The building’s facade is the first thing people see when they gaze upon a skyline or down the street. The facade is not only there to evoke a feeling upon first impression, but it also serves as a vital part of the building envelope. In short, the building envelope is meant to keep the outside out and the inside in while providing occupants with a safe and comfortable environment that will promote their physical and mental health and welfare. The challenges presented by the environment and exacerbated by climate change put added pressure on the building envelope, which can lead to unwanted air and moisture intrusion and all the costly hazards and repairs that follow. Thanks to technological advancements, modern architectural features not only help protect the building envelope against wind, rain, water, and snow, occupants do not have to sacrifice comfort, energy efficiency, or sustainability to enjoy aesthetically pleasing facades. Striking the balance between beauty and function, a well-designed facade can provide the means to ensure that a building is both easy on the eye and easy on the environment, as high quality, long-lasting sustainable materials also require less maintenance and fewer updates or replacements.

Creating balance between beauty and function

Sponsored by 3A Composites USA, Inc., Cosentino, Endicott Clay Products, Hofmann Facades Group, Inpro, Neolith®, Vitro Architectural Glass

By Jessica Jarrard

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AIA COURSE #K2112K
MATERIAL SOLUTIONS FOR HIGH QUALITY FACADE
With many different materials available on the market, building designers and architects have a myriad of options to choose from. High quality, sustainable materials are often a blend of naturally occurring and manufactured materials, thus combining the natural weatherproofing qualities provided by Mother Nature with man-made technology solutions.

A key attribute of sustainability is to ensure the balance of natural materials left in nature when extracting them or making a concerted effort to replenish them. Combining natural materials with man-made materials can help make them more durable and increase their life span, preventing an early trip to the landfill. Specifying products that can be recycled or repurposed at the end of their life span is another way to further decrease material impact on the environment.

After a material is selected, it can be treated with coatings or glazes not only to ensure an aesthetically pleasing facade, but also to provide additional protection against the elements, improving the health, safety, and well-being of occupants. Materials can be cut into various shapes and sizes. Coatings and treatments can be applied to update textures, colors, and even designs.

**Sintered Stone**
Sintered stone is a fairly new material that combines a perfect blend of man-made processes with natural materials to create surfaces that can withstand both natural elements (hurricanes, blizzards, driving wind and rain) and man-made elements (industrial smog, graffiti). This durable surface is resistant to water, chemicals, scratches, abrasions, and thermal shock, making it a facade material of choice for architects and specifiers worldwide.

Sintered stone can be used for exterior building projects, whether commercial or residential, especially in areas where added thermal and weather protection is needed to protect against extreme temperatures and driving rain or snow. While it is 100% natural in composition, sintered stone can be treated with another material agent to transform the slab into a self-cleaning, anti-pollution, air purifying surface perfect for use in busy, high-emission urban environments.

This natural premium surface is produced in a carbon neutral environment and is one of the most sustainable facade materials on the market. Using 100% natural raw materials, a variety of surface designs can be manufactured including wood, marble, and metal. High performing, ultra-resistant, and low maintenance, sintered stone is available in over fifty colors, patterns, and finishes, providing a striking appearance by combining aesthetic appeal with longevity and resilience.

**Natural Stone**
Natural stone works well in exterior facades. It has the lowest embodied carbon of any fascia/cladding material—four times lower than timber, 3.3 times lower than brick, and 10 times lower than terracotta, ceramic, or architectural precast with high cement or steel content. Natural stones such as sandstone, limestone, and granite can be combined with ultra-high performance concrete (UHPC) into a thin, lightweight, high performance cladding system. This innovative low-weight facade system does not require the use of aluminum, steel, or precast concrete, leaving a much lower carbon footprint. Brick, terracotta, and wood also can be unitized on thin, lightweight cladding panels made of UHPC.

Natural stone can emulate and achieve the look of other less sustainable materials. Faux joints in large natural stone panels can mimic the look of brick or terracotta, as well as yellow or red sandstone.

Performing as a decorative rainscreen, or even a load-bearing outer wall, natural stone has a high thermal mass and a low U-value which reduces the amount of heat loss in the winter and heat gain in the summer.

Natural stone is also highly durable. A well-maintained natural stone facade can easily last 150 to 200 years as it does not use or require structural silicone like glass curtain wall.

**Ultracompact Surface Material**
The ventilated facade is a high performance solution for building enclosures, which takes advantage of mechanical anchoring elements. Through connections between the siding material and the mechanical assembly, design loads are effectively transferred back to the structural wall, providing a safe and secure facade.

For facades fixed with glue, it is very important to select the appropriate adhesives. Mechanical tiebacks or safety brackets can also be incorporated as needed.
Spandrel panels are used in place of glazing units in curtain wall systems when hiding the edges of floor slabs, ceiling details, insulation, or other building elements. Ultracompact surface material is available in large format panels (126-by-56-inch) and varying thickness (8 mm, 12 mm, and 20 mm). This material has excellent dimensional stability with a reduced number of joints needed, thus limiting the number of openings in the building envelope.

Thin brick is a thinner version of full-face brick and can be applied to places and large expanses that were once too physically impractical or too costly for application.

These panels come in many colors and styles leading to endless design possibilities. Reduced porosity means this material is easy to clean, and resistant to water absorption, thermal shock, extreme heat, graffiti, and freezing.

**Thin Brick**

Thin brick is a thinner version of a full-face brick that can both functionally and aesthetically work with traditional face brick. Thin brick uses less material and so proves more cost-effective, creates a smaller carbon footprint, and is less expensive to ship. Thin brick is also easy to install. This product can be used in places that were once thought to be physically impractical or too costly for application, such as large stadiums and massive sports arenas.

Thin brick is available in many colors and textures to match the aesthetics of face brick counterparts. Some thin brick comes with a "keyback" design that protects the wall system from having the brick pull out when used in precast or tilt-up applications, allowing the thin brick to be better used in a panel system when applied. The keyback design also offers a seamless look and feel when transitioning from thin to face brick on a single facade.

**Glass Expanses with Low-e Coatings**

To achieve bright beautiful buildings with plenty of daylighting for occupants, architects can specify low e-coated glass in larger expanses without sacrificing energy efficiency and sustainability. Low-emissivity (low-e), low-iron glass can be used to create views so clear and crisp that it’s hard to believe the glass is even there. Low-e coatings are engineered to minimize the amount of harmful ultraviolet (UV) and infrared light that can pass through the glass without compromising the amount of visible light that is transmitted. A microscopically thin transparent coating allows low-e glass to reflect exterior heat in warm temperatures and hold in heat during cold temperatures. This helps prevent unwanted heat exchange, reducing the need for HVAC to maintain occupant safety and comfort.

Building-Integrated Photovoltaics (BIPV) options are also available, allowing the integration of solar cells into the building envelope. BIPV materials simultaneously serve as the facade, the building envelope barrier, and as a source of power generation.

LUCAS OIL STADIUM
INDIANAPOLIS, INDIANA

The 1.8-million-square-foot Lucas Oil Stadium conjures a charming, turn-of-the-century look for one of the most distinctive, multi-use venues in the United States. Home to the Indianapolis Colts, the NFL Combine and multiple major collegiate tournaments, the brick, steel, and glass structure reflects the traditional forms and historical feel of the state’s revered, old-school basketball arenas. Perhaps the most striking aspect of the exterior is the attractive reddish-brown brick, commanding the attention of visitors from all four sides of this massive structure. The Medium Ironspot #77 thin brick from Endicott was selected for its warm, classic feel that enhances the muscular steel-framed design while complementing the city’s captivating skyline. Thin brick allowed construction of large brick-and-mortar panels to be assembled offsite and then brought in for efficient on-site installation.

Lucas Oil Stadium’s exterior is clad with thin brick, a versatile and cost-effective option for larger arenas with many angles and large surfaces that could not be clad in traditional brick.

The Comcast Center Atrium utilizes low-iron glass with low-e coatings to provide occupants with clear, crisp views while also preventing unwanted heat transfer.
The systems can help increase the value of the building by enabling it to produce energy while also reducing electricity costs, use of fossil fuels, and emissions.

**Expansion Joint Systems**

To ensure that the building envelope is designed, specified, and installed to protect the interior and its occupants against the elements, facades must ensure that all seams and joints are adequately sealed. These systems are an integral part of many buildings due to expected movement that naturally occurs over time. Expansion joint systems not only allow for movement but are also designed to provide additional moisture and fire protection and to handle unique conditions within a building.

Closed-cell foams are absolutely water-tight and do not allow moisture to enter the body of the foam. This is the best application for horizontal runs where water could pool. The other key advantage of closed-cell foams is that they take well to heat welding of seams. This renders a monolithic installation that reduces risk of water infiltration.

Compression seal joint systems are installed into a joint block out and absorb movement and flexing through compression of the seal. The product is also an excellent option for exterior applications where waterproofing is required.

The hybrid design of a compression seal system is designed to deliver a greater level of waterproofing in split slab construction. A key benefit of this system is its integrated counterflushing, which is engineered to channel water away from the joint opening.

A roof bellows system uses either an ethylene propylene diene terpolymer (EPDM) or a neoprene seal that flexes to accommodate seismic movement. As with counterflushing, the seal must run under the metal flanges to allow water to be shed away from the joint opening. In addition, a compatible non-reacting mastic should be used to ensure watertight adhesion of the seal.

A reinforced vapor barrier (RVB) is another option that can be specified to prevent water infiltration or channel water via an integrated drain tube to drain locations.

**A SYSTEMS APPROACH**

In the design and planning stages, architects and specifiers must consider how all aspects of the building will work together to ensure that the end result is a high performance building that provides occupant health, safety, and comfort.

The building envelope is the first line of defense when it comes to keeping outside air out and inside air in. Whether designing and constructing a new building or renovating/retrofitting an old building, it’s important to understand the entire building envelope system as having a direct impact on energy use and indoor air quality (IAQ). According to a 2015 report from the U.S. Department of Energy, “about 50% of the heating load in residential buildings and 60% in commercial buildings results from flows through walls, foundations, and the roof.” Energy created within the home that flows to the exterior is just one of the problems caused by a poorly sealed building envelope. Unwanted intrusions from outside the building also can penetrate the envelope, flowing inside and harming the building’s structure and its occupants.

Over the past several decades, huge technological advancements have been made to materials, products, and construction best practices. The adoption of new technology and high quality products is becoming increasingly important as the effects of climate change are leading to increased instances of extreme weather that can directly impact

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**570 BROOME**

**NEW YORK CITY, NEW YORK**

Standing at nearly 330 feet tall in downtown New York City is 570 Broome, a brand-new 25-story building nestled between bustling Soho and Hudson Square. This marvel of modern design, clad with a stunning glazed curtain wall, consists of 54 luxury boutique residential units as well as a commercial component at ground level.

The skyscraper is inspired by its setting: a whimsical combination of contemporary and contextual elements which define its environment.

Sintered stone was specified across the whole facade, framing three-story-high expanses of glass which capture spectacular vistas of downtown and the Hudson River. The overall design is symbolic of NYC’s rich history by way of the tower’s soaring ceiling heights and a silhouette evocative of staggered cubes.

Due to the project’s location near the heavily congested Holland Tunnel, the client wanted to deliver a durable, low-maintenance building that could withstand physical damage. Also stain-resistant and impervious to natural and man-made atmospheric deterioration, such as UV-rays and car exhaust fumes. Sintered stone had all these features, proving to be the ideal material.

The application of this exclusive water-based solution the sintered stone slabs enhances the surface, transforming it into a self-cleaning air purifier which helps to improve air quality and keep the surfaces clean.

A custom color that is similar to limestone was used, as limestone is a traditional cladding choice for luxury buildings, and beautifully contrasts the smooth glazed surfaces of the building’s curtain wall.

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**Photo courtesy of Neolith**

**Photo courtesy of Inpro**
hurricanes that can produce dozens of inches from larger and more intense storms such as wildfires, and unprepared buildings are more vulnerable to costly damage. Areas – while others experience extreme swings as well as increased flooding in some areas – while others experience extreme drought – can leave an area susceptible to extreme weather events and unprepared buildings. Drought – can leave an area susceptible to extreme weather events, as well as increased flooding in some areas. Areas that typically have precipitation are suffering from larger and more intense storms such as hurricanes that can produce dozens of inches of rain in a single storm, or blizzards that drop large amounts of snow. All of these conditions strain buildings and threaten to damage the building envelope, allowing unwanted air and water to penetrate building materials. As flood waters recede or blizzard snows melt, the buildup of water can flow into spaces around exterior flashings or expansion joints. If not prevented or quickly remedied, unwanted moisture intrusion can cause catastrophic physical damage that is not only expensive to fix but also can be harmful to building occupants. Mold and mildew can easily grow in water-damaged spaces, leading to poor air quality and causing physical harm to occupants. By keeping outside air and moisture out, the building envelope assists other systems. For example, the HVAC system works more efficiently to keep occupants comfortable with consistent temperatures and safe with improved air quality. Sintered stone has a porosity of less than 0.09 percent, so it doesn’t easily absorb water. By keeping water out of the surface material, the building is less likely to be affected by water penetrations and subsequent staining, mold, or mildew on the exterior facade. Sintered stone is also resistant to thermal shock, making it suitable for any climate. Ultracompact surface materials are shown to be impervious with an average water absorption rate of 0.03 percent. They also have an average moisture expansion of 0.02 percent and an average abrasive wear index of 182.2. Natural stone can be manufactured in large panels that contain faux joints to achieve the look of brick or terracotta; a single panel may appear to have more than a dozen bricks. Fewer seams and fewer spaces...
TOHA BUILDING
TEL AVIV, ISRAEL
In the center of Tel Aviv, the ToHA building was designed by Ron Arad with the local team of Avner Yashar. The ToHa building offers a unique office complex complete with a public garden, an observation deck, and a restaurant.

More than 300,000 square feet of ultracompact surface clad the ensemble and appear on the ventilated facades, fixed facades, cladding on the exterior insulation and finish system (EIFS), flooring, elevators, ceilings, and the interior partitions. The ultracompact surface pieces are 126-by-56-inches with thicknesses of 30 mm, 20 mm, 12 mm, 8 mm, and 4 mm.

One of the main strategies in the design of the project was that of reducing the built area at street level to create a large park with the idea of giving the surroundings a public character. The building emerges atop two large legs that widen gradually and create a twisting volume. Because of its geometric versatility, the ultracompact surface manages to adapt with precision to this formal complexity thanks to its endless range of formats, with many thicknesses and ultra large format. In the building’s intermediate levels, the jagged perimeter of the concrete slabs is clad with panels measuring 12-mm- thick and 79-inches-wide that, with their careful detailing, define the vertices and edges, conveying an image of perfection.

The ultracompact surface material used has a carbon neutral certification is noncombustible, making it perfect for building facades. The surface material has an extremely minimum porosity with maximum resistance to scratching and impact and will not expand. The large format allows for dimensional stability and resistance to sunlight (UV) rays. It is also stain and graffiti resistant. The low porosity also makes it freeze and thaw proof.

DESIGN AND AESTHETICS
When specifying materials and products for facades, it is also important to consider how the material will be manufactured, shipped, and installed. For large scale commercial projects, large panels can provide options for unique, visually stunning facades. Panels can be cut into custom shapes and offer infinite options as to how they are displayed. Large panels can even include designs that give the illusion that the panel is made up of many smaller pieces of different shapes and sizes. However, the major benefit to having large sheets and panels is that there are fewer seams or areas where water and moisture can seep into the building.

Sintered stone is a lightweight product that can be cut to almost any requirement, making it cost-effective to ship and easy to fabricate and install. The material can be affixed to a building’s structure by using one of the following systems:

Visible Mechanical Fastening Fixation (VM): Comprised of a self-supporting metal structure for ventilated facades designed to support ceramic tiling in different formats and thicknesses.

Strongfix: A longitudinal mixed (chemical and mechanical) hidden profile system.

Natural stone can be shipped as large-scale, thin, lightweight prefab panels on UHPC. Natural stone not only creates a unique facade, but it also reduces the carbon footprint in manufacturing processes, transportable weight on the roads, and the structure.

Ultracompact surface materials can be specified, manufactured, and cut into large panels for a visually appealing facade that has fewer seams that need to be sealed in the building envelope.

Glass panels can be manufactured, cut into various large panel shapes and sizes, and installed on the exterior facade. Tempering processes during manufacturing as well as glass coatings help reinforce the glass, making it more durable and aesthetically pleasing both for occupants indoors and for those viewing the structure from the outside. Coatings also can be used to reduce heat transfer and glare.

SUSTAINABILITY
In addition to creating aesthetically pleasing and unique facades, natural and durable materials promote sustainability in a few
EXPLORATORIUM
SAN FRANCISCO, CALIFORNIA

The Exploratorium was opened by Frank Oppenheimer in 1969 and is located at the Palace of Fine Arts in San Francisco. Nearby are Pier 17, built in 1912, and Pier 15, built in 1915, with a major renovation in 1931. During a recent renovation of The Exploratorium, the architect wanted to create a LEED Gold, net-zero facility that was resistant to seismic movements, while also providing protection against fire and moisture from precipitation and the nearby saltwater from the San Francisco Bay. The facade of this contemporary building would still blend in with its historical surroundings while utilizing the latest technology to keep occupants safe and comfortable.

A single manufacturer was specified to provide the entire expansion joint and barrier package for the Exploratorium project. Almost 1,500 linear feet of interior and exterior seismic expansion joints are used throughout the building. Joint widths varied from 8 inches to as wide as 27 inches. Of the 1,500 linear feet, nearly 95 percent of the joint systems were custom designed and built, including several joints incorporating 3/8-inch-thick aluminum diamond plate. Where these joints bridged fire separation areas, waterproof fire barriers were specified and installed. The fire ratings were needed to maintain the safety of the walls, floors, and roof systems that made up the fire separations. The waterproof component was needed to withstand the moist and humid conditions of being over the water. Designers also specified specific coatings on many of the exposed joint systems to fight saltwater degradation and assure durability.

In thin brick applications, the keyback design provides a mechanical lock into the concrete for maximum durability and permanence. This design brings added strength and performance with an increased sheer value and pull-out strength. Both of these attributes lead to a longer product life and fewer replacement costs along with less material waste. When brick does reach the end of its life, it can be recycled as it is made from abundant, natural materials.

END NOTE


Jessica Jarrard is an independent writer and editor focusing on health, science, and technology. She contributes to continuing education courses and publications through Confluence Communications. www.confluencecc.com