LUMIFLON®
FEVE RESIN

architectural market e-book

www.lumiflonusa.com

Uber Headquarters: California

Image courtesy of Jason O'Rear Photography

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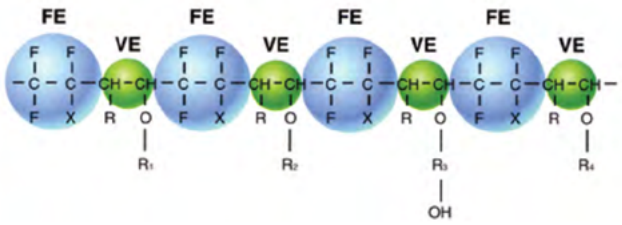
With their superior performance and life cycle cost advantages, it's no wonder fluoropolymer paints based on LUMIFLON FEVE have been applied to more than 150,000 industrial and architectural structures worldwide.

What Is Lumiflon

LUMIFLON is just one of the many innovative products and materials created by AGC, a company that's driven to excel in a high-tech world. But what a difference it makes for manufacturers, designers, and builders who demand the combination of quality and value that only LUMIFLON delivers.

LUMIFLON resins consist of alternating segments of fluoroethylene and vinyl ether, or FEVE. This regularly alternating structure, combined with the chemical stability of the carbon-fluorine bond is responsible for LUMIFLON's durability, weatherability, and corrosion resistance. The fluorinated segments protect the vinyl ether segments from degradation by UV light and chemicals, while the vinyl ether segments impart solubility, gloss, pigment compatibility, adhesion, and reactivity.

Unique Fluoropolymer Chemistry
FEVE, Fluoroethylene vinyl ether chemistry offers solubility



Fluoro Ethylene
Weatherability
Durability
Chemical Resistance

Vinyl Ether
Gloss
Solubility
Crosslinking

Why Lumiflon for Architecture

LUMIFLON® FEVE resin technology is used in coatings that protect metal, plastic, concrete, cement fiber board, composite, and wood substrates against degradation and moisture intrusion. The FEVE polymer is a platform chemistry that is supplied in various forms including solvent based liquid for easy application, water based resins for low VOC and low odor coatings, and a flake for sustainable powder coatings.

Metal Extrusions (Windows/Curtain Wall/Storefronts)
Aluminum extrusions are used to construct some of the most iconic structures around the globe. Protecting the aluminum from corrosion is critical. LUMIFLON LF710F is a FEVE flake resin that is used to formulate powder coatings. Powder coatings are electrostatically sprayed on aluminum extrusions (and sometimes even steel) that are used to create windows, storefronts, and curtain walls.

Architectural Panels (ACM/MCM/Single Skin/Metal Sheet)
Architectural panels are a convenient, light weight façade choice for many low and mid- rise buildings. The traditional ACM/MCM panel is engineered as a "sandwich" of two layers of thin-gauge aluminum that has a polymer, often fire-retardant core. The exterior aluminum is coated using a coil-coating process with coatings based on solvent grade LUMIFLON resins for finishes that have superior color and gloss retention. Various grades of LUMIFLON, including LF600X, LF552, and LF200 can be used. Because LUMIFLON FEVE resins are transparent and inherently high gloss, they are excellent choices for bright, bold colors and metallics that pop. These grades can also be used in conventional spray applied coatings for use on single skin or aluminum sheet panels.

Plastic and Composite Building Materials
LUMIFLON FEVE resin chemistry allows for use in coatings that cure at ambient or low temperatures. This is important for use over heat- sensitive substrates like vinyl and fiberglass. Solventbased and waterbased FEVE resins may be used to create highly weatherable coatings for vinyl and fiberglass building materials that allow for a cure process that meets the specific needs of these sensitive substrates.

Mount Si High School: Washington
Image courtesy of Benjamin Benschneider Photography

Wood and Cement Fiberboard
The various grades of LUMIFLON FEVE resins offer a wide- range of choices for coatings that can be used over porous substrates. Coatings made with LUMIFLON FEVE liquid coatings are used on fiber cement facades around the world.

Aesthetics

When choosing an exterior cladding material, it is paramount to specify a material with a coating system that contains a variety of weatherability and aesthetics properties to ensure a long-lasting design.

> *"projects using LUMIFLON continue looking good with little to no maintenance required, up to 60 years!*

Because LUMIFLON-based coatings offer crisp, clean colors and a wide range of gloss, designers and builders choose them to achieve a superior look from day one. And with LUMIFLON's ability to resist UV degradation, corrosion, and the ill effects of chemical exposure, projects using LUMIFLON continue looking good for years with little or no maintenance required. That means markedly less fading, discoloration and chalking for the life of the coating – estimated at up to 60 years! Meanwhile, AGC's research and development team continues to press LUMIFLON's aesthetic advantage with new FEVE resin formulations that add even more improvements, like the ability to resist dirt and grime. FEVE resin technology has an unparalleled gloss range which allows for brighter color palettes. With a long life-cycle, architectural projects with fluoropolymer technology have reduced recoating needs which could be an expensive and disruptive potential cost.

Great Northern Way & Pavilion: Canada
LUMIFLON FEVE resin topcoat allows for unparalleled gloss, brightness and color retention and also prevents against both chalking and fading.

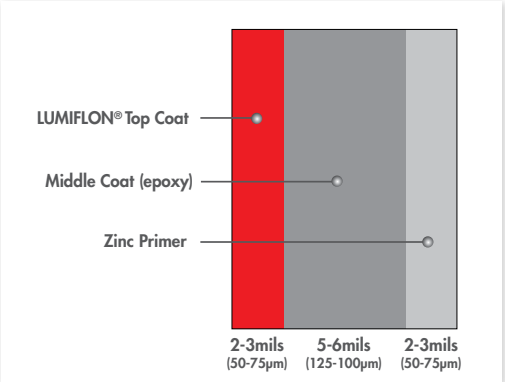
Corrosion Resistance

Corrosion is a major problem that can dramatically add to a project's life cycle costs, especially for bridges, water towers and other metal structures.

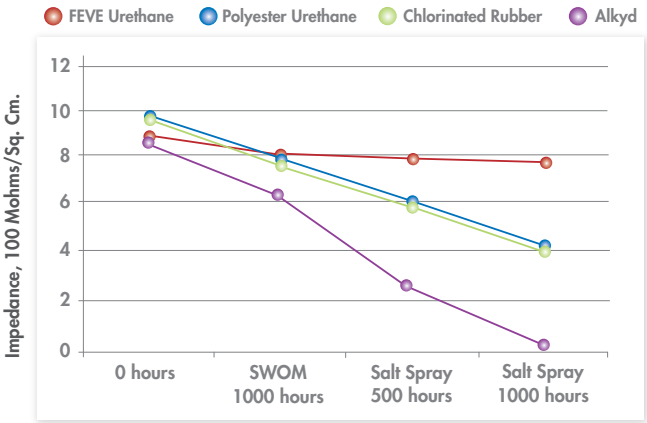
A LUMIFLON-based coating:

- Resists degradation due to weathering and exposure to chemicals
- Over the course of many years, loses little of its thickness
- Keeps corrosion initiators from penetrating the topcoat and degrading the zinc-rich primer underneath
- Has an estimated coating life of 60 years or more
- Passes all ISO 12944-9 CX Im4 and C5 Corrosion Tests

Cross Section of Coating System



Electrochemical Impedance Spectroscopy



Accelerated Weathering Followed by Salt Fog Test

Corrosion resistance is directly related to the slope of the line. The lower the angle difference from horizontal, the better the corrosion resistance.

Corrosion Resistance of LUMIFLON FD-1000: Salt Fog Test

Product (NCO index)	LUMIFLON FD-1000 (1.0)	Polyurethane Dispersion[1] (1.0)	Polyurethane Dispersion[1] (1.5)
Coating System	primer[2]/topcoat/topcoat		
Salt Spray, 1000 hours	good (rating 0)	good (rating 0)	very slight blisters 1mm (rating 1)
Salt Spray, 1500 hours	good (rating 0)	slight blisters, 1mm (rating 2)	slight blisters 2mm (rating 2)

[1]Bayhydrol 145 (Bayer Corp.) [2]Waterborne 2K epoxy primer

Performance

Industry insiders know that LUMIFLON-based coatings look great.

But they look even better when cold, hard data comparing LUMIFLON with high-performance polyesters and other competitors are collected from tests and studies conducted in laboratories, simulators and harsh, real-world environments.

Advantages of FEVE Based Coatings

- Ambient or elevated temperature cure – field or shop applied coatings
- Solvent soluble – clean crisp colors and a wide gloss range
- Versatile – solvent grade, solid, water based and powder coating resins offered
- OH functional – polyurethane chemistry, use standard paint equipment
- Fluoropolymer segments – ultra-weatherable and corrosion resistant
- Longer life cycle – up to 60 years

LUMIFLON FEVE vs. PVDF

	LUMIFLON	pvdf
Resin Type	solution	solvent dispersion
Curing Temperature	room temp. to 230˚C	>250˚C
60˚ Gloss	5 to 90	5 to 35
Color Range	>230 colors	color selection is limited
Recoatability	excellent	difficult

Alkyd coating is peeling

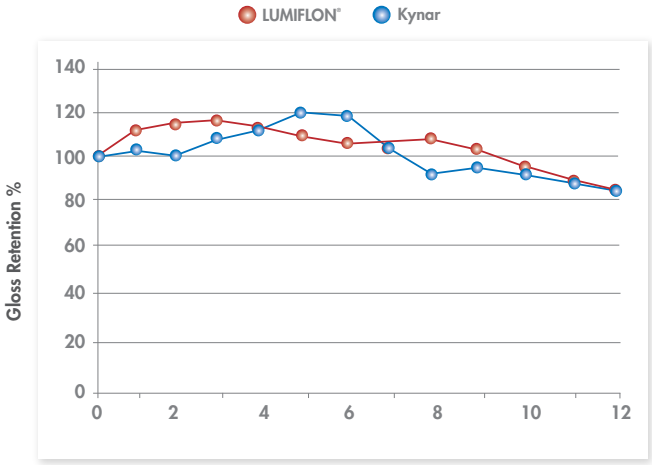
LUMIFLON coating: no chalking or peeling

Alkyd coating: chalking and color fade have occured

"FEVE based coatings require no special or unusual surface preparation compared to conventional or traditional coatings sytems.

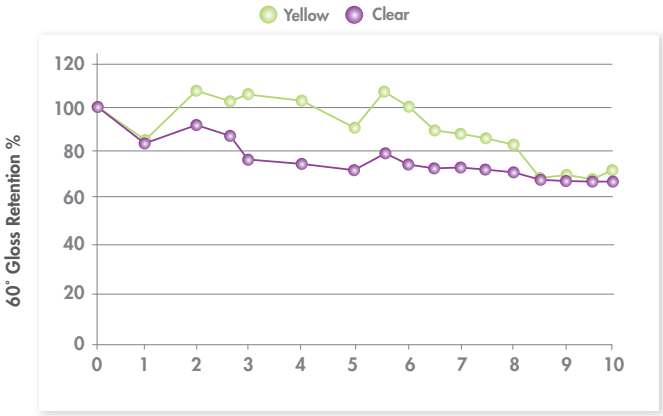
Ferrari World: Abu Dhabi U.A.E.
Long lasting LUMIFLON FEVE resin based coatings all over the world, outperform the competition.

Okinawa Weathering Chart



Exposure Time (Years)
Okinawa Exposure Test

Natural Exposure Test on LUMIFLON Miami, Florida (ASTMG7)



Exposure Time (Years)
Florida exposure test on LF-200
Direct 30˚ south, open back

Lower Life Cycle Costs

There are those who make buying decisions based on price – and then there are those who are more interested in value. With LUMIFLON, the difference is clear.

Nassau Veterans Memorial Coliseum: New York
Image courtesy of Jamey Price Photography

Over time, all that protection also protects your bottom line. Total life cycle costs, factoring in savings on maintenance, recoating and replacement, are much lower with LUMIFLON. Based on results from numerous projects, it's estimated that the life cycle cost of LUMIFLON coatings is only 40-80% of that of polyurethane. Price versus value. Over the course of a project's lifetime, the difference can be monumental.

Life Cycle Cost Advantages

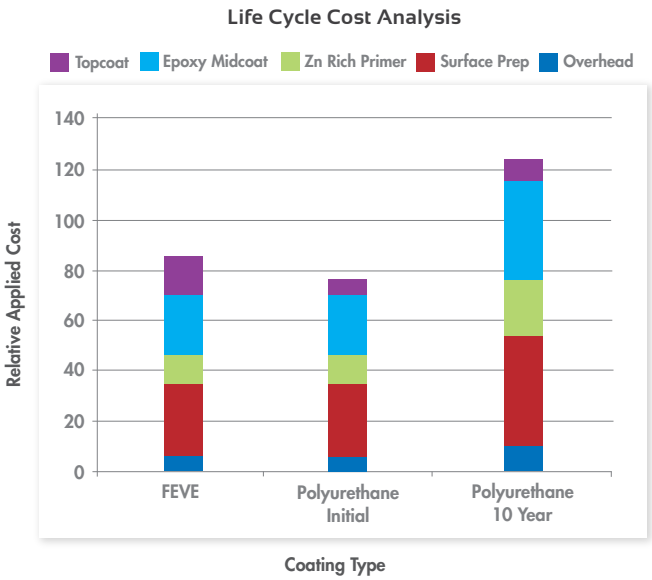
- **Initial applied cost of FEVE-based topcoat:**
  5-10% higher than standard polyurethane topcoat
- **FEVE-based topcoat life expectation:**
  30-60+ years
- **Expected maintenance of standard polyurethane topcoat in this time frame:** 2-3 repainting cycles
- **Additional costs of repainting:**
  Asset downtime
  Staging costs
  Environmental costs
  Emissions and CO2 from equipment
- **Longer life cycle**: –up to 60 years

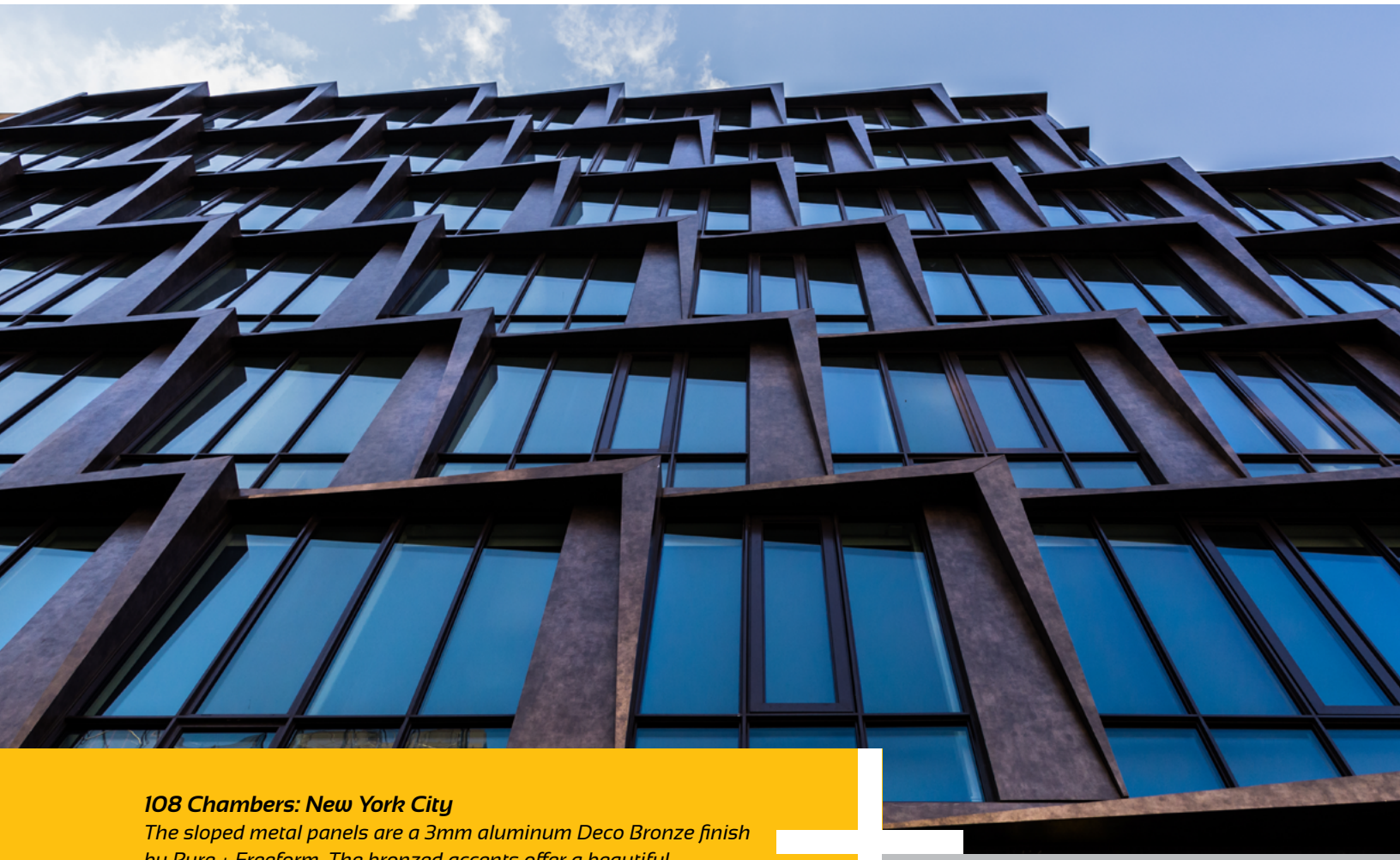
Color & Gloss

LUMIFLON-based coatings maintain gloss and color when applied to buildings, bridges, water towers, and other structures for between 20 and 60 years – significantly longer than other coating types.

Substrates

LUMIFLON resins protect steel, aluminum, fiberglass, concrete, and other materials from corrosion, sun, wind, rain and chemical exposure.





108 Chambers: New York City
The sloped metal panels are a 3mm aluminum Deco Bronze finish by Pure + Freeform. The bronzed accents offer a beautiful juxtaposition to the glass façade.

Comparative Life Cycle Costs: Lumiflon Coating And Chlorinated Rubber Coating					
Coating Type	**Process**	**Cost, $/m²**	**Initial Cost Ratio**	**Coating Life, Years**	**Cost/Year, $/m²**
Chlorinated Rubber	surface preparation	$10.08	0.19		
	staging	$27.48	0.52		
	coating	$15.53	0.29		
	TOTAL	$53.09	**1.00**	**8**	**$6.64**
Lumiflon Coating	surface preparation	$10.08	0.19		
	staging	$35.08	0.66		
	coating	$32.98	0.62		
	TOTAL	$78.14	**1.47**	**>21**	**$3.72**
	LCC Ratio				**0.56**

Chase Center: San Francisco

The panels were enriched with Lumiflon FEVE resin technology, with the clarity of the finish attributed to the clear nature of the LUMIFLON FEVE resin.

Photography ©Jason O'Rear

> *"formulation and type of resin are the most impactful variables on carbon footprint*

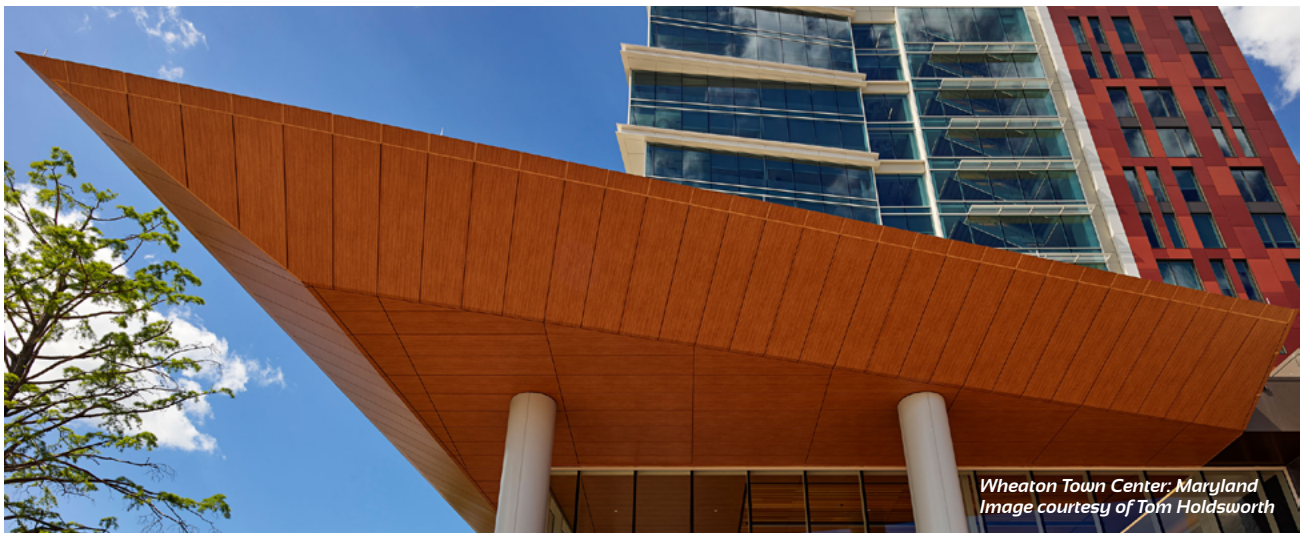
Sustainability

The use of a LUMIFLON FEVE powder coating system decreases the carbon footprint compared to a PVDF liquid coating by anywhere from 23% to 46% depending on which formulations are compared. This means using an FEVE powder coating in a 100,000 square foot project could reduce CO2 emissions as much as 14,700 kg, or about 16 tons of CO2.

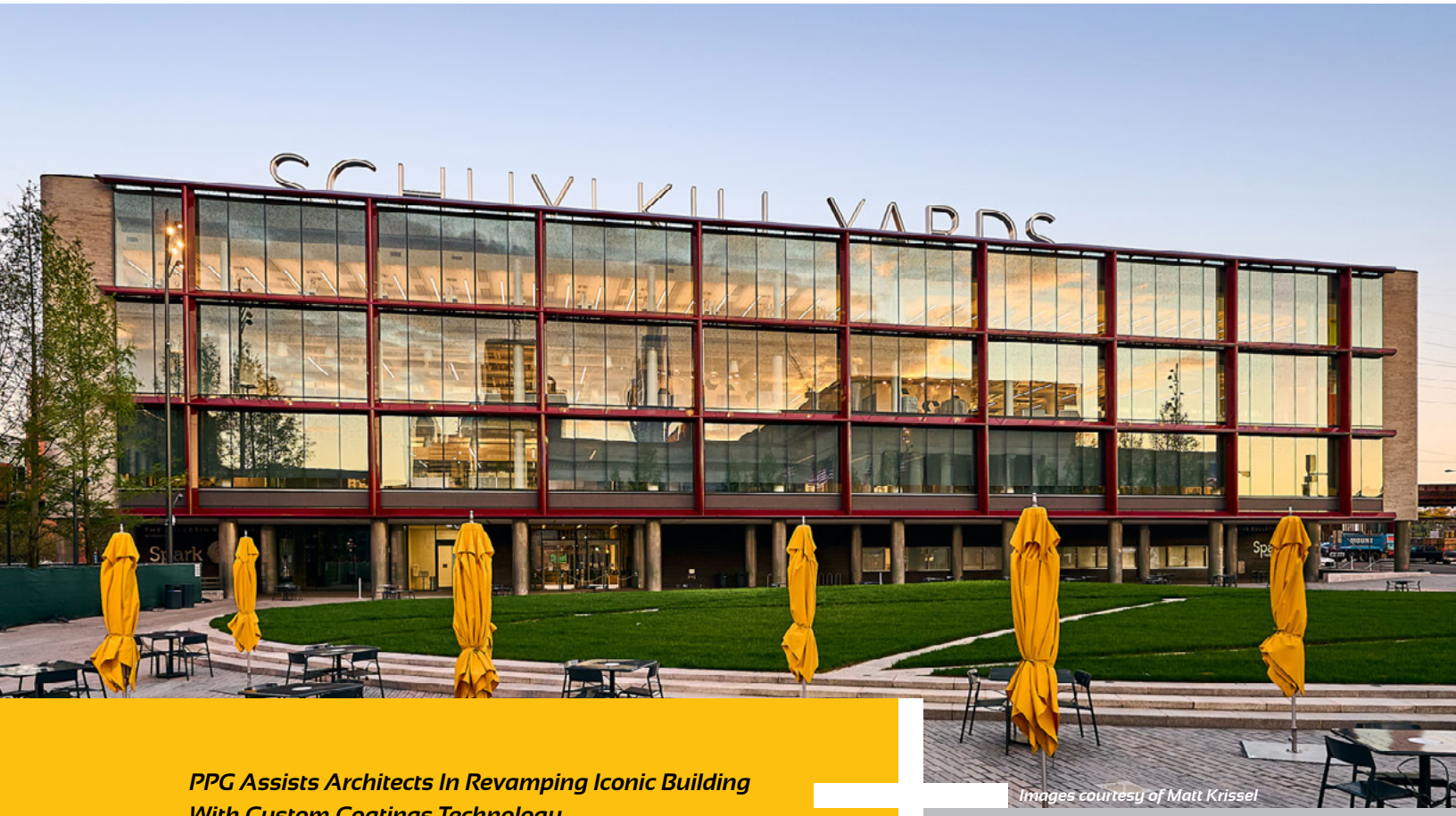
"Create healthy, productive environments"
There are four types of LUMIFLON resins, three of which – solid, powder, and emulsion grades contain either zero volatile organic compounds (VOCs) or can be formulated to contain less than 50 g/L of VOCs, meeting the most stringent green building criteria in the US. Due to its longevity, LUMIFLON reduces the environmental impact associated with production, transportation (energy consumed, greenhouse gases emitted), and VOCs off-gassed during the repainting/recoating process.

"Minimize waste"
By extending the life of roof and wall systems, LUMIFLON topcoats reduce waste created from disposal of damaged roofing and walls; avoid energy consumption in the production, transportation and installation of new systems; and maintain energy and equipment savings from continued high-performance of the building envelope. In addition, the energy consumed in removing a coating from a structure can be avoided through the use of a new paint product containing a LUMIFLON clearcoat with excellent durability and weatherability.

"Reduce consumption of non-renewable resources"
LUMIFLON coatings can last more than 30 years without fading, reducing life cycle costs related to the maintenance, re-application and/or replacement of underlying surfaces. On existing roofs, a LUMIFLON topcoat can stop the degradation of the underlying reflective coating, thus extending the life and solar reflectance capability of the roof and minimizing the use of raw materials derived from oil.



Wheaton Town Center; Maryland
Image courtesy of Tom Holdsworth



PPG Assists Architects In Revamping Iconic Building With Custom Coatings Technology

Images courtesy of Matt Krissel

The Bulletin Building

The Bulletin Building in the University City neighborhood of Philadelphia was initially built in 1954 by legendary American architect George Howe. The former headquarters of the Evening Bulletin newspaper, the building became iconic, undergoing a series of renovations since the newspaper collapse in 1982. The most recent renovation was completed by KieranTimberlake.

PPG, the coatings and paint specialists, were part of the recent renovation. With Spectrum Metal Finishing, PPG developed a customized Coraflon® powder coating system for the new multi-story glass façade. In addition, the featured finish in glossy "galaxy red" was developed exclusively for the project. The renovated design is part of the highly anticipated Schuylkill Yards development by Brandywine Realty Trust in West Philadelphia.

The custom coating was adapted from PPG's automotive expertise. Desiring an iridescent sheen, the team incorporated existing "glass flake" technology into the system. While complying with the highest weathering standards, Fenestration and Glazing Industrial Alliance and American Architectural Manufacturers Association (FGIA/AAMA) 2605, the coating achieved a 70-degree gloss in a deep cherry red.

In an article with Design and Build with Metal, the editors describe, "Powered by 12 computer-driven electrostatic guns, the two-coat system enabled PPG's Galaxy Red base coat to cure on the metal substrate before it was top-coated with the high-gloss powder. In addition, by inserting a bake interval between the application of the base coat and the topcoat, Spectrum's coating system prevented the glass flake in the topcoat from bleeding into the base coat, which further enhanced the finish's three-dimensional effect."

Coraflon® employs Lumiflon FEVE resin technology that protects a coating against UV radiation, rain, salt, and other environmental deterrents, preventing coat degradation. The low-VOC fluoropolymer is ideal for high-exposure projects like City Point, as the FEVE resin ensures color and gloss retention of a coating that will allow the building to remain in pristine condition for decades.

Canadian Library Wows With Intricate Metal Composite And Glass Facade Enhanced With Lumiflon FEVE

Images courtesy of Snøhetta

Central Library

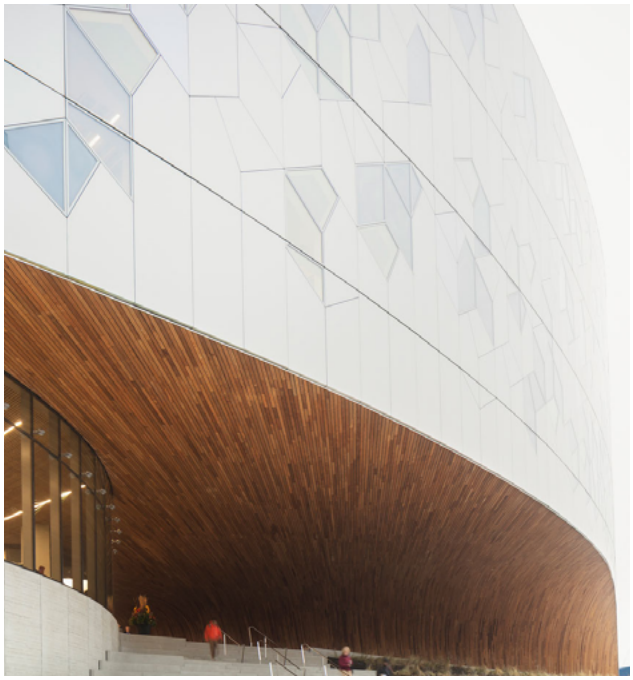
The new Central Library in Calgary was a collaborative project with architecture firms Snøhetta and DIALOG. As the architects at Snøhetta explain, "Calgary Public Library is one of the most actively used library systems in North America, where more than half of its residents are active cardholders, and accordingly, the new main branch was created for and inspired by its diverse inhabitants."

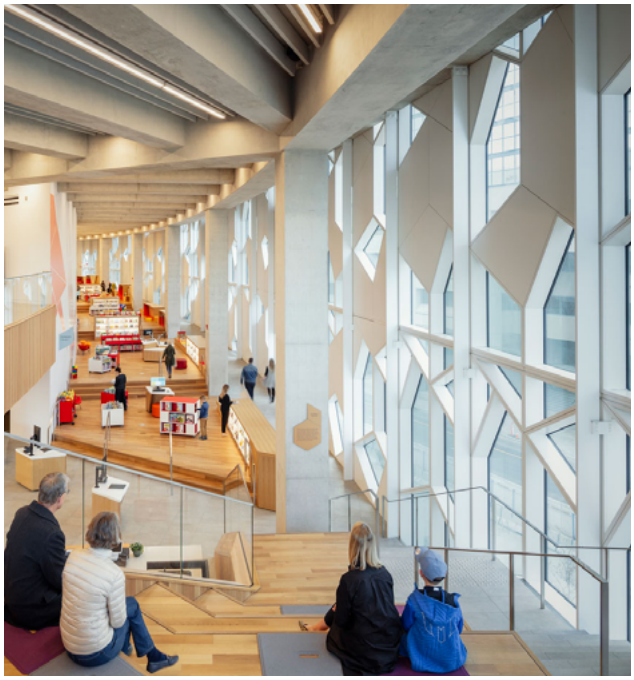
Adapting to its urban context, the building has an interesting component in which its main entry is lifted over the city's fully functioning Light Rail Transit Line. As the library sits between Downtown and the East Village, the building serves as both a visual and pedestrian connection to the neighborhoods.

The building boasts an impressive façade, one that is visually appealing from both the exterior and within the interior as well. Composed of a pattern of hexagonal shaped glass and metal composite panels, the building's seemingly random pattern is meant to invoke various themes. As the architects further explain, "From these shapes emerge familiar forms; Parts of the pattern might resemble an open book, snowflake-like linework, or interlocking houses, anchoring the ideas of the collective and community."

The building also features a large wooden archway made of indigenous western red cedar. This visual aesthetic invites people inwards where the interior is equally stunning. Large open areas with exposed concrete and warm wooden panels throughout offer a sense of both communicative and secluded spaces.

The aluminum composite material used on the building's exterior crystalline geometric design is ALPOLIC®/fr material with Valspar's Valflon® fluoropolymer coating system. Valflon® employs Lumiflon FEVE resin technology, which ensures color and gloss retention. The FEVE fluoropolymer resin creates a coating system that is hyper-durable and long-lasting in the face of UV radiation and other elemental deterrents without sacrificing a polished appearance.





NBBJ Designs Facebook Spring District In Washington With Sustainable Design

Images courtesy of Benjamin Benschneider

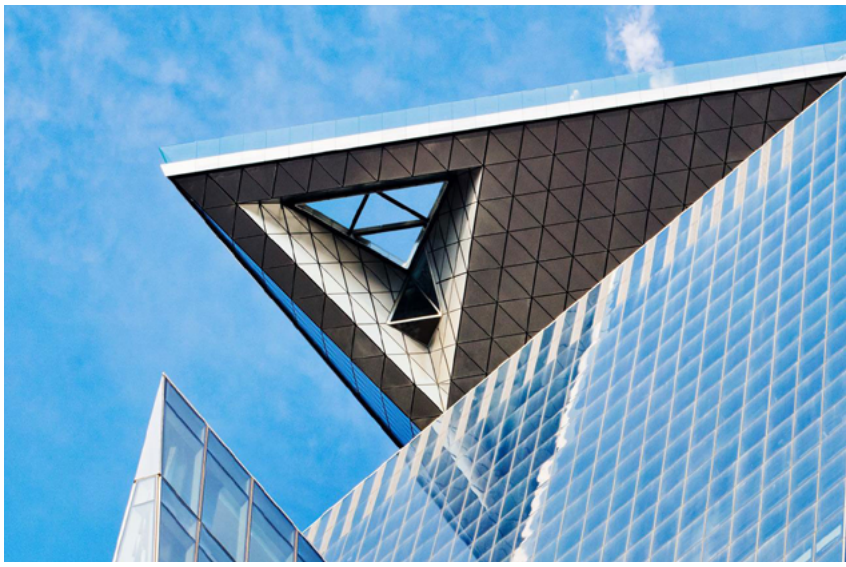
Facebook Spring District

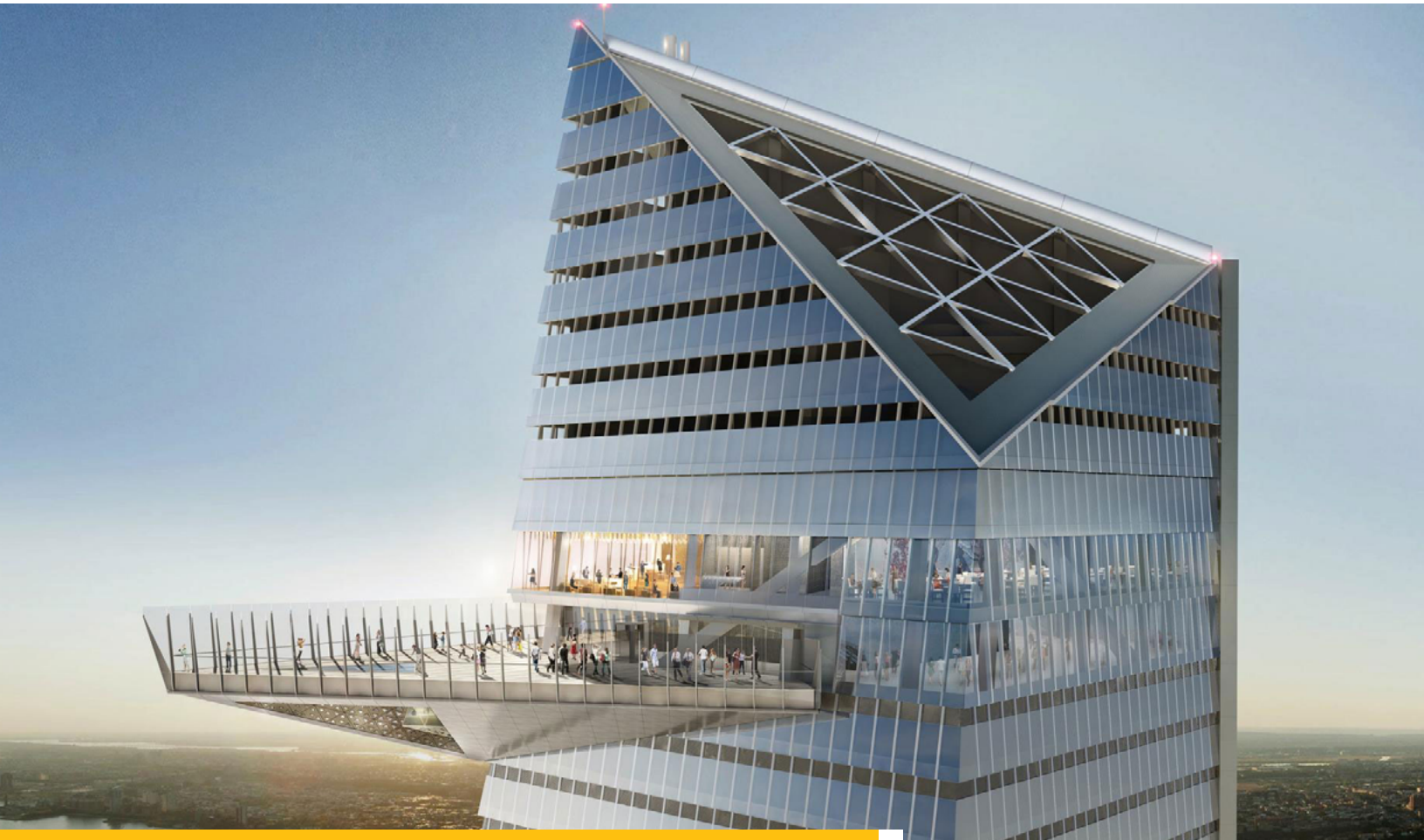
Facebook's Spring District development is its most significant presence outside its Menlo Park, California, headquarters. The Seattle location houses 7,000 employees in a state-of-the-art facility worthy of the social media empire. In addition, the over one million square foot development features one particular property, a 400,000 square foot building formerly the REI Co-op headquarters.

The Spring District embodies natural architecture, creating a harmonious relationship between the two. Designed by NBBJ, the project features an abundance of walkways and automatic doors to blur the lines between indoor and outdoor spaces. Large windows allow a consistent influx of natural light, while reflective cladding materials create a beautiful juxtaposition.

The designers and manufacturers at Pure + Freeform describe, "We helped contextualize the façade by designing and fabricating a custom tight-profile Shark Tooth Corrugation in two additional custom finishes, Washington Steel and Twilight Bronze. The materials, originally designed for REI, simultaneously signify the ethos of the storied, rugged brand while also referencing their creativity and nonconformity. Additionally, the project helps further Facebook's Spring District mini-empire with an additional 400,000 square feet of office space, designed to meet LEED standards."

The Pure + Freeform panels are enriched with Lumiflon FEVE resin technology. Coatings with Lumiflon FEVE resin technology offer benefits that many other coatings do not. The fluoropolymer provides unmatched weatherability, which helps prevent coating degradation. FEVE-based coatings also help reduce lifecycle costs, as their hyper-durability allows a coating to resist degradation in the face of UV radiation, salt, and water for decades.





Stunning Hudson Yards Commercial Building Features High Performance Coating System

Images courtesy of Kohn Pedersen Fox

30 Hudson Yards

30 Hudson Yards in New York City is the tallest tower in the Hudson Yards development and features the highest observation deck in the Western hemisphere. Home to global media company, Time Warner, the building houses the company's powerhouse subsidiaries, HBO, CNN and Warner Brothers. Project architects Kohn Pedersen Fox (KPF) describe, "At a time when extraordinary urban projects are arising around the world, Hudson Yards is an important symbol for New York's continued leadership in global urbanism."

The Midtown skyline is forever changed by the 73-story, 1,296-foot building. The tower was developed by Related Companies and Oxford Properties Group and within the first phase of the colossal Hudson Yards project. Interestingly, according to Design Boom editors, Hudson Yards is the largest private real estate development in U.S. history. The glass building features over two million square feet of space, making it one of the largest commercial office buildings in the city.

Jay Cross, President of Related Companies, stated, "The topping out of Hudson Yards, and completion of its steel crown, represents another important milestone...We want to thank the entire team of construction professionals for all of their hard work on one of the most challenging and exciting towers in all of New York City."

The exterior façade was coated with AkzoNobel's Interpon Powder Coating system. One of the coating systems utilized was the long-lasting finish, Interpon D3000. This system was formulated to withstand the toughest environments while creating a greener, cleaner alternative to traditional liquid PVDF coatings. Featuring outstanding weather resistance, the system meets the requirements of AAMA2605, the most demanding architectural specification in the world.

The Interpon D3000 system is enriched with Lumiflon FEVE resin technology. Surfaces that are enhanced with Lumiflon fluoropolymer technology offer a multitude of benefits such as durability and outstanding color and gloss retention. These coatings feature exceptional weatherability properties allowing the coating to remain intact for decades despite exposure to UV radiation, salt, and water degradation.

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