requirements or the IMP manufacturer will provide sufficient documentation to the engineer of record (EOR) demonstrating this performance. In the latter case, an evaluation report from a third-party agency such as ICC-ES or IAPMO showing compliance with ACO4 is normally used.

Fast Installation

Another benefit of selecting an IMP roof is the speed with which it can be installed. Instead of the multi-piece field-assembled metal systems or built-up roof systems that require the addition of several individual layers and components, the IMP roof system installation is comprised of basically one installation step. The panel contains the exterior face, the insulation, the air and water barriers, and an interior face. Installers only need to install the panel. Now this is a rather simplified explanation, but it does correctly convey the comparative simplicity of the different installation processes.

This quicker installation results in labor cost savings and dramatically shorter project schedules. It also allows the inside finish work to begin sooner. Let's take a closer look at how these panels are installed and how they are able to offer such a time-saving benefit.

The first step in the process is getting the panels to the elevation of the roof. Numerous lifting methods are available, but suction lifters are the safest and most efficient method.

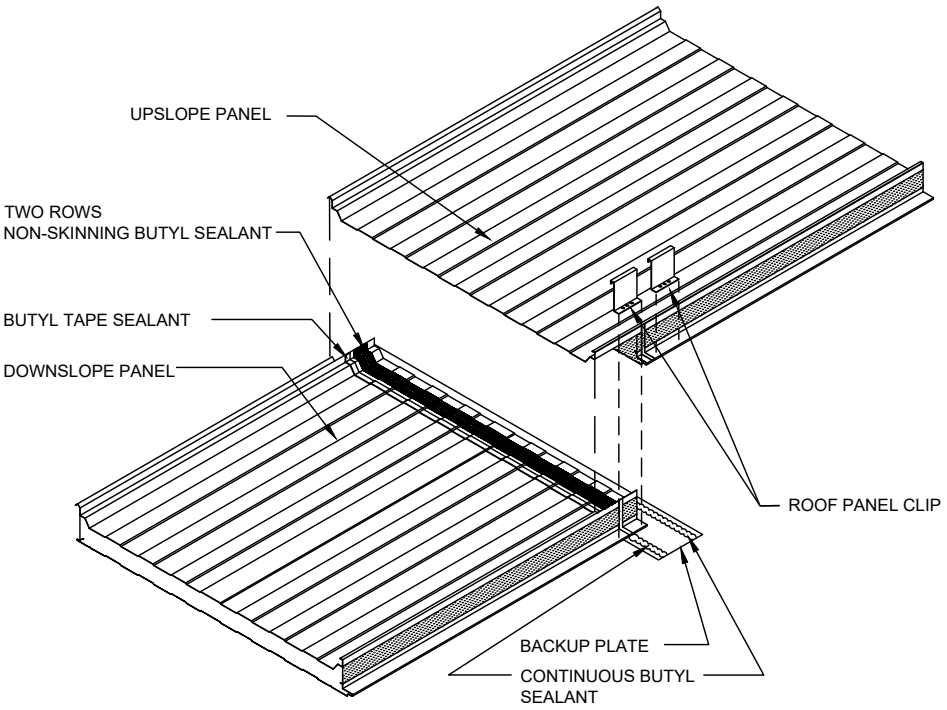
One item to note about IMP roof panels is that thermal expansion is accommodated by thermal bow which induces thermal stress. Because IMPs are a composite sandwich with both the interior and exterior facings bonded to the core, there is no significant linear differential expansion between the interior and exterior facings. Instead, the expansion of the panel is distributed among the individual spans as curvature, called thermal bow, rather than linear expansion. Because the overall panel does not significantly elongate or contract, there is no need to install an insulated metal roof panel with slotted clips. Thermal bow does not adversely affect the performance of the panels in a properly detailed system.

One step that is unique to IMP installation is the creation of an end lap. An end lap can be necessary when the length of the panel installed at the perimeter of the roof must be adjusted to perfectly fit the size of the roof. To create an end lap, installers will typically cut away the inner facing (liner) and foam core, leaving a nominal exterior facing extension that will then lap over the lower panel. The length of the extension and end lap is dependent on the slope of the roof and the panel profile. The end lap joints are caulked and fastened according to the roof panel manufacturer's recommendations.

APPLICATIONS

The combination of the versatility, thermal performance, sustainable design qualities and speedy installation offered by IMPs, make them an attractive roofing solution for almost any type of application—retail, commercial, warehouse, recreational centers, entertainment venues, educational facilities, and residences are just a few of the places where IMP roofs have been installed. Even projects with the most demanding performance specifications, such as government buildings and climate-controlled facilities, can be satisfied with an IMP roof.

Image courtesy of Kingspan Metal Panels



SUMMARY

Here are a few of the key takeaways from this course exploring the benefits of IMP roofing.

Insulated metal panels, or IMPs as they are often called, are lightweight sandwich panels comprised of exterior and interior metal skins and an insulating foam core.

Every IMP contains the water-control layer, air-control layer, vapor control, and insulation for thermal control.

IMPs can be used to create exterior walls and roof assemblies.

IMP roofing panels have two types of profiles: a standing seam profile and a through-fastened profile. Panels with standing seam profiles are mechanically seamed together during installation and the fasteners are not visible. Panels with through-fastened profiles have fasteners that are exposed and visible.

IMP roofs can be designed to deliver an R-value of up to R-48.

IMPs offer continuous insulation inside the panel, with no compression of insulation and no thermal bridging.

This solution has several sustainability-related qualities including its recycled content and recyclability. Insulated metal panels do not produce VOCs, have zero ozone depleting potential, and meet current EPA blowing agent requirements.

IMP panels have high strength-to-weight ratios that allow for excellent spanning capability.

Another benefit of selecting an IMP roof is the speed with which it can be installed. The installation process is essentially one self-contained panel being installed in one step.

Ultimately, roofs constructed from IMPs offer architects a way to reliably meet the increasingly stringent thermal performance requirements demanded by building codes, complete with all necessary moisture and air barriers, because the installation is so straightforward and streamlined. Avoiding the layer-by-layer, trade-intensive installation process typically employed in built-up roof assemblies avoids a lot of potential mistakes and missteps that will compromise the performance of the roof.

CASE STUDY: FINLEY CENTER SPORTS COMPLEX

The Finley Center sports complex in Hoover, Alabama, just outside Birmingham, features more than 100,000 square feet of insulated metal wall and roof panels.

As veteran designers of sports arenas and stadiums, the design team at Goodwyn Mills Cawood Architecture was drawn to an insulated metal panel building envelope from the project's inception due to the fact that the IMPs provide all essential thermal and moisture controls in a single, easy-to-install component. "Our experience on collegiate sports facilities led us to select IMP products for the Finley Center for ease of installation in an accelerated construction schedule, compliance with energy code requirements, cleanliness, and rigidity of the interior of the building with minimal maintenance," explains project manager Erik Consuegra.

The design team also placed a high emphasis on sustainability. All lighting throughout the sports complex is done via highly efficient LEDs, and the project provides athletes and fans with access to natural light by incorporating translucent panel clerestories and fenestration into the facades that enclose the event and auxiliary spaces. The use of IMPs also support sustainable design as the panels are constructed from recycled material and equip the building envelope to deliver a high level of thermal performance that reduces the energy that must be consumed to condition and maintain the interior space.

The architectural team selected IMPs in vibrant colors—blue and grey—to complement the surrounding facilities. "The greys and blues of the Finley Center are primarily drawn from the adjacent Hoover Metropolitan Baseball Stadium that has Hoover-city blue roofing and exposed cast-in-place concrete. There was a desire for these two facilities to visually relate to one another, creating a common sports campus language," says Consuegra.

CASE STUDY: PEPPER GEDDINGS RECREATIONAL FACILITY ROOF

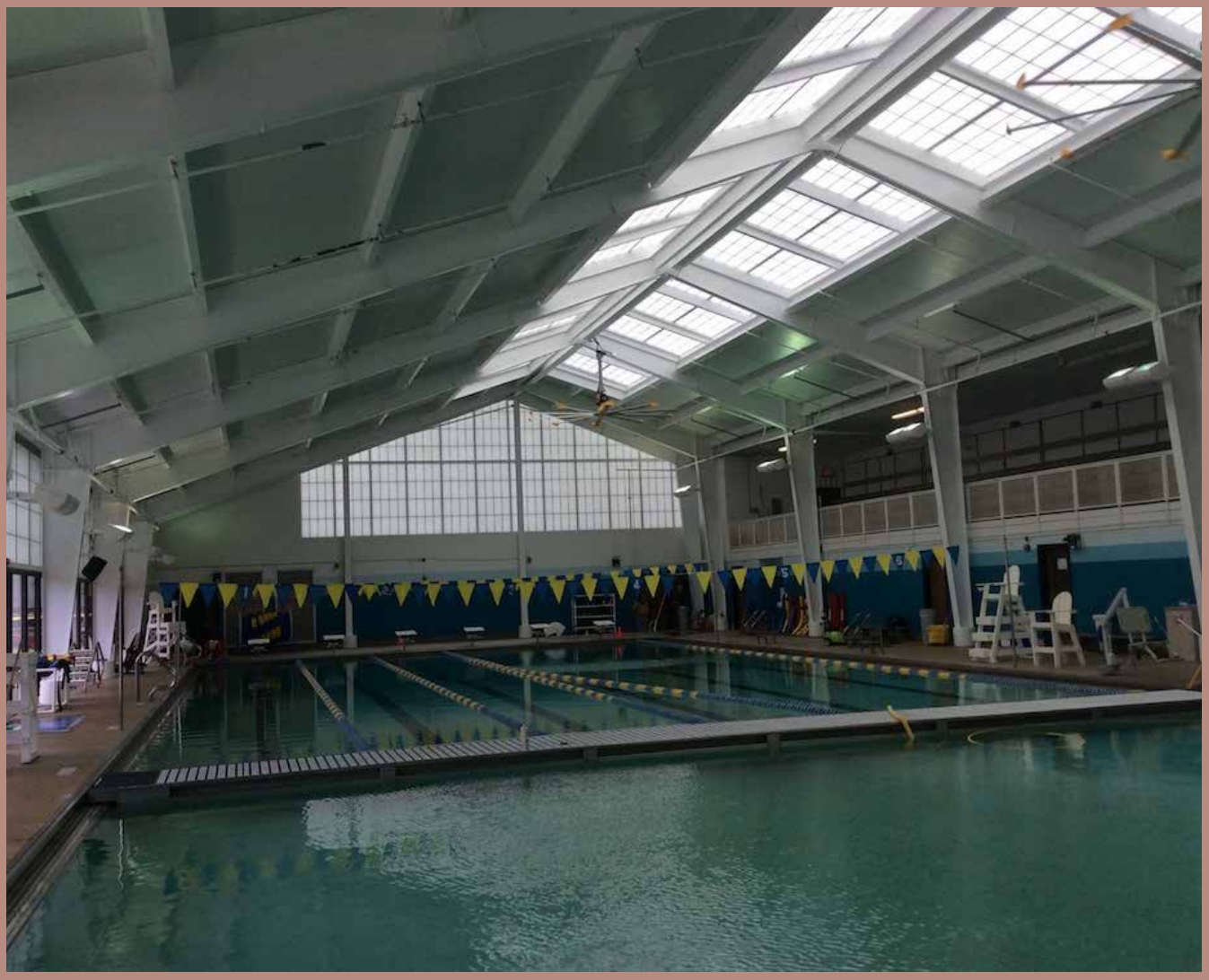


Photo Courtesy of Metl-Span

IMP roofing solved mold, mildew, and condensation problems at the Pepper Geddings Recreational Facility in Myrtle Beach, South Carolina.

The original roofing system on the Pepper Geddings natatorium was sagging. Mold and mildew had infiltrated the batt insulation and the continued exposure to condensation had caused the structure to rust. The City of Myrtle Beach in South Carolina needed an efficient and cost-effective method of dealing with this issue, so that the pool could be open in time for summer vacation.

IMPs with a 6-inch urethane core were selected for the project. The exterior face featured a special coastal finish to better stand up to the salty sea air as the facility is about a mile from the Atlantic Ocean. The interior face was also coated to withstand exposure to chlorine.

"The insulated metal panel is an all-in-one product," explains Michael Walker, AIA, LEED AP, at Tych & Walker of Murrells Inlet, S.C. "The interior panel was coated with a product that is resistant to chlorine. The six inches of insulation gave us the R-value we wanted and the standing seam metal roofing."

Spann Roofing & Sheet Metal of Conway, S.C., installed more than 9,000 square feet of insulated metal panels on the roof. "It was a tight schedule and challenging working above a pool, but the installation was pretty straightforward, and the manufacturer did a good job of taking us through the drawings," says Jimbo Spann, project manager.

The installation crews were onsite for about four weeks and wrapped up in April 2015, in plenty of time for the summer season.