Aluminum Composite Material (Fire Rated): Manufacturing, Installation, and Sustainability

AIA Continuing Education Provider

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Purpose and Learning Objectives

Purpose:

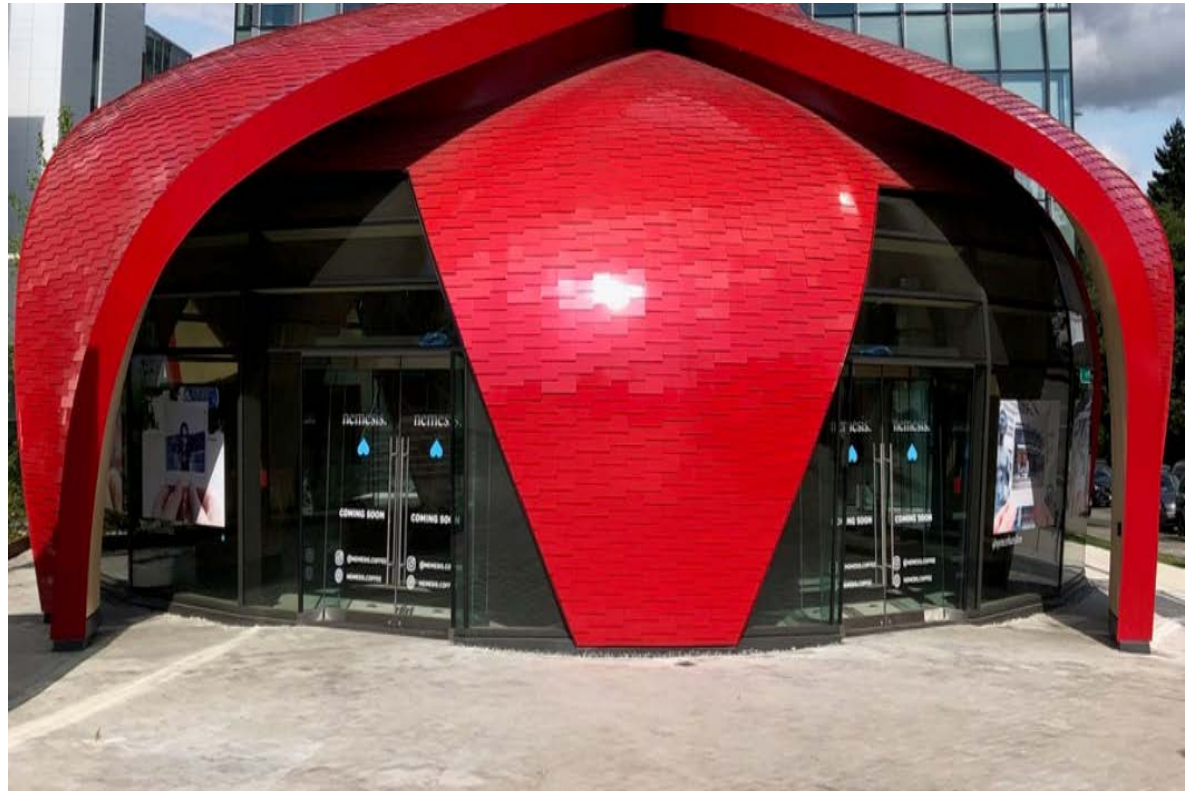
Aluminum composite material (ACM) is a lightweight composite material consisting of two sheets of aluminum facings thermobonded to a fire-retardant core. This course will discuss the versatility, sustainability, and functionality of fire-rated ACM and its properties. We will discuss why it is selected for architectural cladding, interiors, and signage applications in new and existing buildings around the globe.

Learning Objectives:

At the end of this program, participants should be able to:

- Summarize the fundamentals of ACM, including its history, components, benefits, and environmental aspects.
- Describe how ACM products are manufactured in an environmentally responsible manner.
- Identify the specification considerations, codes, and testing requirements relating to ACM.
- Differentiate between the common types of ACM systems, finishes, and coatings.
- Explain how ACM is installed, and discuss different applications citing case studies.

Contents

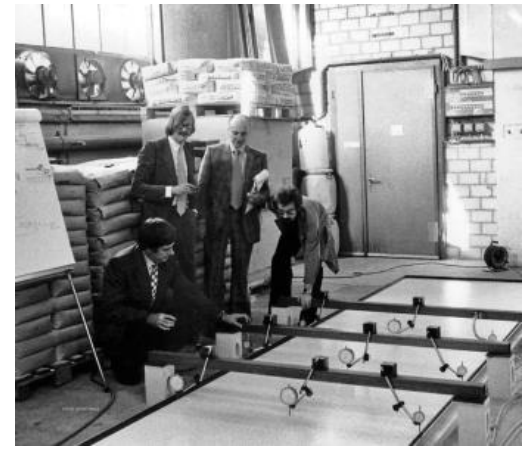


Designed by Perkins + Will, 569 Great Northern Way was part of a larger redevelopment project at the Emily Carr University of Art & Design in Vancouver, British Columbia. The 3,000-square-foot building is clad in a custom color-shifting paint finish.

ACM Attributes

ACM History

This course begins with a discussion of the fundamentals of aluminum composite material, including its history and attributes.



Aluminum was first discovered and successfully extracted from ore (bauxite) in 1825. Bauxite, a sedimentary rock with a relatively high aluminum content, is the world's main source of aluminum.

In 1968, the first aluminum composite material was created in Europe by Alusuisse of Zurich. Even though it was being commercially produced in Germany in 1969, production of ACM was not introduced to North America until 1977.

The first ACM was produced domestically in Benton, Kentucky, in 1978. The first building project—Spaceship Earth at Epcot in Disney World—utilizing ACM in the United States had its grand opening in 1982.

ACM History

While aluminum was the first and remains the predominant skin for metal composite panels, the product category reflects the use of new skin metals, such as zinc, copper, titanium, and stainless steel.*

Today, ACM is used worldwide since it provides a sustainable solution for building design in a variety of climatic and environmental conditions.

Fifteen colors of ACM are used to clad the Marine Gateway mixed-use development, a LEED Gold-certified complex located in Vancouver, British Columbia.

*Source: “What is Metal Composite Material?” Metal Construction Association (MCA). Web. September 2019. <www.metalconstruction.org>.

ACM Applications

ACM is used for exterior as well as interior applications, including cladding for exterior canopies, soffits, fascia's, interior columns, graphic displays, and decorative elements.

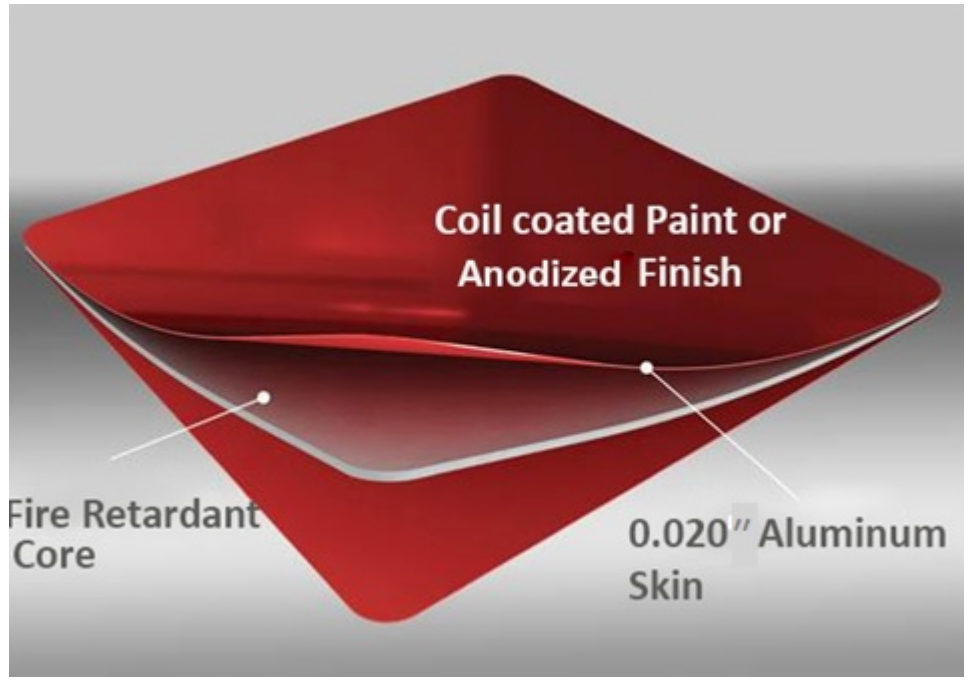
From building an innovative and modern facade to one that is decidedly more subtle or giving existing structures a fresh look, ACM offers architects flexibility in design.

ACM provides functional and decorative surfaces that offer long-term color consistency, weather resistance, excellent flatness, rigidity and formability, and ease of maintenance.

What Is Fire-Rated ACM?

Fire-rated aluminum composite material is made of two sheets of 0.020-inch aluminum facings thermobonded to a fire-retardant core in 3-, 4-, and 6-millimeter thicknesses; however, 4-millimeter core is the most common and widely available.

ACM may be available in an anodized finish or a premium coil coating in a full spectrum of appealing standard colors or any custom color a project demands.

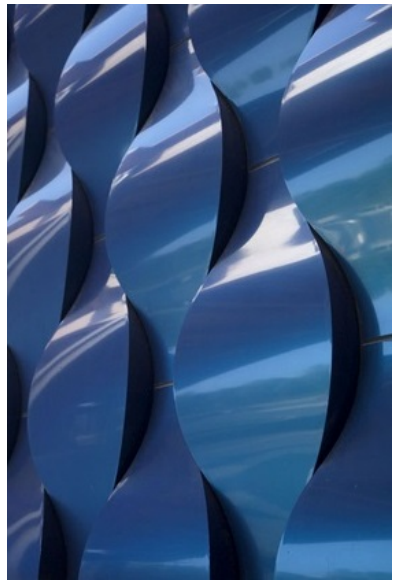


ACM Benefits and Attributes

There are many cladding materials available in today's market, so why choose ACM?

The following slides provide an overview of the attributes and benefits of ACM.

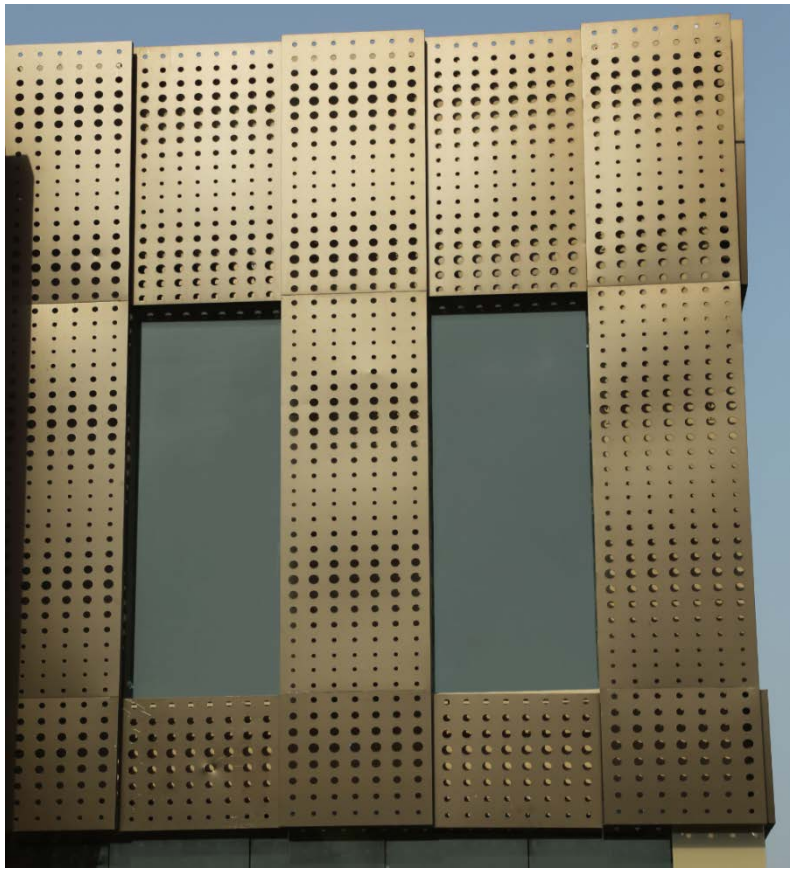
Being formable and versatile, ACM can achieve sweeping curves and tight radiuses and can perfectly adapt to a building's contours. Brick, stone, and wood cannot be shaped with the same ease. Because of these attributes, ACM encourages innovative architectural design.



Seven Clans Casino Red Lake, Red Lake, Minnesota

ACM also offers great aesthetics. There is an endless palette of coil-coated colors and finishes to meet design requirements, plus it can mimic the surface appearance of metals and natural materials, like stone and woodgrains.

ACM Benefits and Attributes



Paras Trinity, New Delhi, India

ACM has perforation capabilities (one sided or two sided). Perforation patterns can be geometric, slotted, or customized. Holes may be punched or computer numerical control (CNC) routed. Perforated panels are ideal for a variety of applications including parking garages. Note that perforation is not the responsibility or capability of the ACM manufacturer but of the fabricator. As such, warranty issues for the material are supported by the ACM manufacturer, but CNC or punching of ACM sheets falls on the fabricator. A polyvinylidene fluoride (PVDF) paint finish is available on both faces of the perforated panel.

Because ACM is lightweight, it is easy to transport and handle on-site. It places a reduced load on the wall framing and foundation (brick, stone, and solid sheet weigh more). Plus, the building components use less material, resulting in construction cost savings.

ACM Benefits and Attributes

ACM also provides high rigidity. Due to its rigid core and composite structure, ACM achieves a high strength-to-weight ratio, even when comparing large panel sizes. It is durable, stable, and can be perfectly formed without any loss of rigidity. The panels keep their shape and remain flat, even when exposed to extreme temperature changes.

Flatness is critical, and it is important for architects to specify the right type of panels to avoid oil-canning, elastic buckling that causes visible waviness in the panel. Note that oil-canning compromises the aesthetics of the panels, not the performance.

Steel or flat-sheet aluminum are at high risk of oil-canning. The degree of oil-canning and the appearance of the panels will vary depending on factors such as the length and color of the panels, alloy, gauge, galvanizing process, substrate condition, and exposure to sunlight.

ACM panels are naturally flat and provide the lowest risk of oil-canning.

ACM: Flat panels

Flat-sheet aluminum displaying oil-canning

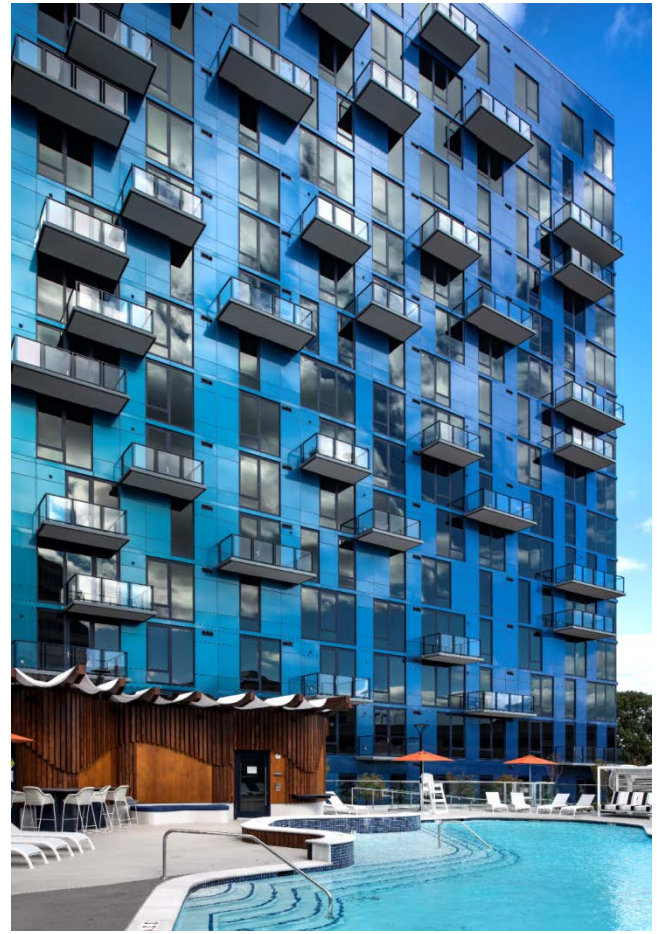
ACM Benefits and Attributes

Reflective: ACM is reflective (of both heat and light). This can reduce the thermal loading on a building. Furthermore, special “cool” paint finishes may be utilized to increase this reflectivity.

Vibration dampening: ACM limits sound transfer across media so no additional sound damping is needed.

Weather/corrosion resistance: ACM does not weaken in harsh environments. Paint finishes can be selected to inhibit corrosion in the toughest conditions, such as along coastlines, where the air is filled with salt.

Affordable: Many systems are available to meet any budget. Large panels sizes and prefabricated panels provide fast installation at a lower cost. Estimated installed cost ranges from $25 to $80 per square foot, depending on the complexity of the project, panel sizes, and attachment system.



Exo Residential Building, Reston, Virginia

Mark Kempf Photography

Materials, Manufacturing, Colors, and Finishes

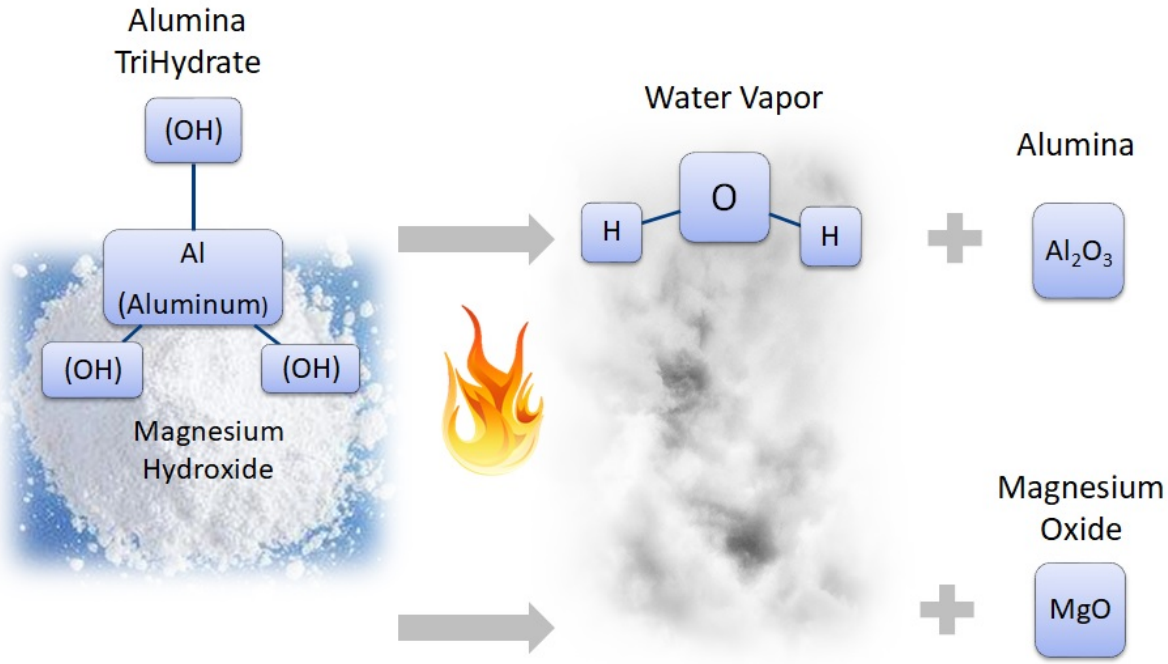
ACM Core Materials

ACM with a fire-retardant core is the primary offering from all U.S. manufacturers.

The fire-retardant core typically consists of alumina trihydrate (ATH) or magnesium hydroxide (MDH) bound with a polymer base. The properties of the material offer improved fire safety and the ability to meet code requirements, including NFPA 285, at limited to no additional costs.

ACM is tested in accordance with:

- NFPA 285
- ASTM E84
- ASTM D635
- ASTM D1929



Materials, Sheet Widths, and Lengths

Next, we look at materials, sheet widths and lengths, and the types of finishes that are available.

Materials:

- Aluminum interior and exterior skins are manufactured in smooth, non-embossed, 0.020-inch (0.5-millimeter) nominal thickness to ensure flatness.
- The fire-retardant core is 3 millimeters thick for the standard 4-millimeter panel.

Sheet Widths:

- The standard coil-coated widths include 40, 50, and 62 inches.
- The standard anodized width is 62 inches.

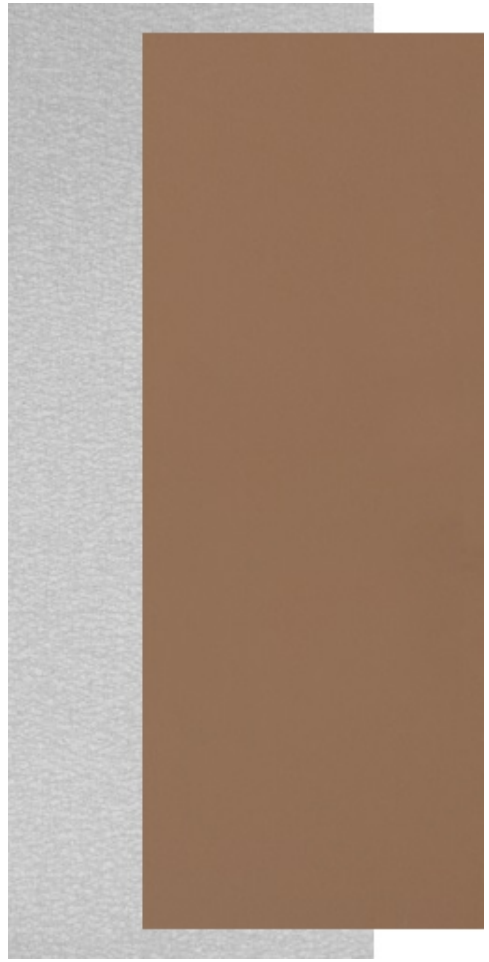
Sheet Lengths:

- The standard length is 196 inches.
- Custom sheet lengths range from 48–360 inches.
- The standard anodized length is 198 inches.

Finishes

There are a variety of finish options available, including:

- polyvinylidene fluoride (PVDF)
- FEVE clear coats
- silicone-modified polyester (SMP) and highly-durable polyester (HDP)
- color-shifting paints
- exotic (bright colors) and custom colors
- patterns that mimic natural surfaces and metals (stones, woodgrains, abstracts, graphite, stainless, zinc, mica, and metallic)
- anodized



It is important to specify the right finish for the project. Taking into consideration coastal or chemical influences, positioning of the sun, and desired appearance are important in determining not only the correct finish for the application but also warranty issues.

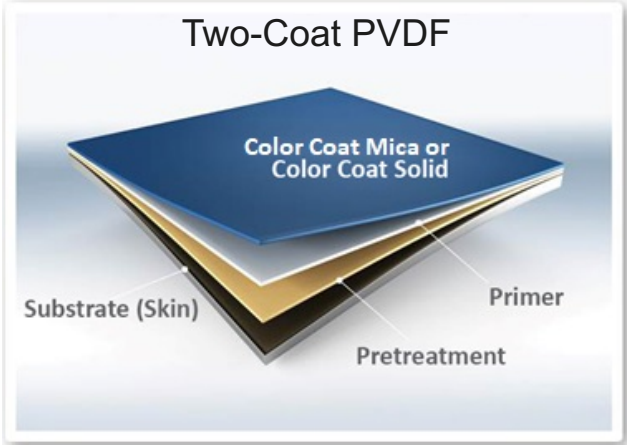
Let us look at the finish options in greater detail.

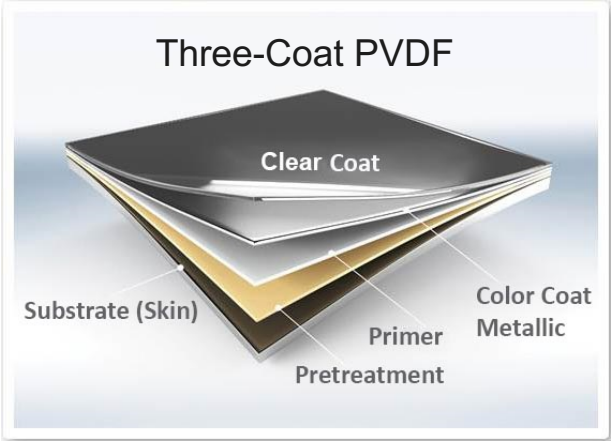
Two- and Three-Coat PVDF

The resin in a paint is the source of a coating's durability and physical properties. Due to its durability to withstand harsh climatic conditions, 70 percent PVDF resin-based coatings are used around the world on the exteriors of numerous architectural projects. Paint containing 70 percent PVDF is able to resist chalk and fade, and withstand lengthy exposure to UV rays, temperature, humidity, water, and atmospheric pollutants, like smog.

Two-coat PVDF paint systems are common for solid and mica finishes, which are coil coated over a pretreated aluminum substrate with a primer and color coat at a nominal 1-mil thickness. When a two-coat PVDF system is used, the primer allows bonding and color consistency in the color coat to show in lieu of having the underlying metal affect color consistency. Note, the pretreatment is not considered one of the paint "coats."

Three-coat systems are generally used for solid and metallic finishes which are coil coated over a pretreated aluminum substrate with a primer, color coat, and clear coat at a nominal 1.5-mil thickness. The clear coat protects the aluminum flake from oxidizing and adds increased weatherability and protection against the elements.





Two- and Three-Coat PVDF

Many believe that a three-coat finish is better than a two-coat finish simply because of the extra layer of paint. However, this is not the case in all instances.

Some paint manufacturers offer a two-coat metallic paint system to reduce cost. With this system type, the aluminum flake is encapsulated in the paint coat to remove risk of corrosion. The warranty for this system is the same as with the three-coat system.

Along the coastline or in heavily corrosive environments, three coats are recommended for added protection. In fact, some paint manufacturers require a three-coat system in these areas to receive warranty.

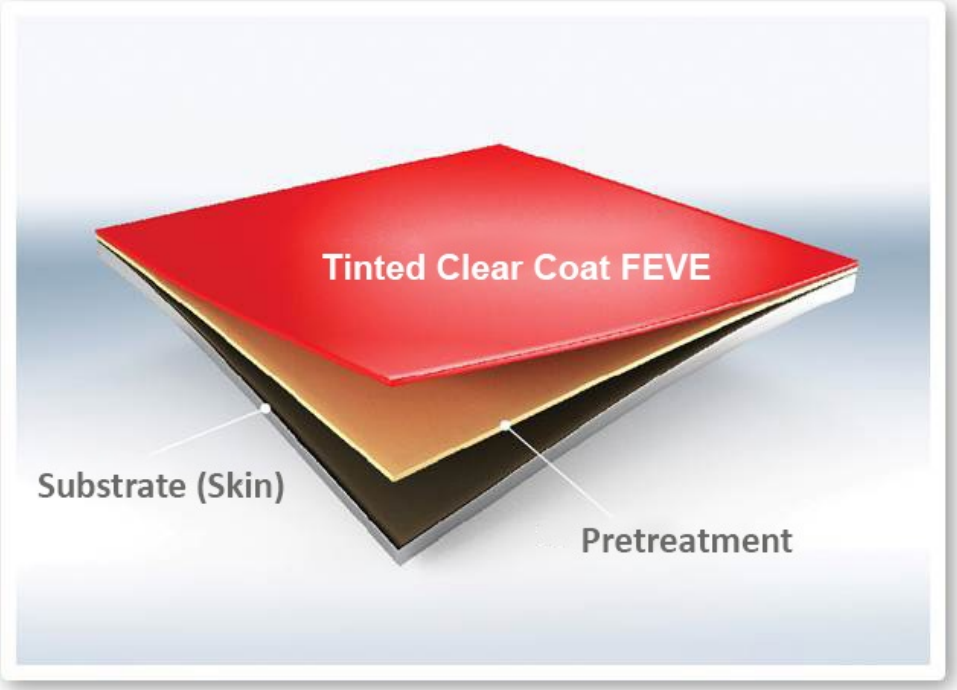
An ACM representative can help you decide which finish option is best for a project based on the location and application.

Gustavo House, Berlin, Germany

This was a coil-coated retrofit project. What was once an East German concrete block apartment building was transformed into a five building complex of modern art with coil-coated ACM.

FEVE

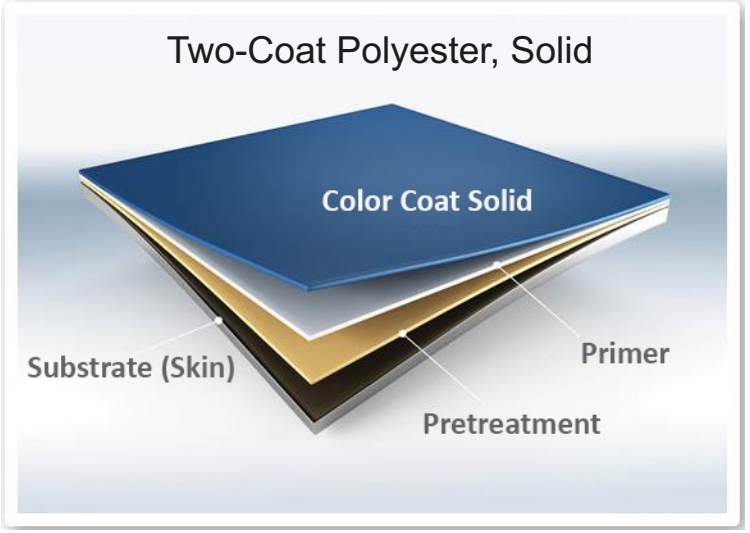
FEVE clear coats are often used on bare finishes (such as various brushing patterns). It offers protection from the elements to preserve the aesthetic of the bare finish. This clear coat provides transparency to observe the natural brush strokes applied to the coil. Various tints can be applied to broaden the color palette and add to the aesthetics of the project.

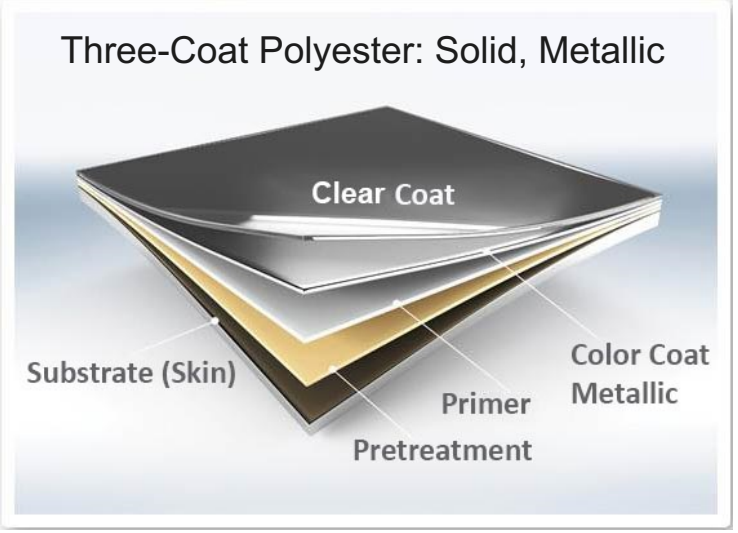


Two- and Three-Coat SMP and HDP

Silicon-modified polyester and highly-durable polyester finishes are also common in the industry. Highly-durable polyesters have improved formulation resulting in significantly improved durability and greater resistance to UV degradation. Both SMP and HDP are ideal for canopies, store fronts, and commercial interior design (CID).

While PVDF finishes provide the longest UV stability of any commercially available coating, polyester coatings provide a higher range of gloss and are often used in some of the exotic finishes, such as color shifting and textured finishes.





Color Shifting

Color shifting materials were originally derived from the automotive industry. These transitional color finishes change color as different wavelengths of light are reflected to the audience.

Depending upon the viewing angle, the panels offer ever-changing color gradients with iridescent highlights. As the light is broken up and refracted by the individual surface layers, the color effects are enhanced.

Typically, two or three colors are selected with one opposing color from the color wheel selection.

The ever-changing color spectrum of the MCM panels on the Cullum Tower in North Bergen, New Jersey, make the building stand out in the city's skyline.

Custom Colors

Custom color capabilities are a large part of most ACM sales. Manufacturer's usually have a color-match department that specializes in color development to help guide architects/designers through the process. Suppliers can match Pantone, RAL, NCS, or other paint manufacturers' paint systems. However, providing the manufacturer with a paint chip or sample of the desired color will expedite the matching process. Note that dye lots will be different on ACM compared to residential paint or textiles.

Gloss levels and finish types should also be discussed at the onset which will provide direction to the applicable paint supplier and ensure the finish selected will be the best option for the application. Minimum orders apply, and the warranty may vary depending on supplier and paint type selected.

The Marine Gateway Mixed-Use Development uses eight different custom ACM colors, including four custom color-shifting finishes.

Vancouver, British Columbia

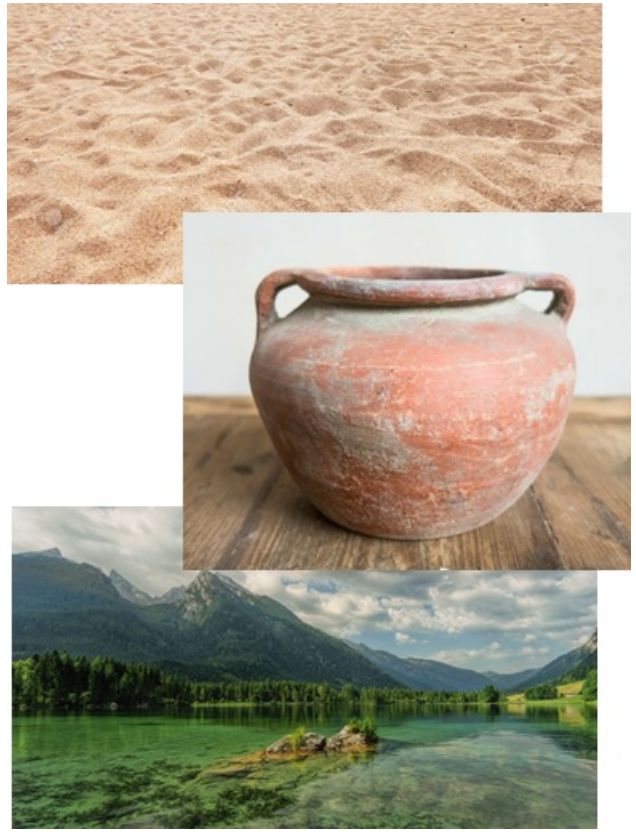
Biophilic Design and Textured Finishes

Biophilia is the practice of incorporating nature and natural elements into the built environment.

According to Stephen Kellert, Ph.D., biophilic design includes “buildings and materials that enhance human physical and mental well-being by fostering positive connections between people and nature.”*

Biophilic design has been proven to measurably reduce stress, enhance cognitive function and creativity, and expedite healing in health-care facilities. This translates to increased productivity, reduced health-care costs, and reduced staff turnover.

Understanding how people viscerally respond to nature and how such beneficial experiences can be supported in urban settings is essential to shaping a healthy and vibrant society.



Biophilic design celebrates the relationship between nature, science, and the built environment.

*Source: Stephen, Kellert. “Biophilia and Biomimicry: evolutionary adaptation of human versus nonhuman nature.” Intelligent Buildings International, 2014.

Biophilic Design and Textured Finishes

ACM is available with abstract and textural patterns that mimic natural surfaces that enhance the design of the architectural project while maintaining the durability and lightweight properties of aluminum.

The best option is to work closely with the manufacturer’s design team to meet the desired finish and color requirements and ensure the finish is appropriate for the application.

Woodgrain Finishes

Woodgrains can amplify the inherent beauty and character of a project.

ACM with woodgrain finishes are available with custom capabilities or may be part of a stocking program. These types of finishes allow designers to achieve a different look and feel across the building while maintaining one wall system. Reducing transitions between wall types can lower costs, risks, and design detail complications.

Architects/designers can select a custom design by collaborating with the manufacturer’s design team. For example, an architect may request a linear woodgrain similar to teak. The design team will source a veneer or select a design available from a library of images/veneers/slabs. The team would work closely with the manufacturer’s supplier on scale, color, variety, and depth within manufacturing capabilities. Note that minimums will apply and a setup fee may be levied depending on volume. Lead times vary from eight weeks or more based on the design selected and production schedules.

Metal and Stone Finishes

Custom metal and mineral finishes are available in a variety of options in color, depth, and saturation. Inspiration can be derived from culture, the auto industry, fashion/textiles, or nature.

Various additives can be included to produce a ‘sparkling’ metallic effect.

Colors and patterns that mimic metals, such as graphite, zinc, or a rusted appearance, can be rolled directly onto a coil. Not only do these finishes amplify the natural beauty and character of many natural elements, but they also provide biophilic design elements.

Metals	Minerals	Stones
Zinc	Ruby	Calcutta or statuary marble
Corten steel	Sapphire	Terrazzo or concrete abstract patterns
Copper patina	Topaz	
Gold		

Anodized Finish

Anodizing is an electrochemical process that thickens and toughen the natural occurring protective oxide on aluminum. The anodic coating is part of the metal and its porous structure allows for coloring and sealing. Aluminum oxide is the second hardest surface known to man, after the diamond.

There are two classes of thicknesses: Class I and Class 2 (ACM are coated with Class 1).

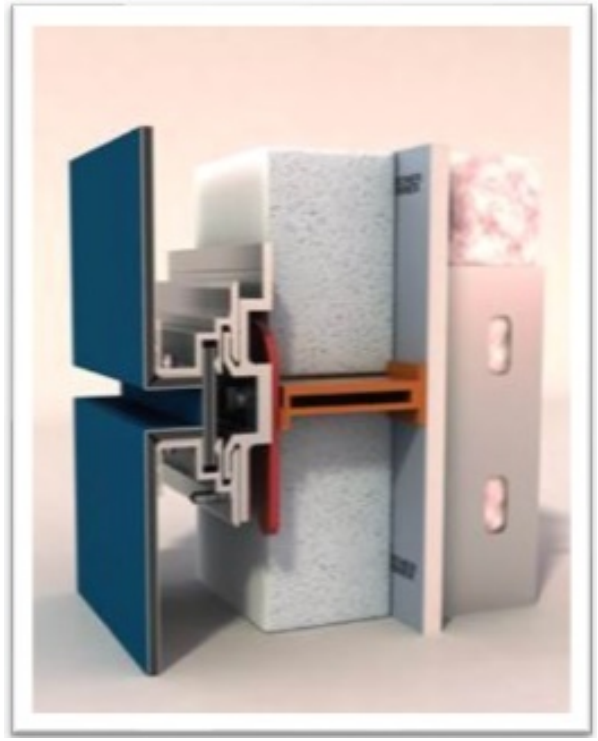
An anodized finish offers a consistent batch-batch appearance and provides an enhanced level of weather resistance in addition to the standard rigidity and high-quality appearance of ACM.

Brushed and Mirror Finish

A brushed finish provides warmth and richness and offers an alternative to a colored opaque finish. However, it lacks color consistency from batch to batch and it is not recommended for coastal or harsh chemical applications.

Reflective mirror panels are manufactured in United States and Europe. They can open the window to the surroundings of the structure.

ROUT AND RETURN WET SYSTEM



RAINSCREEN

Specification Considerations and Attachment Systems

NFPA 285

In the United States, ACM is tested to meet fire classifications, including NFPA 285 and ASTM E84.

NFPA 285: Standard Fire Test Method For Evaluation of Fire Propagation Characteristics of Exterior Non-load-bearing Wall Assemblies Containing Combustible Components

- This standard provides a standardized fire test procedure for evaluating the suitability of exterior, non-load-bearing wall assemblies and panels used as components of curtain wall assemblies that are constructed using combustible materials or that incorporate combustible components for installation on buildings where the exterior walls are required to be noncombustible.
- Required above 40 feet or at any height when plastic insulation is outboard exterior sheathing.

What does NFPA 285 address? Fire propagation characteristics are determined for post-flashover fires of interior origin. NFPA 285 requires both visual observations made by laboratory personnel conducting the test and temperature data recorded during the test. It is important to note that NFPA 285 is an assembly test.

ASTM E84

ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials

This fire-test-response standard for the comparative surface burning behavior of building materials is applicable to exposed surfaces, such as walls and ceilings. The purpose of this test method is to determine the relative burning behavior of a material by observing the flame spread along the specimen.

The surface burning characteristics obtained are the Flame Spread Index and Smoke Developed Index values. The Flame Spread Index is a relative indication of the flammability of the test material with respect to a red oak standard. The Smoke Development Index is a classification indicating a comparative measure derived from smoke obscuration. However, there is not necessarily a relationship between these two Indices.

For more information, refer to www.astm.org/Standards/E84.htm.

Proper Specification

When specifying ACM systems, it is important to select the system type as well as some minimum product specifications as indicated below.

ACM should be specified with the 0.020-inch nominal thickness, which is standard in the United States, but not necessarily in other regions of the world. Other attributes to consider are bond strength, finish performance, and third-party listing. Additionally, it is important to note that system performance to air/water infiltration, wind loading, and vertical/horizontal flame spread ought to be included in each specification. Note that testing of the system is typically provided by the ACM fabricator/contractor and not the manufacturer.

Panel Type

- Skin Thickness
- Core Material
- Finish

Panel Attributes

- Bond Strength
- Finish Performance
- Surface Burning Characteristics
- 3rd Party Labeling

System Type

- Pressure Equalized Rainscreen
- Drain Back-Ventilated Rainscreen
- Wet Joint
- Special Performance

System Attributes

- Air-Water Filtration
- Wind Load Rating
- Project-Specific Requirements

Technical Specifications

Other technical specifications of ACM include minimum bending radius and temperature resistance.

Minimum Bending Radius:

The minimum bending radius of FR core panels 4–12 inches varies per manufacturer. The minimum bending radius of a panel with a FR core without routing the interior skin is 15 times the thickness of the material.

Temperature Resistance:

ACM products withstand environmental temperature changes from -55 to +175 degrees Fahrenheit (-50 to +80 degrees Celsius). The coefficient of linear expansion is governed by the aluminum sheet. A 10-foot panel could expand 3.5 millimeters or 0.14 inch over a 90-degree-Fahrenheit temperature range.

Attachment Systems

A building's design, aesthetics, and performance requirements (control of wind-driven rain, etc.) will determine the type of ACM cladding system and attachment method required.

Systems requiring the prevention of air and water infiltration must utilize a different attachment method to those that, by design, allow water and air infiltration.

There are the two types of attachment systems:

- Rout and return wet
- Rainscreen

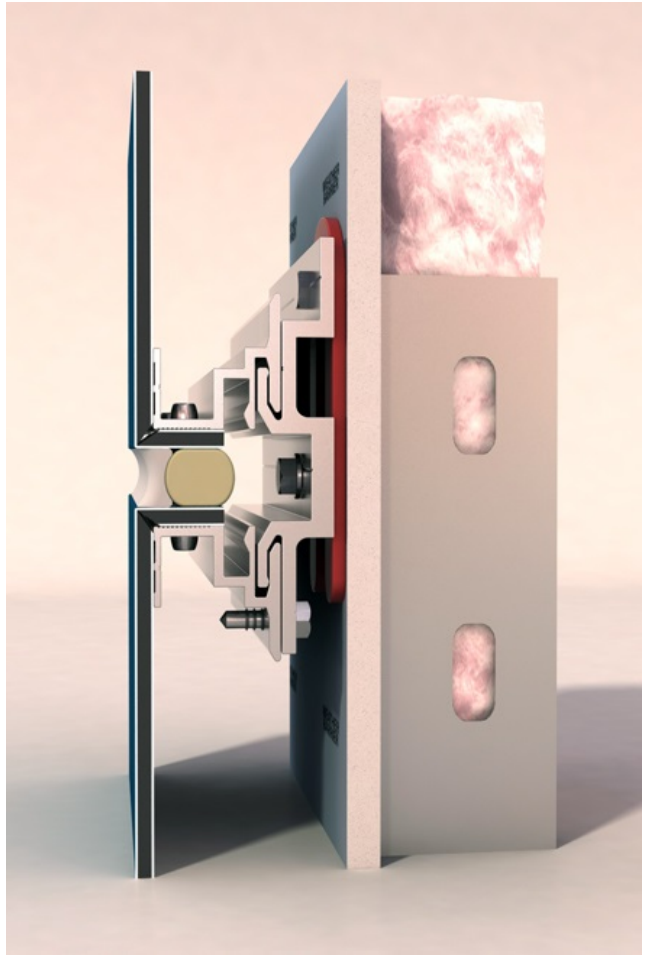
A review of each system type of presented in subsequent slides.

Rout and Return Wet Systems

The rout and return wet system uses a silicone sealant for the air and water barrier along with a simple male/female clip design. These systems are the most economical and they can accommodate simple to complex panel designs. They are recommended for use on sloping walls.

The disadvantages are they rely on caulk to completely seal the system; therefore, they do not drain. Overtime, the caulk can collect dirt, discolor, and stain the panel finish.

Rout and return wet systems comprise 10–15 percent of the market and their use is in decline.

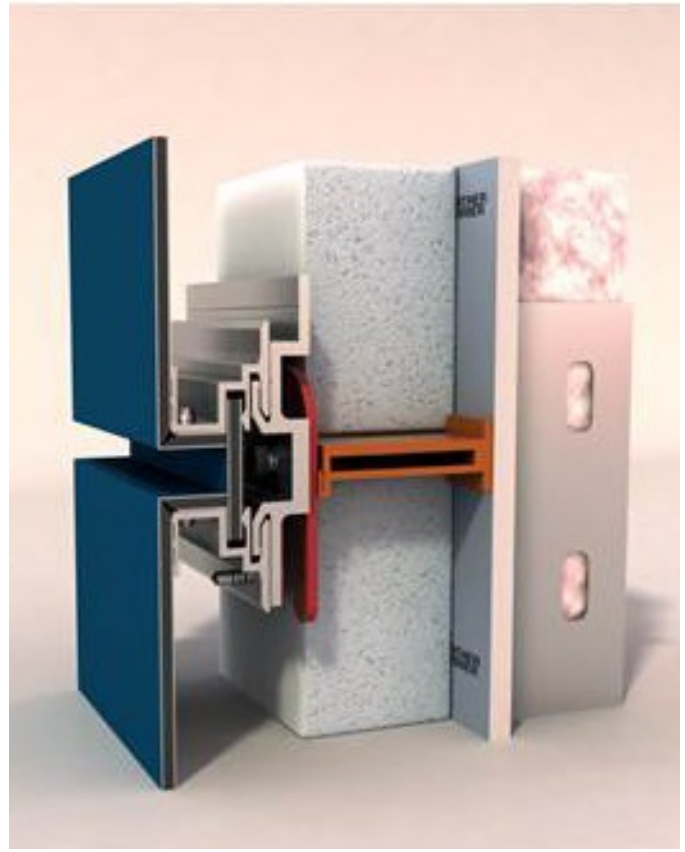


Rout and Return Wet Systems: Video

Click below to see a video of the installation of a rout and return wet system, commonly utilized in North America.

Rainscreen Systems

Deigned to allow drainage and air flow, rainscreen systems use concealed air and water membranes that provide improved weather resistance. The spline and joint filler allows for variable color and reveal size. Rainscreen systems are high performance and flexible in addition to being low-maintenance and cost-effective. These systems are typically a sequential system and are not recommended for sloping walls.



Rainscreen systems are available in two design variations:

- Pressure equalized:
  - American Architectural Manufacturers Association (AAMA) 508 compliant
  - High performance
- Drained-back ventilated:
  - Rated via AAMA 509
  - No performance criteria requirement

Rainscreen Systems: AAMA-508 and AAMA-509

AAMA-508 is a test method based on the results of testing a pressure-equalized rainscreen wall cladding systems. This test method addresses:

- water infiltration through the entire wall system;
- pressure-equalized behavior; and
- the maximum differential between the cyclic wind pressure and cavity pressure in the system.

AAMA-509 is a test and classification method based on the results of testing a representative sampling of drained and back-ventilated rainscreen wall cladding systems.

This test method addresses:

- air leakage of the air/water barrier;
- air flow/cavity ventilation; and
- water management.

The primary purpose of this test method is to quantify the volume of rainwater contacting an imperfect air/water barrier and the system’s ability to allow for ventilation/drying as measured by airflow through the cladding.

Benefits of an ACM Cladding System

During decades of use in a drain-back ventilated cladding system, ACM protects the building from weathering and the harmful effects caused by industrial and environmental pollution.

An external cladding system using ACM acts as a barrier against solar radiation. The ventilated space between the ACM panels and the wall or the thermal insulation reduces the heat transmission.

The drain-back ventilated cladding system using ACM protects the wall of the building from high and rapid temperature changes. Moisture can pass through the wall so the building structure keeps dry.

Advantages
Lower maintenance costs
Long-term preservation of building structure
In winter: savings in heating costs
In summer: savings in air-conditioning costs
Reduction of thermal expansion
Reduction in crack formation

ACM Sustainability

Manufacturing Environmental Impact

In this section, we discuss why ACM is a sustainable product, beginning with its manufacturing process.

Manufacturing:

During the manufacturing process, all excess is recycled back into the manufacturing process, and all scrap aluminum is sent back to aluminum processing plants for recycling.

Composite Concept:

The sandwich concept reduces energy input and consumption. Given the fact that aluminum requires large amounts of energy to be produced, the portion of aluminum to manufacture ACM is by far less compared to flat sheet aluminum. In fact, typical ACM uses 70 percent less aluminum than a 1/8-inch plate.

Coil Coating Environmental Impact

The continuous coil-coating process provides ACM with a protective coating available in a wide range of paint colors and finishes.

During the coil-coating process, 99.9 percent of all volatile organic compounds (VOC's) are captured. Excess paint is recovered and used to cover the non-visible side of ACM, so no excess paint is burned as waste.

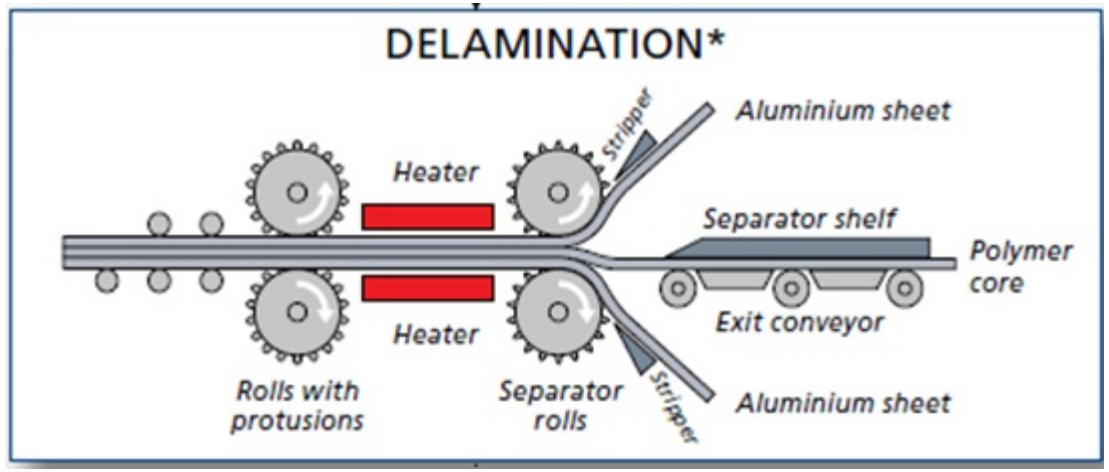
Additionally, all solvents used to clean the machinery are collected and reused.

Seventy percent PVDF resin-based coatings are used around the world on the exteriors of numerous architectural projects because it is able:

- to resist chalk and fade; and
- withstand lengthy exposure to UV rays, temperature, humidity, water, and atmospheric pollutants, like smog.

Core Environmental Impact

Next, we look at the environmental impact of the core materials of ACM.



FR Core Material:

- Fully recyclable
- Scrap panels are separated and re-processed
- FR core uses 70 percent less polymer than PE core
- FR components (ATH and MDH) are minerals

Thermoplastic Cores:

- Fully recyclable
- Can be re-melted, retreated, and reused

Aluminum Environmental Impact

Let us review the environmental impact of aluminum.

In the wake of the “green” movement, there is an increase in demand for energy efficiency, from consumers and regulations/mandates set by the government.

Aluminum plays a key role in sustainability of new buildings and renovation of existing structures. Due to its performance properties, aluminum largely contributes to the energy performance, safety, and comfort of new buildings. It also plays an important role in the production of renewable energy from solar sources.

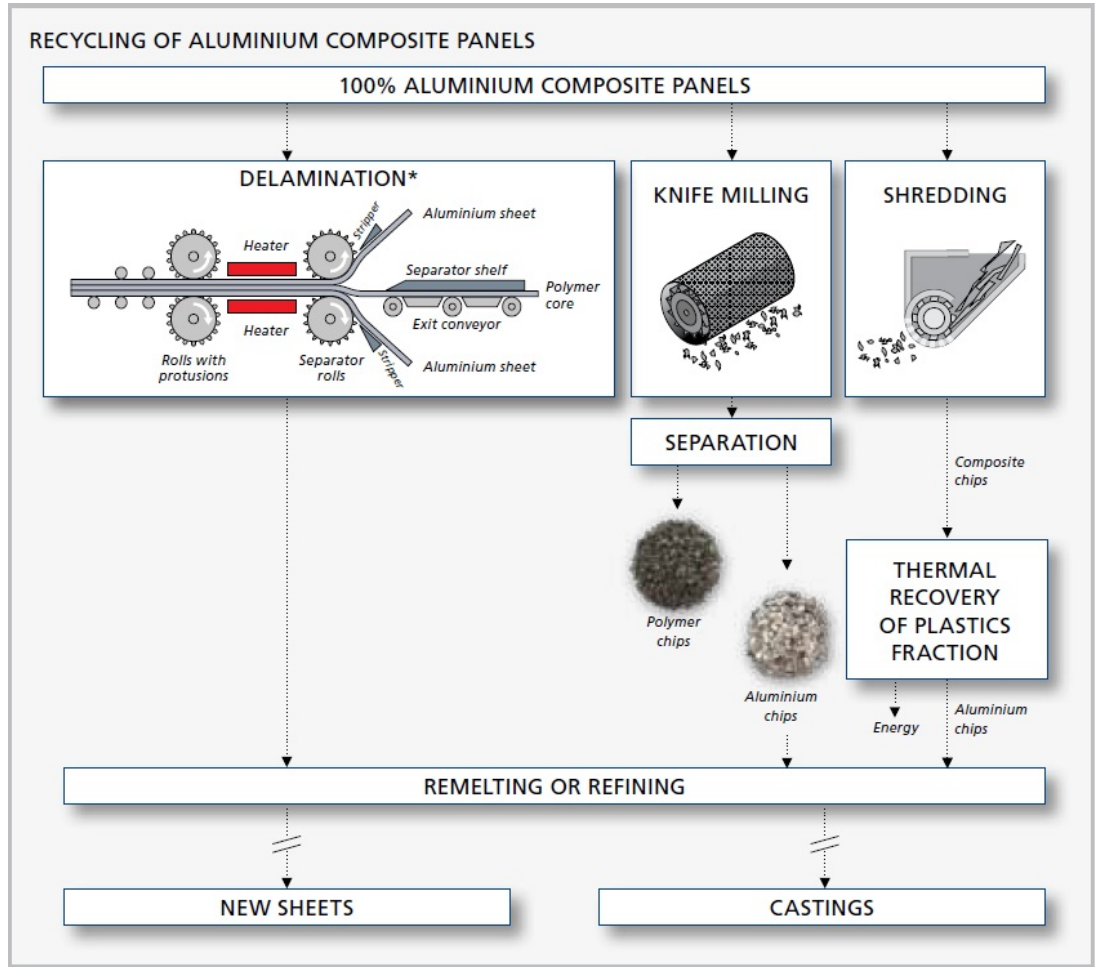
Aluminum’s ability to reflect 95 percent of solar energy significantly reduces costs to cool buildings; energy efficiency is a key qualifier for LEED building standards.

Finally at end of very long lifespan, ACM is 100 percent recyclable.

Recycling Process of ACM

The adjacent image illustrates the recycling of aluminum composite panels.

The metal of an ACM is 100 percent recyclable without loss of the material's properties.



Environmental Product Declaration (EPD)

An EPD offers a standardized, internationally recognized way to evaluate and specify a product with a low environmental footprint. An EPD can be produced for one specific manufacturer's product (proprietary EPD) or for a specific group of manufacturers' product type (industry wide or generic EPD).

EPDs are created using life-cycle assessment (LCA) data specified by the product category rules (PCRs) and based on ISO 14025 standards. PCRs determine product information collected and define the type of LCA data to be evaluated.

EPDs are included under the U.S. Green Building Council's (USGBC's) Leadership in Energy and Environmental Design (LEED) program, LEED v4, in new criteria for the Materials and Resources category—Building Product Disclosure and Optimization—Environmental Product Declarations.

CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION

EPD **Transparency Summary**

COMPANY NAME **Metal Construction Association**

PRODUCT TYPE **Wall Panel Systems**

PRODUCT NAME Metal Composite Material Panels

PRODUCT DEFINITION Metal Composite Material (MCM) panels have been used in North American construction for over 30 years. They are formed by bonding two metal skins to a highly engineered plastic core.

PRODUCT CATEGORY RULE (PCR) Insulated Metal Panels & Metal Composite Panels, and Metal Cladding: Roof and Wall Panels (UL, October 2012)

CERTIFICATION PERIOD February 5, 2014 - February 5, 2019

DECLARATION NUMBER 13CAS6115.101.1

LIFECYCLE IMPACT CATEGORIES

The environmental impacts listed below were assessed throughout the product's lifecycle – including raw material extraction, transportation, manufacturing, packaging, use, and disposal at end of life.

	ATMOSPHERE			WATER		EARTH	
	Global Warming Potential refers to long-term changes in global weather patterns – including temperature and precipitation – that are caused by increased concentrations of greenhouse gases in the atmosphere.	Ozone Depletion Potential is the destruction of the stratospheric ozone layer, which shields the earth from ultraviolet radiation that's harmful to life, caused by human-made air pollution.	Photochemical Ozone Creation Potential happens when sunlight reacts with hydrocarbons, nitrogen oxides, and volatile organic compounds, to produce a type of air pollution known as smog.	Acidification Potential is the result of human-made emissions and refers to the decrease in pH and increase in acidity of oceans, lakes, rivers, and streams – a phenomenon that pollutes groundwater and harms aquatic life.	Eutrophication Potential occurs when excessive nutrients cause increased algae growth in lakes, blocking the underwater penetration of sunlight needed to produce oxygen and resulting in the loss of aquatic life.	Depletion of Abiotic Resources (Elements) refers to the reduction of available non-renewable resources, such as metals and gases, that are found on the periodic table of elements, due to human activity.	Depletion of Abiotic Resources (Fossil Fuels) refers to the decreasing availability of non-renewable carbon-based compounds, such as oil and coal, due to human activity.
TRACI	6.11E003 kg CO2-eq.	1.45E-4 kg CFC-11-eq.	292 kg O3-eq.	1.83E003 kg H+ mol-eq	0.852 kg N-eq		
CML	6.12E003 kg CO2-eq.	2.43E-4 9.29E-05	3.07 kg Ethene-eq.	38.6 kg SO2-eq.	1.68 kg PO43--eq.	0.00255 kg Sb-eq.	7.77E004 MJ

FUNCTIONAL UNIT The functional unit for this study is defined as "coverage of 93 square meters (1,000 sq feet) with metal product". The coverage area refers to the projected flat area covered by the product as output by the final manufacturing process step, and does not account for losses due to overlap and scrap during installation.

Environment

Environmental Product Declaration (EPD)

Aluminum composite material manufacturers that hold EPDs have invested time and money in gathering LCA information. This information is useful for identifying processes and ingredients that negatively impact the environment and human health. Architects can use this information to look for evidence of improvement in the environmental impact of a product across its life span. The LCA information identifies what the company acted upon, and what positive changes an ACM manufacturer has made or is making.

Using an EPD to compare the environmental impacts between same or similar products can be difficult since not many are available and the same PCR has been used, with the same life-cycle phases evaluated. However, they can be used to start a discussion about the sustainability goals of a company.

LEED Project: SFO Airport Traffic Control Tower

Project: Air Traffic Control Tower
Location: San Francisco International Airport
Design architect: HNTB Corp.
Design-build architect: Fentress Architects
Year of installation: 2011
Certification: LEED Gold

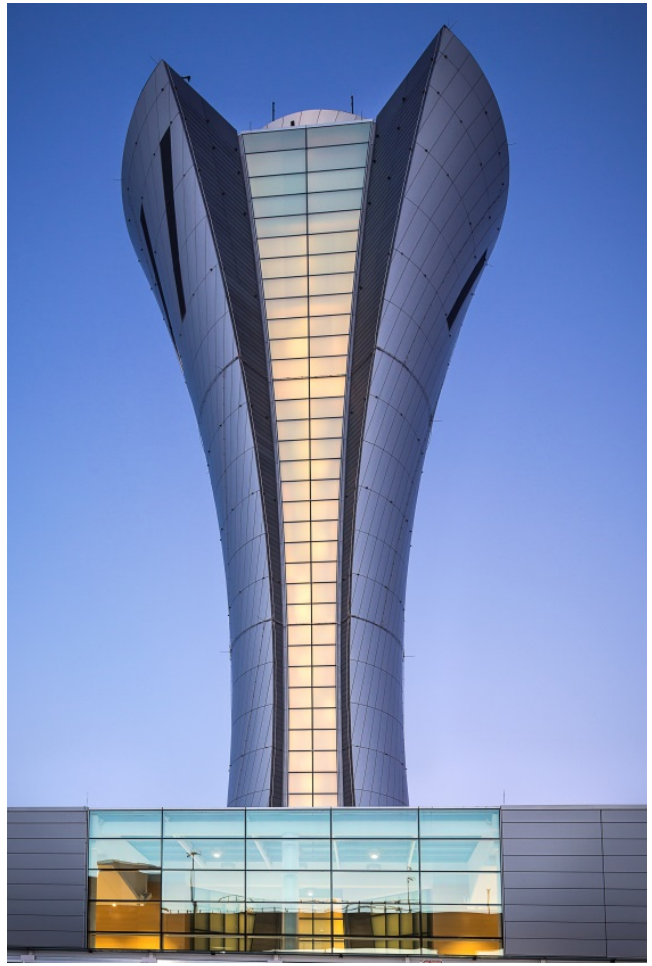
The design of San Francisco International Airport's (SFO's) new airport traffic control tower not only focused on functional goals—including meeting the strictest seismic event standards, offering maximum sightlines, and accommodating state-of-the-art electronics—but it also needed to serve as an iconic airport symbol.

LEED Project: SFO Airport Traffic Control Tower

The resulting 221-foot-tall 5,652-square-foot shimmering-metal tower features a geometrically complex design resembling a sweeping torch that is topped with an offset control cab—the latter providing Federal Aviation Administration (FAA) air traffic controllers with an unobstructed 270-degree view of airport runways and taxiways.

A total of 10,000 square feet of formable 4-millimeter ACM in the custom SFO silver color clads this spiraling torch-shaped structure.

The new air traffic control tower is the tallest vertical self-centering post-tension concrete structure in the United States and is designed to achieve LEED Gold certification from the U.S. Green Building Council.



LEED Project: Visitor Centre

Project name: VanDusen Botanical Garden Visitor Centre Project
Location: Vancouver, British Columbia

Architect: Perkins + Will Canada

Year of installation: 2011

Certification: LEED Platinum

This one-story, 19,000-square-foot Visitor Centre, which houses a cafe, library, volunteer facilities, a garden shop, office space, and flexible classroom spaces, utilizes an iconic design reflective of the organic forms and natural systems of a native orchid. Completed in 2011, the Visitor Centre achieved LEED Platinum certification in 2014. The project was also submitted to the International Future Living Institute's Living Building Challenge—the most stringent measurement of sustainability in the built environment. The Visitor Centre serves as a public face for the City of Vancouver's initiative to be the "Greenest City in the World" by 2020.

Images: Raymond Chan, Photomedia Canada, and Keith Panel Systems

LEED Project: Visitor Centre

To meet Living Building Challenge standards, only building products that did not contain “Red List” chemicals were utilized.

Materials included fully recyclable ACM, wood, glass, and rammed earth. Approximately 12,000 square feet of ACM in a custom plain mill finish and 4-millimeter thickness was used on the roof.

ACM was considered the best material to achieve this three-dimensional design challenge—it had to go up and down and sideways at the same time to achieve the undulating roof lines and the positive and negative curves.

Images: Raymond Chan, Photomedia Canada, and Keith Panel Systems

Applications

Applications: Introduction

ACM is an ideal product for all types of applications.

- Commercial
- Retail
- Transportation
- Health care
- Hospitality
- Education
- Multifamily

Shown in subsequent slides are examples of the wide range of ACM applications.

Corporate and Retail

Toro Headquarters, Bloomington, Minnesota

IKEA Home Furnishings, Coquitlam, British Columbia

Transportation

Los Angeles International Airport (LAX) is the sixth busiest airport in the world and the third busiest in the United States.

The Tom Bradley International Terminal's (TBIT's) uniquely formed roof was created with 253,000 square feet of formable ACM in 4-millimeter thickness and finished with a custom metallic color.

Tom Bradley International Terminal, Los Angeles International Airport, Los Angeles

Health Care

The 14-story building at Rush University Medical Center in Chicago, which is referred to as The Tower, stands out in the city's skyline with a unique butterfly design and striking white exterior—both visual symbols of the medical center's goal to transform health-care delivery.

ACM in a custom white color was selected to realize the hospital's shining, clean exterior image and its unique butterfly design. The 840,000 square-foot, LEED Gold tower stands out in the market not only by offering state-of-the-art health-care technology but also the medical center's overriding goal to reorient its facilities around patients and their families.

Rush University Medical Center, Chicago

Health Care

A total of 267,000 square feet of ACM with a fire-retardant core was installed on The Tower, including approximately 250,000 square feet of ACM with a fire-retardant core in the white color and 4-millimeter thickness as exterior wall cladding.

Approximately 17,000 square feet of ACM with a fire-retardant core in a pewter color and 4-millimeter thickness was installed as a recessive color accent on column covers and interior mullions.

Rush University Medical Center, Chicago

Hospitality

The new Jumer's Casino & Hotel in Rock Island, Illinois, was designed to bring a Las Vegas-style gaming experience to the Midwest. The $151-million, 270,000-square-foot complex includes one 170,000-square-foot casino and entertainment center connected to a five-story, 205-room hotel.

Jumer's Casino & Hotel features 57,083 square feet of ACM in 4-millimeter thickness.

Finishing with a color-shifting system allowed the architects to incorporate a unique, ever-changing color spectrum into the cladding of this sophisticated building design. With each shift of the sun and clouds, the ACM changes color—from red to orange to almost brown.

Jumer's Casino & Hotel, Rock Island, Illinois

Hospitality

Painted Rock Estate Winery Tasting Room, Penticton, British Columbia

The new 1,600-square-foot, one-story Painted Rock Estate Winery Tasting Room—which opened in September 2013—was designed not only to accommodate on-site retail wine-tastings and sales but also as a unique destination site for weddings, banquets, and corporate events.

The architect team created a sleekly contemporary building design for the facility that makes the most of the natural view while honoring the brand's upscale marketing approach.

Hospitality

Painted Rock Estate Winery Tasting Room, Penticton, British Columbia

Cladding this contemporary building design is a total of 2,400 square feet of modern ACM in 4-millimeter thickness, including 1,800 square feet of ACM in a seafoam metallic color and 600 square feet in a reflective finish.

Formable ACM played a vital role in creating the tasting room's flowing form not only by accommodating the design's radius curves but also through its surface color.

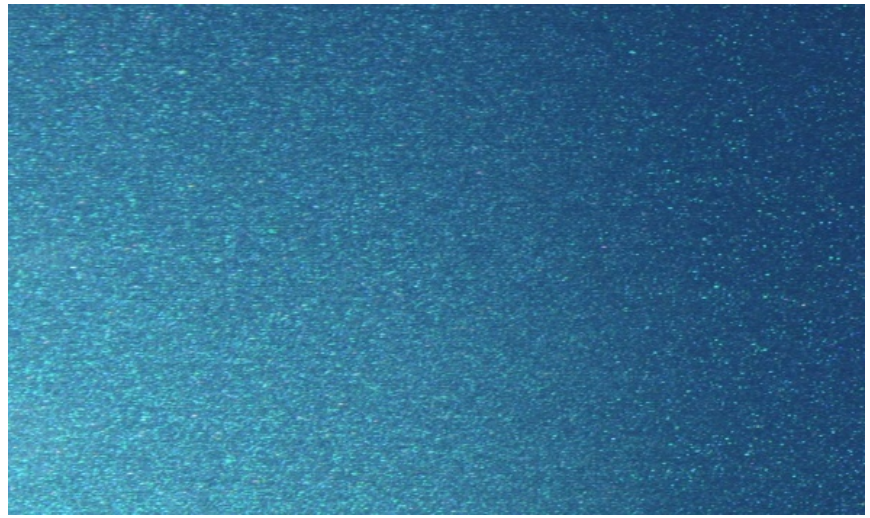
Education

Residence Hall, Stony Brook University, Stony Brook, New York

Residence Hall, University of Arizona, Tucson, Arizona

Multifamily Residential

Before the exterior retrofit, the exterior facade of this 200,000-square-foot tower in New Jersey was constructed of a blue and white aluminum curtain-wall system set over reinforced concrete walls. The exposed gray concrete columns had faded and looked utilitarian at best. Approximately 117,000 square feet of ACM in nine different colors, including eight transitional color finishes, was installed. The three major goals—improving the building's thermal performance, eliminating air and water infiltration, and improving the building aesthetics—were achieved with the use of ACM.



Paul F. Cullum Tower, North Bergen, New Jersey

Corporate Identity

Conveying corporate identity internally and externally is multifaceted: ranging from facades, canopies, and totems to interior design, store fittings, and signage.

ACM offers long-lasting color fidelity and brilliance, decor surface options, excellent dimensional stability, easy processing, and cost-effectiveness.

Curtain Wall

As one of the first high-rises constructed in Fairfax County, Virginia, a mixed-use residential community called Adaire stands out not only for its 35 stories towering into the sky but also its striking ellipsoidal design and modern facade.

This 600,000-square-foot community features a 400-unit residential tower over a rectangular retail and parking podium.

The residential tower's unique oval design is accentuated with sweeping white balconies and a modern facade of glass mixed with multiple custom colors of ACM installed in a random pattern. A total of 113,160 square feet of 4-millimeter ACM was used for this project.

Interiors

The whimsically designed six-story Children's Atrium at Oklahoma University Medical Center never lets viewers forget who it is there to serve—the youngest of patients who might just as well prefer to be playing with toys outdoors.

In addition to cladding the curved roof, ACM was installed throughout the building, including on the exterior columns, soffits, entryway canopy, and curtain wall, as well as on interior wall columns, beam wraps, and revolving-door trim. The fabricator also created custom coverings for everything from lights in the terrazzo floors to recessed lighting, mechanical boxes, and return-air enclosures.

A total of 46,739 square feet of ACM in a silver metallic color and 6-millimeter thickness was fabricated for the atrium.

Children's Atrium, Oklahoma University Medical Center, Oklahoma City

Soffits, Walkways, Canopies, and Column Covers

With expansive panel length capabilities, ACM can be used for soffits, walkways, canopies, and column covers. The material can be bent into curved shapes and can provide aesthetic accents to a variety of structures. Additionally, letters can be easily cut out for back panel illumination.

Applications include gas station canopies, CID, retail, and education interiors.

Summary

Summary Points

- ACM is used worldwide since it provides a sustainable solution for building design in a variety of climatic and environmental conditions.
- ACM is used for exterior as well as interior applications, including cladding for exterior canopies, soffits, fascias, interior columns, graphic displays, and decorative elements.
- Made of two sheets of 0.020-inch aluminum facings thermobonded to a fire-retardant core, fire-rated aluminum composite material meets code requirements, including NFPA 285 and ASTM E84.
- Benefits and attributes of ACM include: formability, versatility, eye-pleasing aesthetics, light weight, perforation capabilities, high rigidity, reflectivity, limits sound transfer, weather/corrosion resistance, and affordability.
- Providing excellent design flexibility, ACM is available in a variety of finishes and textures, including standard and custom colors, anodized, and metal, wood, and stone patterns.
- Specification considerations include: minimum bending radius, temperature resistance, bond strength, finish performance, and third-party listing, as well as system performance to air/water infiltration, wind loading, and vertical/horizontal flame spread.
- There are two types of attachment systems: rout and return wet, and rainscreen.
- ACM is a sustainable product, beginning with its manufacturing process where all excess core is recycled back into the manufacturing process and all scrap aluminum is sent back to aluminum processing plants for recycling.

Resources and References

- “What is Metal Composite Material?” Metal Construction Association (MCA). Web. September 2019. <www.metalconstruction.org>.

- Kellert, Stephen. “Biophilia and Biomimicry: evolutionary adaptation of human versus nonhuman nature.” Intelligent Buildings International. 2014.

Conclusion

Thank you for completing this continuing education course.

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