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Course Description

Architectural metal fabric is a dynamic exterior and interior material that can be used to create beautiful and functional facades, balustrades, screening, ceilings, and wall coverings for libraries, academic buildings, parking garages, stadiums, and other public and commercial buildings.

This course will discuss exterior and interior applications for metal fabric and its performance benefits, including safety, security, solar management, and sustainability. We will also explore coatings and graphics technologies that can be incorporated into metal fabrics to create a building and brand's visual identity.



PICTURED:
Museum of the Bible, Washington, D.C.
Houston Area Safety Council, Houston

Learning Objectives

1

Examine how architectural metal fabrics for interior and exterior applications provide solutions for design challenges.

3

Explore how to create visual identity and branding with metal fabrics, including etching, lighting, color, and transparent media facades.

2

Review the performance benefits of metal fabrics, including safety and security, solar management, and sustainability.

4

Identify ideal applications for the product, and review case studies where the material was used.



PICTURED:

Tripoli International Convention Center
Adelaide Airport Facade, Adelaide, Australia
Gould Evans Investment Firm, San Francisco

Learning Objective #1

Examine how architectural metal fabrics for interior and exterior applications provide solutions for design challenges.



First, let us begin by examining how architectural metal fabrics for exterior and interior applications provide solutions for design challenges.

PICTURED:
Golden Box (Private Residence), Singapore

Architectural Metal Fabric Solves the Challenges of Outdoor Design

Building products need to be:

- Weather resistant
- UV resistant
- Corrosion resistant

Stainless steel is extremely durable and perfectly suited for exterior applications.



Designing exterior architectural features can be challenging, as natural elements such as wind, rain, and snow test even the most durable materials. Building products must not only be weather resistant, but also UV resistant to combat the damaging effects of sunlight, and corrosion resistant when used in coastal environments and other harsh climates. Materials such as wood will rot and are vulnerable to insect infestation; PVC products will yellow in sunlight and become brittle; and porous concrete will stain, crack, and spall. Stainless steel is extremely durable and perfectly suited for exterior applications.

PICTURED:

Newark Liberty International Airport, New Jersey

Griffiths Avenue Pedestrian Bridge, Burnaby, British Columbia, Canada

Eastern Michigan University, Ypsilanti, Michigan

Woven Metal Fabrics: A Durable Outdoor Solution

- Fabric types developed specially for architecture, design, and function are manufactured from cables and wires (predominantly stainless steel).
- Different fabric types offer different degrees of penetrability and reflectance, creating virtually invisible facades.
- Constructed of AISI Type 316L stainless steel, they create visual permanency and surface durability.



For project teams seeking a dynamic exterior material with a very long life cycle, one solution is technologically advanced woven metal fabrics. Fabric types developed specially for architecture, design, and function are manufactured from cables and wires, which are predominantly made of stainless steel, although other metals such as copper, bronze, and aluminum are also used. Different fabric types offer different degrees of penetrability and reflectance, which vary strongly in terms of effect and color on the building according to lighting and weather. These enable the creation of virtually invisible facades. Metal fabrics are suitable for large or small-scale projects, in both interior and exterior applications.

High-quality woven metal fabrics are primarily constructed of American Iron and Steel Institute (AISI) Type 316L stainless steel, which for more than half a century has provided architects with the means to produce a permanent expression of their design concepts. This visual permanency is due to the material's excellent resistance to corrosion as the "L" stands for low carbon. This allows the surface to retain its original appearance indefinitely with very little maintenance. Adding to stainless steel's design appeal is its excellent performance properties of fire, heat, and impact resistance. Consequently, it is

not surprising that stainless steel has been specified with confidence by generations of architects for so many indoor and outdoor applications.

PICTURED:

Newark Liberty International Airport, New Jersey

Woven Metal Fabric: High-Performance Solutions for Interior Design

- Durable, low-maintenance material for use in a variety of applications
- Partitions, walls, columns, ceilings, specialty furniture

With tailor-made attachment solutions, the panels are optimally integrated into the building structure, thereby creating a high-grade, protective shell.



Interior Surfaces Shine

While metal fabrics used on an exterior can affect the indoor environmental quality regarding views, solar management, thermal comfort, and acoustics, they can also be used effectively on interior surfaces to complement outdoor designs and create spaces that are both highly functional and pleasant to live in.

Metal fabrics adorn the walls of the finest hotels, museums, office buildings, and restaurants. They can be used for partitions to create isolated private enclosures or more airy spaces depending on whether a tight or open weave is specified. Metal fabrics are also an ideal material to clad interior surfaces, such as walls, columns, and ceilings. They can be tiled or framed for flat surfaces, but their flexibility allow free-form installations, such as draped from columns or suspended from ceilings.

Metal fabric always adds aesthetic quality and durability, making it an easy material for maintenance and the first choice for high traffic environments. In many cases, a metal fabric wall can also provide sun-shading benefits, depending on whether it is an inside or outside installation. In any interior

application, metal fabrics add glamour and allure.

PICTURED:

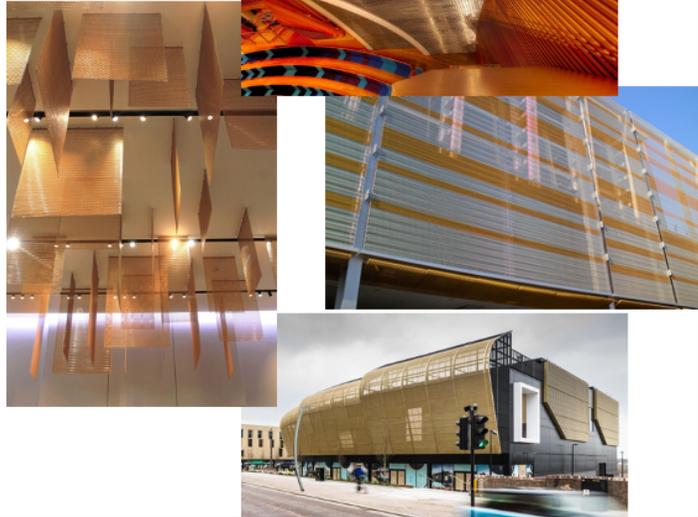
Museum of Islamic Art, Doha, Qatar

Akademie Hohenheim, Stuttgart-Hohenheim, Germany

Tencent Headquarters, Shenzhen, China

Woven Metal Fabrics: Aesthetic Juxtaposition

- A new world of design in the interplay between aesthetics and function, lightness and robustness, transparency and reflection, screening and views, daylight and sun protection
- Installed horizontally or vertically, framed in panels or hung like curtains, and shaped into fins, curves, axial twists, screens, or fixed elements
- Etched, lighted, manipulated, and coated to great aesthetic effect



In commercial and institutional buildings, metal fabrics provide both visual versatility and functional elements. They open up a new world of design in the interplay between aesthetics and function, lightness and robustness, transparency and reflection, screening and views, and daylight and sun protection. They can be installed horizontally or vertically, framed in panels or hung like curtains, and shaped into fins, curves, axial twists, screens, or fixed elements. Metal fabrics in a wide variety of patterns and weaves can be etched, lighted, manipulated, and coated to great aesthetic effect. We will discuss each of these treatments later in the course, but it is important to know that engaging a manufacturer that can provide innovative material combinations and holistic system solutions is the key to design freedom and a well-executed project.

PICTURED:

Chamber of Commerce and Industry (IHK) for Munich and Upper Bavaria, Germany (left)

Kauffman Center for the Performing Arts, Kansas City, Missouri (top)

Paris Expo Porte de Versailles, France (middle)

Elswick Place, Ashford, England (bottom)

Woven Metal Fabrics: Functional Advantages

- Some buildings such as multistory parking garages or stadiums require an outer shell that permits air transmission for ventilation.
- Buildings with large glass surfaces need protection from the sun, driving rain, and wind as well as privacy for occupants.
- A connecting outer shell is often desired to lend surfaces a sense of homogeneity.



Alongside a striking visual effect, metallic fabrics also offer an impressive array of functional advantages. Some buildings such as multi-story parking garages or stadiums require an outer shell that permits air transmission for ventilation. On other buildings, large glass surfaces need protection from the sun, driving rain, wind or privacy for occupants. Elsewhere, a connecting outer shell is desired to lend surfaces a sense of homogeneity. Robust, high-grade metal fabric is perfect for all these applications. Not only do they provide cost-effective installation, plus efficiencies associated with stainless steels long lifespan, but they are also easy to maintain and suitable for all climates.

Woven metal fabrics both protect and enrich structures around the world, and are ideal for parking garages, facades, and interiors in numerous types of buildings from residences, offices, and factories to hospitals, schools, and sports facilities. It is no longer necessary to choose between attractive design and the essential functions of these structures.

PICTURED:

One Brookline Place, Brookline, Massachusetts
Florida International University, Miami, Florida

Practical Benefits of Metal Fabric Parking Facades

Ubiquitous
and Bland



Works of Art



Ubiquitous, bland parking garages are being transformed into works of art with woven metal fabric. There are no longer limitations to how good a parking structure can look or how safe and secure it can be. Some parking garages require mechanical systems for ventilation to reduce the effect of vehicle emissions within the space. Their open nature also lends itself to safety issues, so fall protection is a key concern in parking garage design. Vehicle and occupant security are also high-priority safety concerns. Metal fabrics are the optimal material to provide both ventilation, fall safety, and security.

PICTURED:

New World Symphony Parking Garage, Miami Beach, Florida

Practical Benefits of Metal Fabric Parking Facades

Code Concerns

IBC 406.4: Enclosed vehicle parking garages must be equipped with a mechanical ventilation system in accordance with the International Mechanical Code.

IBC 406.3.3.1: For natural ventilation purposes in open garages, the exterior side of the structure should have uniformly distributed openings on two or more sides.

IBC 406.2.3: Guardrails must be provided at these exterior and interior vertical openings on floor and roof areas where vehicles are parked and where the vertical distance to the ground or surface directly below exceeds 30 inches.



Code concerns

There are fundamentally two types of parking garages regulated by the International Building Code (IBC): private garages and public garages. Although there is no specific definition for either type of garage, the primary difference between private and public garages is the size of the facility, rather than the use.

A public parking garage is then further characterized as one of two types—either an enclosed parking garage or an open parking garage—and regulated accordingly. According to IBC 406.4, enclosed vehicle parking garages must be equipped with a mechanical ventilation system in accordance with the International Mechanical Code. In open parking garages, only the percentage of openings is specified, not mechanical ventilation.

IBC 406.3.3.1 states that for natural ventilation purposes in open garages, the exterior side of the structure should have uniformly distributed openings on two or more sides. The area of the openings in exterior walls on a tier (floor) must be at least 20 percent of the total perimeter wall area of each tier. The aggregate length of the openings considered to be providing natural ventilation

should constitute a minimum of 40 percent of the perimeter of the tier. Interior walls should be at least 20 percent open with uniformly distributed openings.

According to IBC 406.2.3, in both commercial and private facilities, guardrails must be provided at these exterior and interior vertical openings on floor and roof areas where vehicles are parked and where the vertical distance to the ground or surface directly below exceeds 30 inches.

Source:

media.iccsafe.org/news/eNews/2013v10n17/2012_ibc_sigchanges_p27-28.pdf

Source: www.ibc-wiki.com/section-406/

PICTURED:

Winstar World Casino, Thackerville, Oklahoma

Solution: Metal Fabric Systems

- Vehicle and pedestrian security
- Visual appeal
- Energy and cost savings
- Protects from the elements

Metal fabrics provide a secure environment that limits unwanted access, protects from the elements, and provides pedestrian safety by way of balustrades.



Solution: Metal Fabric

You can see how open parking garages, which require a large percentage of open area at significant heights, could pose a fall hazard and a security concern. Metal fabric systems and hardware have been developed so that metal fabric facades can be incorporated into a parking structure to create an environment for vehicle security and visual appeal. Because of the fabric's transparent characteristic, no mechanical systems are required for ventilation, translating into energy and cost savings. Metal fabrics provide a secure environment that limits unwanted access, protects from the elements like wind, rain, snow, and ice, and provide pedestrian safety by way of balustrades.

Woven fabrics are available with varying open area that range from 0–71 percent. Open weave is the amount of light and fresh air permitted through a woven metal fabric panel. The open area that is driven by code ensures that loads experienced against the building are not so severe that they result in damage either building or metal fabric. The open area allows enough movement of air to relieve pressure. In fact, it is often the building, not the fabric system, that fails in such circumstances. Building code language is project specific to the physical location of the garage. Local codes will dictate

the required open area of the product.

*A note about ventilation: Ventilation is important not only in parking garages but also other open-air facilities, such as stadiums. It would be wasteful to heat or cool an entire stadium that is largely exposed to the elements, but with the right mix of cooling and natural ventilation, the stadium becomes instantly more comfortable reducing temperatures and saving energy costs. This is particularly important because stadiums are expensive to build and maintain, and many have to operate as fully multiuse venues for economic survival. Lowering energy costs while letting ventilation work its magic is a win-win. Like in parking garages, fabric mesh systems can be used to provide both natural ventilation and fall protection.

Source: www.macair.co.uk/blog/importance-stadium-ventilation

PICTURED:

Kunsthalle Mannheim Museum of Modern and Contemporary Art, Mannheim, Germany

Rathaus Galerie Hotel, Innsbruck

Longchamp Racecourse, Paris

Case Study: Samsung American Headquarters Parking Garage



Samsung American Headquarters Parking Garage San Jose, California

The Samsung American Headquarters Parking Structure was enveloped in metal fabric and artistically upgraded with a color coating in a design provided by the owners that combines technology and nature. The pattern represents a printed circuit board and when placed on the facade mimics vegetative growth winding its way from top to bottom. A special process was used to layout, apply the coating, match the panels, and then install them all on site. Engineering, substructure, and mounting hardware were also supplied by the manufacturer. This was a turnkey project with a major benefit being that there was only one company for a general contractor/construction manager to manage where typically there would be several.

**Case Study:
Samsung
American
Headquarters
Parking
Garage**



**Samsung American Headquarters Parking Garage
San Jose, California**

Facades: Not Just a Pretty Face

Flexible, woven metal fabric facades provide both utility and beauty for nearly any structure, from parking lots to museums. The open weaves offer transparency and functionality, thus enticing the building from the outside without obscuring views from within, allowing for air circulation while also providing necessary security. Metal fabric facades stylize a structure by covering an old or visually unappealing building by giving it a living breathing skin.

In fact, you can put a “new face” on buildings of most every type, shape, size, and age as you can see here where an otherwise standard parking garage becomes a striking visual addition to the campus. Fabric facades also help to hide mechanical systems from view. And, with their durability and ease of maintenance, transparent metal fabric facades last for many decades. Some metal fabric manufacturers can assist at every step of the design process, from facade concept and design to engineering and installation.

**Case Study:
Samsung
American
Headquarters
Parking
Garage**



**Samsung American Headquarters Parking Garage
San Jose, California**

It is important to remember that metal fabrics can often be seen from within the building and effect the indoor environmental quality regarding views, solar management, thermal comfort, and acoustics.

Learning Objective #2

Review the performance benefits of metal fabrics, including safety and security, solar management, and sustainability.



Next, we will learn the performance benefits of metal fabrics, including safety and security, solar management, and sustainability.

PICTURED:

University of Florida Research and Academic Center at Lake Nona, Orlando, Florida

Performance Benefits

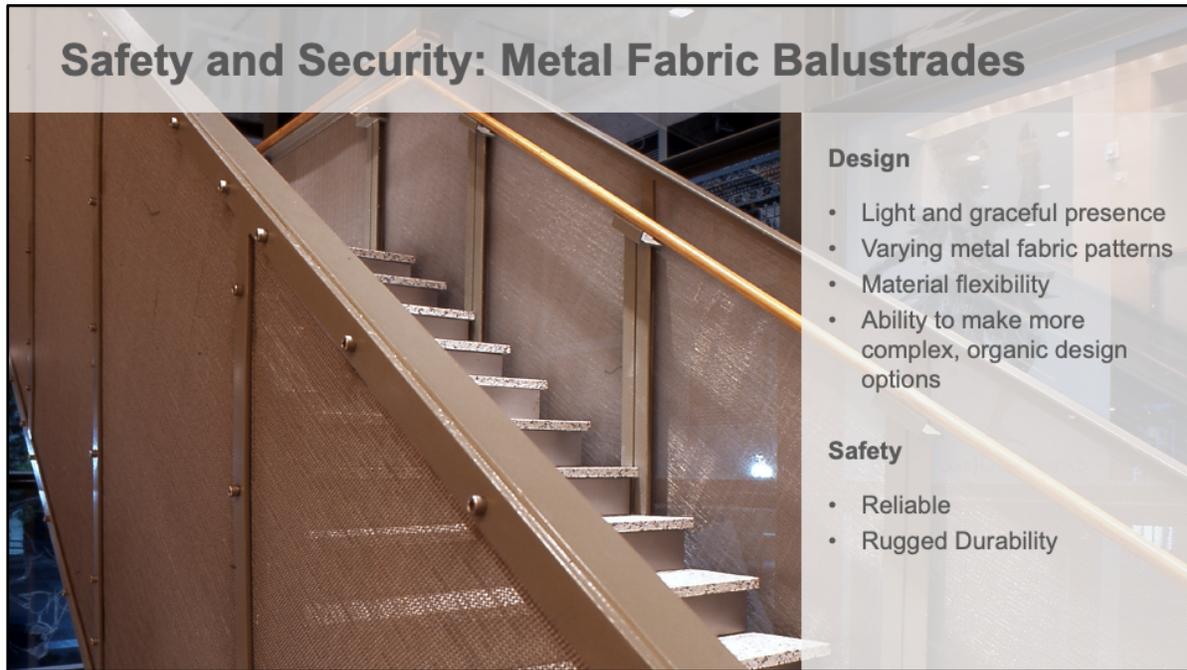
- Safety and security
 - Balustrades
 - Roller shutters
 - Fall-guard protection
 - Fire resistance
- Solar management
 - Maximizes energy efficiency in buildings
 - Provides a thermal environment for occupants
- Plays a key role in sustainable design



Aside from the aesthetic and functional features we have discussed thus far, metal fabric systems go far beyond to provide excellent performance benefits, such as safety and security, solar management, and sustainability. Metal fabric provides safety and security via balustrades, roller shutters, fall-guard protection, and fire resistance. These safety features are extremely important in stairwells, open structures, and pedestrian walkways, while the added security that metal fabric provides is useful in parking garages, shops, and restaurants. Solar management helps to maximize energy efficiency in buildings and provide a comfortable thermal environment for occupants and plays a key role in sustainable design.

PICTURED:

Amgen Helix Pedestrian Bridge, Seattle



Metal Fabric Balustrades

All railing and balustrade applications focus on two key aspects: design and safety. These materials are suitable for both indoor and outdoor applications and provide security while retaining a light and graceful presence. The availability of various metal fabric patterns allows designers to perfectly tailor a solution to individual balustrades. Flexible patterns easily follow the rise of staircases, while typical metal balustrades are comprised of metal fabric panels with an external frame ready for point fittings, posts, and handrails. The material's flexibility also facilitates use on more complex, organic designs, and the project team can select the degree of transparency as required by the application or code. Exceptional aesthetics coupled with reliable safety, minimal care or maintenance, and rugged durability make these balustrades ideal for both new buildings and renovations.

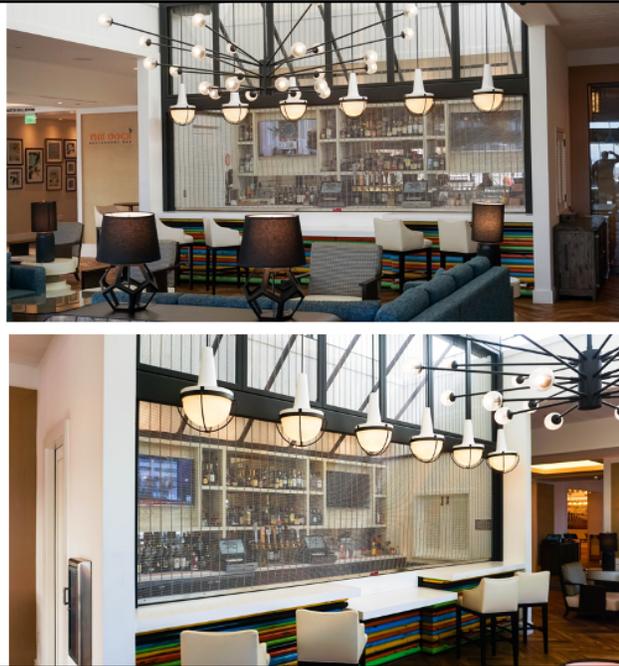
PICTURED:

Harry Ransom Center, Austin, Texas

Safety and Security: Roller Shutters

Safety and Security Considerations

- Effectively segregate sensitive areas
- Protect areas from unauthorized access
- Can be used primarily as a barrier
- Can be equipped with a self-locking system to offer effective theft protection
- May be operated manually or automatically with a fully motorized system



Roller Shutters

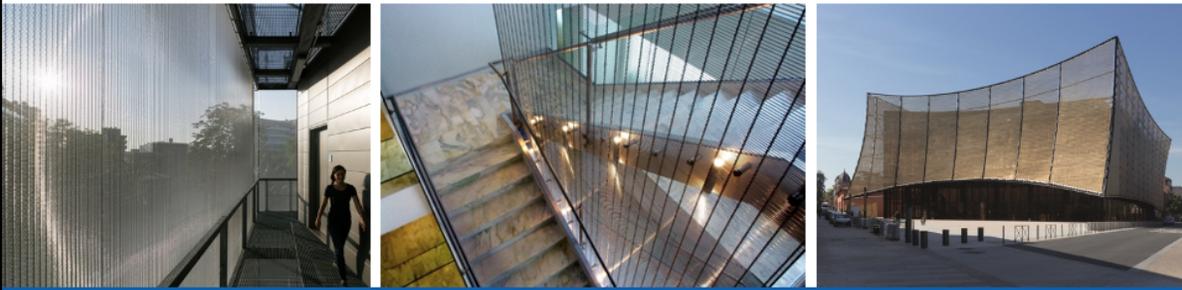
Roller shutters made of metal fabric effectively segregate sensitive areas and protect them from unauthorized access. This can be useful in shopping malls, jewelry stores, bars, and restaurants where open-air environments are prominent. Depending on security requirements, the metal fabric can be used primarily as a visual access barrier, or it can be equipped with a self-locking system to offer effective theft protection. Roller shutters made of metal fabrics can be operated manually or automatically with a fully motorized system. Lateral guides ensure that the grid sections slide down smoothly.

Metal fabrics have long been used in harsh exterior applications and roller shutter systems are a simple extension of this application for both indoor and outdoor use. With their transparent appearance, metal meshes grant a view of the areas they cover, creating an overall sense of space that can be enhanced by complementary lighting. Various fabric types are available, and selection depends on the degree of transparency desired.

Safety and Security: Fall-Guard Protection

- Protection for both indoor/outdoor staircases
- No distracting seams or butt joints

With tailor-made attachment solutions, the panels are optimally integrated into the building structure, thereby creating a high-grade, protective shell.

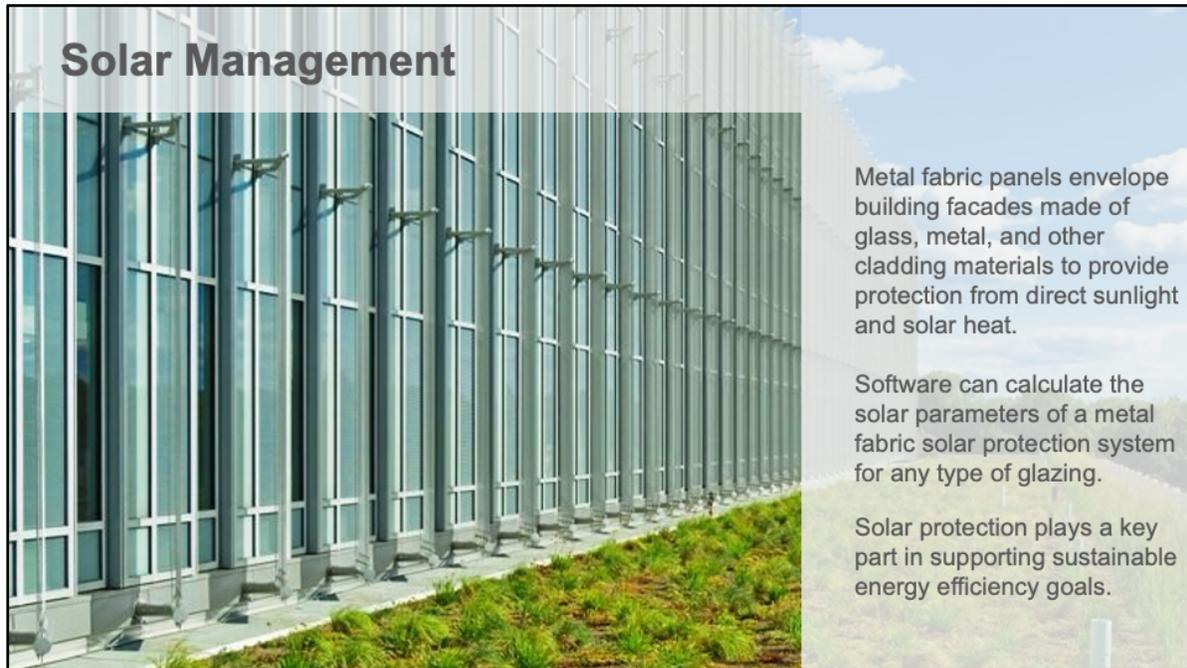


Fall-Guard Protection

Whether designed as an enclosure or tensioned in the center of a stairwell, stainless steel metal fabrics offer woven protection and safety for both indoor and outdoor staircases. Manufacturing ability of up to 26 feet in width and more than a 100 feet in length, make tensioning over several floors simple. The fabrics offer protection over a large area without any distracting seams or butt joints. Different fabric types meet various requirements for transparency and robustness. Due to their structure, metal fabrics can be shaped in a straight cable direction and are even capable of cladding circular building structures almost seamlessly. With tailor-made fastening solutions, the panels are optimally integrated into the building structure, thereby creating a high-grade, protective shell.

PICTURED:

University of Heidelberg, Germany
Phelps Dunbar, Baton Rouge, Louisiana
Grand Theatre des Cordeliers, Albi, France



Solar management is a recent trend that is driving growth in the metal fabric market. Solar management tactics can include solar protection, solar heat gain, shading, daylighting, and views. The goal is to achieve optimum energy efficiency using the outer shell to support climate control by allowing solar heat into the building in winter and screening the building from solar radiation during summer.

Woven stainless steel facades are not only visually appealing but provide function by offering excellent solar protection properties. This is especially true during blazing hot days of summer or the horizon's low direct sun during winter. Modern facade-cladding materials generally allow the heat generated by solar radiation to enter the building very quickly. During the summer months or in climate zones with a lot of daily sunshine, this drives up the interior temperature and consequently the additional cooling requirements too. This creates a negative impact on the building's energy balance, but by using a well-designed metal fabric solution, the building will minimize the harsh effects of direct sunlight and the heat that accompanies this. Metal fabric panels envelope building facades made of glass, metal, and other cladding materials to provide protection from direct sunlight and solar heat.

A pleasant outward view is combined with relief from harsh direct sunlight and solar heating, particularly when the summer sun is high in the sky. This will additionally occur when the sun is low in the sky during winter, and solar heat gains are achieved depending on the type of glazing used. Software can calculate the solar parameters of a metal fabric solar-protection system for any type of glazing. Besides creating a pleasant working environment for employees and other commercial building occupants, solar protection plays a key part in supporting sustainable energy-efficiency goals. Early and comprehensive planning for solar protection is important to maximize energy efficiency.

PICTURED:
Eastern Michigan University, Ypsilanti, Michigan

Solar Management: Daylighting

- Minimizes the need for artificial lighting
- Less waste heat is generated
- Does not restrict outward views

With tailor-made fastening solutions, the panels are optimally integrated into the building structure, thereby creating a high-grade, protective shell.



Controlling daylight and maintaining a clear outward view are other important factors that can improve occupant comfort. In many countries, these basic conditions are legally required for workplaces even when active solar protection systems are already in place. The use of metal fabric to daylight can help reduce power consumption in buildings in two different ways: It minimizes the need for artificial lighting, and since less artificial lighting is used, less waste heat is generated too. The open structure of metal fabrics allow daylight to enter the building without restricting any outward views.

As you can see, metal fabrics play a key role in achieving solar management goals. Solar protection, solar heat gain, and daylighting can be accomplished through fixed metal fabric panels, tensioned vertical panels, and roll-up systems for solar protection. The amount of protection will depend on the pattern of the metal fabric and the open area of that pattern, then whether it is placed horizontally or vertically on the building. Solar management is not just a benefit to facility managers and building owners who face increasing energy costs—it also aids occupant comfort while reducing a building's overall burden on the environment, as we will discuss in the next section.

PICTURED:

Bio-Medical Engineering Cluster, RWTH Aachen Campus, Germany

University of Florida Research and Academic Center at Lake Nona, Orlando,
Florida

**Case Study:
Idaho College
of Osteopathic
Medicine
(ICOM)**



**Solar Shading Made of Stainless Steel Metal Fabric
Idaho College of Osteopathic Medicine (ICOM)
Folsom, California**

The Idaho College of Osteopathic Medicine (ICOM) near Boise, Idaho, inhabits a new 94,000-square-foot campus. Architect Dekker/Perich/Sabatini (D/P/S) identified stainless steel metal fabric as a design solution for solar control and soon discovered metal fabric as an ideal solution. After providing solar-control test data, it was decided that metal fabric would offer optimal solar control without disrupting views of the campus from the inside. Etching capability provided an opportunity to underscore the ICOM brand identity. Etching creates visual imagery that is durable and weather and fade resistant. The multifunctional fabric provides the campus with increased energy savings through solar control while adding to the comfort level of the building occupants. Additionally, the campus is enhanced by the prominent etched graphics that serve to instill a sense of school pride as one of the few osteopathic medical schools in the country.

Case Study: Idaho College of Osteopathic Medicine (ICOM)



Solar Shading Made of Stainless Steel Metal Fabric Idaho College of Osteopathic Medicine (ICOM) Folsom, California

Sustainability

In an increasingly disposable world, reducing demand on our natural resources and providing long-term value is important. Woven metal fabrics optimize the environmental performance of buildings and are thereby gaining importance in green building certification. Utilizing metal fabrics is an environmentally responsible and resource efficient choice because stainless steel used in metal fabrics contains greater than 60 percent post-industrial and post-consumer recycled content. Recyclability directly correlates with minimization of waste and recycling stainless steel does not involve any hazardous materials. Stainless steel is the readily available and active metal markets are currently in place making facilitation and reuse of the product prominent.

Not only is stainless steel made of recycled materials and is 100 percent recyclable, retaining its inherent qualities throughout the recycling process, but it also does not require hazardous cleaning products to maintain or a surface

coating that can deteriorate and possibly pollute the environment. Metal fabrics are non-corrosive, durable, and heat, fire, and impact resistant. As just discussed, they can be utilized as a building facade or skin in all climates and environments to mitigate intense sunlight while providing natural light and ventilation for energy savings.

Case Study: Idaho College of Osteopathic Medicine (ICOM)



Solar Shading Made of Stainless Steel Metal Fabric Idaho College of Osteopathic Medicine (ICOM) Folsom, California

LEED

Additionally, the environmental benefits of metal mesh solar management products support LEED goals. Earning LEED credits through the New Construction, Schools, Healthcare, Commercial Interiors, and Retail rating systems is more important now than ever before. The credit categories that metal fabrics can contribute to are as follows:

- **Optimize Energy Performance:** Metal fabric utilized as a veil or exterior facade reduces solar heat gain by shading the building, thus reducing the energy required to power HVAC systems. Metal fabric also allows the transmission of natural light, providing effective internal illumination while reducing the related energy costs.
- **Building Product Disclosure and Optimization – Material Ingredients:** The cable and materials of metal fabrics are typically 60 percent recycled materials and 40 percent new materials. During manufacturing, 100 percent of the scrap or unused material is recycled. The material is 100 percent

recyclable when it reaches its' useful life.

- Building Product Disclosure and Optimization – EPDs: Environmental product declarations are available for metal fabric products, earning projects points in this category.
- Building Life-Cycle Impact Reduction and Building Reuse: An existing building can be fitted with a facade of metal fabric material for a long-lasting, new appearance with the same sun shading and energy saving benefits of a new building.
- Daylight: The use of a metal fabric facade has the benefit of connecting occupants with indoor and outdoor spaces. Undeniably, this leads to greater productivity, healthier environments, increased airflow, and shading.
- LEED Accredited Professional: To earn points in this category, choose a manufacturer that maintains LEED certified professionals on staff.
- Light Pollution Reduction: A metal fabric facade on the outside of a building helps to control light intensities from natural and unnatural sources. Reasonable light can pass and visibility to the outside is allowed.
- Acoustic Performance: When used for interior ceilings, attractive and durable acoustic ceiling systems provide noise reduction and control.
- Quality Views: The transparency of a metal fabric facade allows for a clear view while shading light and heat.

Learning Objective #3

Explore how to create visual identity and branding with metal fabrics, including etching, lighting, color, and transparent media facades.



Next, we will explore how to create visual identity and branding with metal fabrics, including etching, lighting, color, and transparent media facades.

PICTURED:
Houston Area Safety Council, Houston

Etched Graphics

Etching: a process that transfers graphic elements onto a hard metal surface

1. A graphics file is imported into a masking plotter.
2. The plotter creates masks that are then transferred to grids and applied to the metal fabric for etching.
3. The contrast of the graphics is controlled by the duration of the blasting and blasting media used.
4. Results are permanent.

*Note that because the graphics are etched on the flat surface of the front of the panel, they are not clearly visible from the back of the panel. However, both sides of the metal fabric may be etched if desired.



Etched Graphics

Etched metal fabric combines form and function to provide architects, designers, and facility managers with a unique and artistic solution to traditional building facades, curtains, and other applications. The etching process creates visual imagery that is nothing short of amazing. When used as an exterior or interior facade, transparency is also achieved, allowing visibility and measured lighting. Etching brings logos or permanent branding to life by producing a matte surface that contrasts with the polished surrounding area, providing artwork that is unlimited in scale. The results are unique and artistic, with appearances altering as the viewing and lighting angles change throughout the day.

Etching is the process that transfers graphic elements (i.e., branding, logos, etc.) onto a hard metal surface such as metal fabric. Because the graphic elements are etched directly into the surface, it is weather resistant, durable, and fade resistant. The etching process begins by importing a graphics file, which has been created in a suitable program such as AutoCAD, into a masking plotter. The plotter creates masks, which are then transferred onto grids and applied to the metal fabric for etching. The contrast of the graphics is

controlled by the duration of the blasting and the blasting media used. Since the graphics are etched directly onto the metal surface, the result is permanent.

There are some factors to take into consideration before a graphic is created for etching. Graphics are only limited by the intricacy of the details, but because metal fabrics are woven and contain some degree of porosity, subtle details may be lost. Therefore, large-scale graphics rather than fine-line detailing are more amenable to etching. Lighting and other effects can be added, which we will discuss in the next section.

*Note that because the graphics are etched on the flat surface of the front of the panel, they are not clearly visible from the back of the panel. However, both sides of the metal fabric may be etched if desired.

PICTURED:

Salina South High School, Salina, Kansas

Case Study: Liberty Fund Library Project

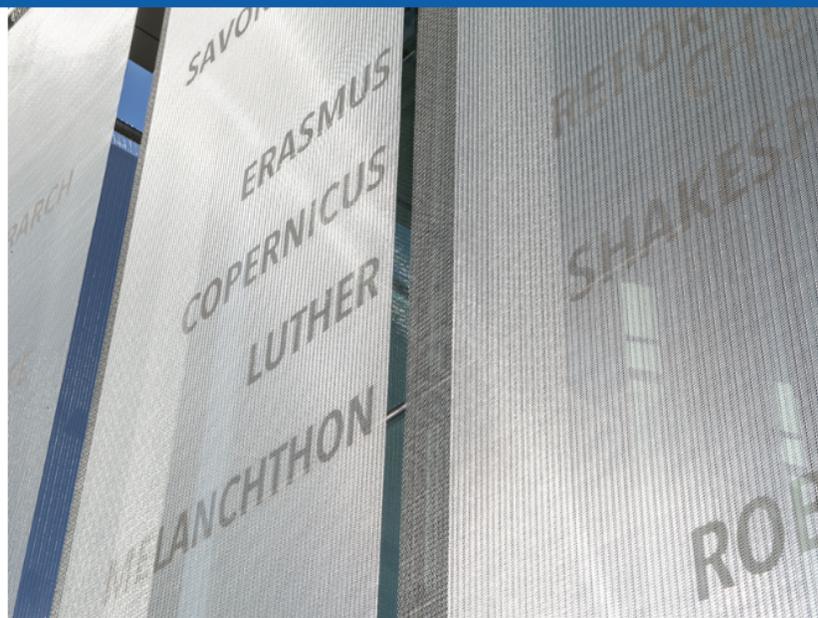


ETCHING CASE STUDY **Liberty Fund Library Project** **Carmel, Indiana**

A case study that demonstrates etching is the Liberty Fund library project. It began with the purpose that the pursuit of liberty be at the forefront of the establishment and its priceless collection of books be visible to passersby.

Clear glass was paired with 30 stainless steel metal fabric sunscreens, totaling 4,771 feet, with etching and custom-designed galvanized steel brackets.

**Case Study:
Liberty Fund
Library Project**



**ETCHING CASE STUDY
Liberty Fund Library Project
Carmel, Indiana**

Liberty Fund's founder Pierre Goodrich created a timeline with key people, writings, and events, which provided the basis for the organization's mission.

The letters etched onto the material became a visual 35-foot-high representation of that mission, with the metal fabric cut in specific widths that represented the centuries.

Case Study: Liberty Fund Library Project



ETCHING CASE STUDY **Liberty Fund Library Project** **Carmel, Indiana**

Flexible, one-direction metal fabric was used as a second screen behind each panel that created a continuous solar-shading effect. This contrasting of metal fabrics helps to avoid geometric shift, also known as the moiré pattern effect, which would be visible to cars passing by.

Colors and Surfaces

Austenitic Stainless Steel (AISI Type 316)

- A protective coating is not required to maintain durability.
- Color coatings and a variety of finishes and surfaces are available.
- Colored coatings produce different impressions and external appearances.
- Coatings may be applied to give the project aesthetic merit.
- **They are able to be coated, anodized, and printed to great effect.**



Colors and Surfaces

Because austenitic stainless steel (AISI Type 316) is noncorrosive, protective coatings are not required to maintain maximum durability, but color coatings and a variety of finishes and surfaces are an option. Depending on the location, colored coatings can produce different impressions and external appearances, and may be applied to give the project an aesthetic merit not otherwise realized with raw metal. Metal fabrics can be coated, anodized, and printed to great effect.

Coated Metal Fabrics

Painted Metal Fabric

- Produced using a continuous wet-coating process that coats both flat and round wires
- Best used with relatively dense mesh types
- Suitable for both indoor and outdoor applications
- Spiral and cable fabrics can be coated with a variety of colors



Colored metal fabrics offer a wide range of colorful architectural textures.



Colored metal fabrics open a wide range of colorful architectural textures. In fact, metal fabrics were discovered as a colorful functional design element in architecture around 20 years ago.

Painted metal fabric is produced using a continuous wet-coating process that coats both flat and round wires; it is best used with relatively dense mesh types and is suitable for both indoor and outdoor applications. During this continuous process, high-grade special coatings are applied and heated to create a powerful bond. The continuity of the process allows any quantity of wires to be permanently color coated and, depending on the mesh, enables finished products of up to 26 feet and virtually any length. Stress tests carried out by an independent party guarantee the durability of the material.

Spiral and cable fabrics can be coated in a variety of standard colors such as black, white, red, gold, and custom RAL colors when ordered in large quantities. Other factors such as the background, viewing distance, and viewing angle as well as lighting and light reflections on the metal fabric have a significant effect on the structure and mounted mesh fabric. Other effects and constantly changing light conditions, such as daylight with varying sun

positions and cloud cover or artificial light from different light sources, can also change how colors are perceived.

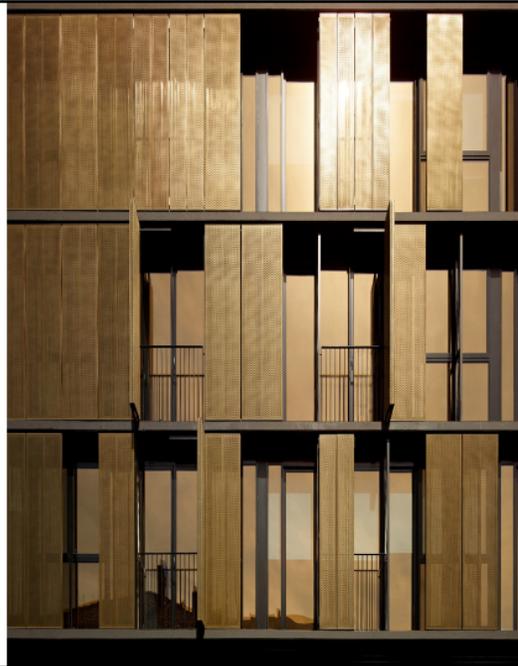
Anodized Aluminum Mesh

Continuous Process (Electrochemical Process)

- Creates an oxide coating that protects the aluminum from corrosion
- Allows fabric to be used indoors and outdoors
- Wire is anodized prior to weaving
- Multicolored panels can be created by interweaving different colored wires
- Protects against environmental influences, such as UV radiation or temperature deviations

Batch Process (Electrochemical Process)

- Suitable only for rigid types of mesh



Aluminum is another material sometimes used for designing facades. The lightweight metal has a low, specific weight while also offering high strength and good corrosion resistance. When exposed to air, aluminum gradually forms a natural protective layer that insulates it from corrosion and gives it a matte-grey appearance. However, aluminum profiles or plates in facades are usually anodized to protect them from environmental influences and mechanical effects. Aluminum mesh can be anodized via a continuous or batch process.

Flexible meshes are anodized in a continuous electrochemical process to create an oxide coating that protects the aluminum from corrosion, which allows the fabric to be used both indoors and outdoors. The wire is anodized prior to weaving and then subsequently colored, which contrasts with the batch process. Multicolored panels can be created by interweaving different colored wires. Alongside its decorative properties, this type of coating also guarantees protection against environmental influences such as UV radiation or temperature deviations.

The batch process is also an electrochemical process for creating a protective

layer on the aluminum wires. However, this method differs in that it is only suitable for rigid types of mesh. The interwoven material is divided into preassembled mesh panels that are immersed in individual tanks where they undergo various coating stages in this static tank system. The resulting oxide layers can achieve highly individualized properties by selecting different electrolytes and bath parameters such as temperature and aluminum content.

PICTURED:

Luna Apartments, Melbourne, Australia

Printed Metallic Mesh: Screen Printing Process



Complex graphics can be applied to exterior metallic mesh projects, such as facades, using a screen-printing technique. One advantage of screen printing is the ability to vary the color application by using different grades of mesh fineness. The paint is applied to the mesh by a template on a frame and then hardens under UV light. Areas not to be printed are covered by the template. The desired motif is thereby reproduced on the surface of the metal. This process results in very thick paint layers that are five to 10 times thicker than other printing methods, making screen-printed meshes perfect for indoor and outdoor applications. All colors can be printed, but blended colors cannot, so screen printing is more suited to full-surface graphics.

Alongside the various methods for printing solid-colored mesh surfaces, UV direct printing allows complex graphics and even photographs with fine color gradients to be printed onto mesh. The digital printing process can be used to print mesh sheets up to 2.50 meters wide and 20 meters long. The motif is applied to the surface of the mesh using a large-format printer and then immediately hardened with ultraviolet light. Therefore, the ink does not dry out through the ambient air (as is the case on paper) but is rather hardened immediately after its application. If the motif to be printed has a white

background, the mesh surface is printed white in the first printing pass, and the actual motif is applied in a second pass. UV technology produces the best matt or glossy effects or a combination of the two.

Thanks to its structure and surface, the printed mesh is generally wind permeable and robust in all weather conditions regardless of the weave type. In the digital printing process, the motif is applied to the surface of the mesh using a large-format printer and then immediately hardened with ultraviolet light. If the motif to be printed has a white background (for example), the mesh surface is printed white in the first printing pass, and the actual motif is applied in a second pass. UV technology produces both matte and glossy effects or a combination of the two can be used. This type of printing is not suitable for outdoor applications.

Learning Objective #4

Identify ideal applications for the product, and review case studies where the material was used.



We have already shared with you several case studies that showcase the many ways that metal fabric can contribute to modern building design and construction:

- Samsung Headquarters showed metal fabric in a parking garage application as well as the some of the secondary finishes that can be applied to realize a design component.
- ICOM demonstrated the solar management capabilities that can be gained through the use of metal fabric and also branding opportunities with capabilities such as etching.
- With the Liberty Fund Library, we again saw metal fabric used in a transparent facade application that allows views to the inside as well as views from the inside out.

In this last portion of the presentation, we would like to discuss the use of metal fabric as a communication medium. Stainless steel metal fabric combined with LED technology creates an architectural material that can be used for large format media displays.

PICTURED:
Tripoli International Convention Center, Libya

Transparent Media Facade Technology

Transparent media facades consist of stainless steel mesh with LED lights interwoven into the fabric to create a transparent, digital display of images, text, logos, video, live broadcasts, public service announcements, and art.

Media facade technology conforms to a structure's unique shape and design and transforms it into a dynamic communications medium.



Through digital technology and the visual power of energy-efficient LEDs, everything from branding graphics to video, live broadcast to conceptual art, can be displayed on what has become the “silver screen” of the 21st century. Transparent media facades consist of stainless steel mesh with LED lights interwoven into the fabric to create a transparent, digital display of images, text, logos, video, live broadcast, public service announcements, and art. Media facades are easily installed over any building surface where transparency, scale, and long viewing distances are present. Media facade technology conforms to a structure’s unique shape and design and transforms them into a dynamic communications medium.

PICTURED:

California State University, Henry Madden Library, Fresno

Transparent Media Facade Technology

- Up to 60 percent transparency
- Allows for natural, filtered daylighting
- Allows for views to be maintained

The perfect solution when transparency is required so that a building's unique architectural elements are visible.



With up to 60 percent transparency, the mesh still allows for natural, filtered daylighting while also shading the building. This is the perfect solution when transparency is required so that a building's unique architectural elements are visible. Views from within the building are maintained and natural daylighting and ventilation to the building surfaces are still provided while generating little residual light into the space.

PICTURED:

Cook Children's Hospital, Fort Worth, Texas (left and right)

Celebrity Cruises' Terminal 25, Port Everglades, Florida (center)

Transparent Media Facade Technology



Large-Format Display

- Ideal for large-scale applications
- Longer, broader viewing range
- Greater message rotation
- Supports a wide range of advertisers on one display
- Transforms a building into a media icon

Transparent media facades are ideal for large-scale applications; the average installations are approximately four times the size of traditional billboards. This larger format allows a longer and broader viewing range and greater message rotation. It also supports a wide range of advertisers on one display without compromising the graphic quality of the message. Dynamic media presentation will draw attention and transform a building into a media icon. Several resolution options are available to meet the needs for viewing distance and clarity.

PICTURED:

Long Beach Court House, California

Transparent Media Facade Technology



Graphics and brightness are controlled through a web-based interface via many formats, so messages can be quickly changed out for promotions, news, weather, or to convey market conditions.

Real-time messages are possible for live events, such as sporting events or concerts.

The graphics may be viewed both day and night due to high-quality LEDs with more than 90,000 hours of high performance with low electrical consumption.

Graphics and brightness are controlled through a web-based interface via many formats, so messages can be quickly changed out for promotions, news, weather, or to convey market conditions. Real-time messages are possible for live events, such as sporting events or concerts. Civic messaging such as National Emergency Broadcasts, Amber Alerts, traffic, and weather conditions can be conveyed in real time. The graphics may be viewed both day and night due to high-quality LEDs with more than 90,000 hours of high performance with low electrical consumption.

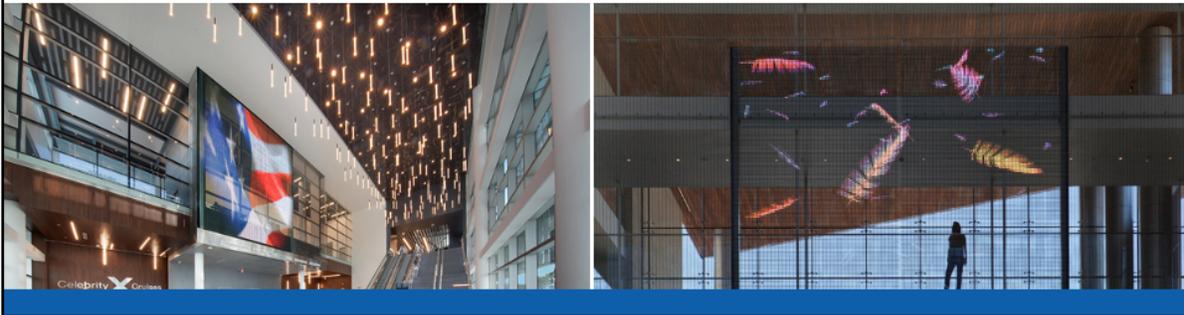
PICTURED:

Stanford University Bass Biology Building, Palo Alto, California

Transparent Media Facade Technology

- Cover four times the surface area of traditional media displays but use up to 80 percent less electricity

Transparent media facades are sustainable, covering four times the surface area of traditional media displays but using up to 80 percent less electricity.



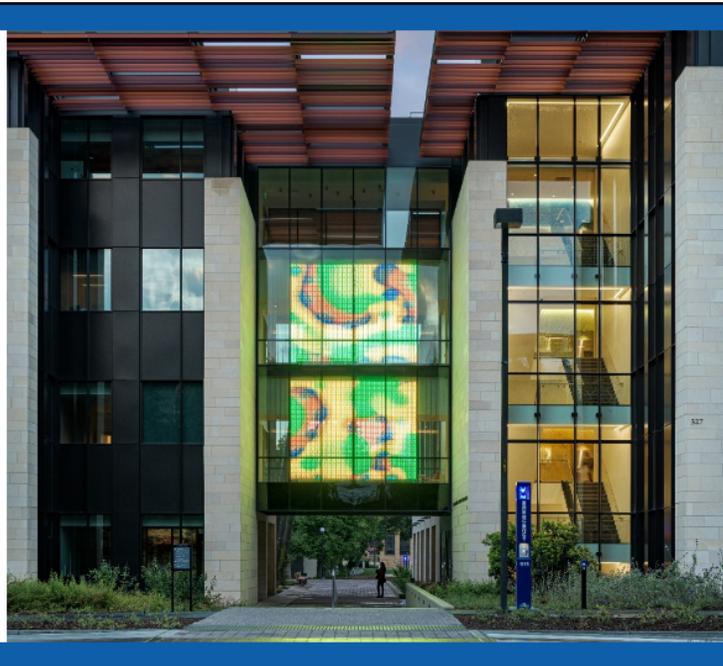
Sustainability

Transparent media facades are sustainable because they can cover four times the surface area of traditional media displays but use up to 80 percent less electricity. Automatic LED luminance controls adjust light intensity for ideal viewing and significant energy reductions, while mesh provides passive solar shading, daylighting, and improved air circulation. LED sleeves slide out and permit LED lights to be replaced after their useful life while the stainless steel mesh remains in place.

PICTURED:

Celebrity Cruises' Terminal 25, Port Everglades, Florida
Long Beach Court House, California

Case Study: Stanford University Bass Biology Building



Stanford University Bass Biology Building Palo Alto, California

Origin

With the completion of the Anne T. and Robert M. Bass Biology Research Building at Stanford University, biology faculty and students that were once spread across campus were brought together under one roof. The five-story structure is dedicated to research in life sciences, providing a shared environment that fosters intellectual and social interaction. Stanford desired an additional layer of design to crown the new building, especially given its high-profile location. Knot, a firm specializing in landscape architecture and experiential graphic design, was hired to create the concept for this next phase of design.

Knot was tasked with telling stories of science in a non-literal, abstract way and given broad artistic license to explore multiple themes and variations.

A Beacon of Science

The result was Morphogenesis (Morpho-GEN-uh-sis), the first installation that

connects user interaction with a large-scale media mesh platform. Based on Alan Turing's theory of Morphogenesis, which describes how spots and stripes manifest in nature, users interact with a generative algorithm by manipulating parameters via a touchscreen at the building's main entrance. Users play with the interactive interface and save the patterns they create. Those settings populate the permanent art piece shown on the display. The longer the artwork is running, the more diverse its content will become.

Case Study: Stanford University Bass Biology Building

Specification

- Install transparent fabric media on a glass bridge spanning Discovery Walk.
- Fabricate a 32-foot-tall display using transparent media facade technology.

"[A fabric media facade] was most appropriate because it is an architecture material and a perfect product for the scale of the piece."—Michael Yun, Principal and Director of Anti-Disciplinary Design, Knot



TRANSPARENT FABRIC MEDIA TECHNOLOGY CASE STUDY

Telling Stories Through Science Stanford University Bass Biology Building Palo Alto, California

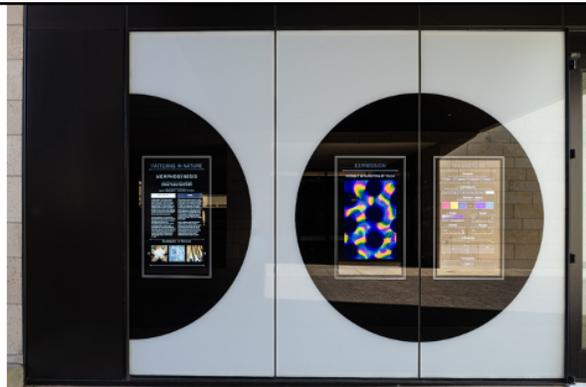
Specification

With the intent for this public art to be highly visible and interactive, the design team saw an opportunity to install it on a glass bridge spanning Discovery Walk. A metal mesh manufacturer was brought in to fabricate a 32-foot-tall display using transparent media facade technology. "Stanford wanted to have impact, something that was large-scale and took advantage of the position on campus," said Michael Yun, principal and director of anti-disciplinary design with Knot. "[A fabric media facade] was most appropriate because it is an architecture material and a perfect product for the scale of the piece."

Seismic-related building codes did not allow placement of the media mesh on the building's exterior. The solution was to hang the media facade between large glass panels located just inside the building envelope. The fabric's finished quality added to the interior space for pedestrians crossing the bridge

span rather than detract from it. As an interior product, noise and heat were of no concern. Transparent media facade technology uses electronic power supplies that are extremely efficient, low voltage, and do not require energy-consuming fans.

Case Study: Stanford University Bass Biology Building



TRANSPARENT FABRIC MEDIA TECHNOLOGY CASE STUDY

Telling Stories Through Science

Stanford University Bass Biology Building

Palo Alto, California

Challenge

While the project ran smoothly, it was not without its inherent challenges. “The biggest thing was attention to detail,” says Mike Leonard, Assoc. AIA, DSCE, technical director of Mediamesh™ Systems with GKD. “Knowing that we were going to have potentially thousands of people interacting with it every day, we had to make sure it was clean and safe. With it located in one of the worst seismic zones in the United States, safety was also a design concern. Logistically, it was a fast-paced project on a busy campus, and we had to crane the crates through windows because there were no freight elevators or other transport large enough to accommodate delivery of the materials.”

One unique requirement of the project team was determining how to engineer an interactive interface to control a 32-foot-tall fabric media wall. Morphogenesis functions using custom-coded touch sensors that integrate

hardware and software for user interaction with a control panel that serves as a visual synthesizer to create an infinite variety of moving patterns and colors.

Visibility took careful evaluation. “With every project, we evaluate the viewing angles of the display and customize the LEDs to reach the targeted audience,” continues Leonard. “We conduct a viewing angle analysis of the site and the location of the screen to ensure the impact of the display is at optimal brightness.” In this particular case, the display is located behind glass with the intent to display to an exterior viewing audience. This required a careful calculation of brightness to the outside as well as reflection level into the room behind it.

Results

Morphogenesis realized Stanford’s vision for abstracted storytelling. The design team created and deployed a new type of interactive, public art that leverages large-scale digital signage technology in new ways. The resulting impact of Morphogenesis extends beyond the building and adjacent plaza, providing a beacon that draws visitors from Stanford’s medical campus into the science quad.

Conclusion



We hope you now have a better understanding of how technologically advanced woven metal fabric can be used to create beautiful, engaging, and highly functional elements for commercial building exteriors.

From its origin as a raw alloy, to finished product, to transparent media facades, metal fabric amplifies the aesthetics of a building while providing safety, security, and solar management, all in a sustainable package.

When used in exterior applications, metal fabrics will outlast the life of the building due to their extreme durability, weather resistance, and corrosion resistance.

Thank You

This concludes The American
Institute of Architects Continuing
Education Systems Course.



www.gkdmetalfabrics.com

Thank you for your interest in this course. We enjoyed showing you how architectural mesh fabric can be a solution for your projects.