FEVE Architectural Coatings: High Performance Coatings for Expansive, Sustainable Design

Course Credit: 1 LU/HSW
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An American Institute of Architects (AIA) Continuing Education Program

COURSE FORMAT

This is a structured, live, instructor-led course

COURSE CREDIT

1 AIA CEU Hour

COMPLETION CERTIFICATE

A copy is sent to you by email upon request. When you fill out the Course Attendance, please indicate if you need one. Also, please ensure the information you provide is legible. Send email requests to **info@lumiflonusa.com**

Design professionals

Certificates of completion are sent to your email address

Course Description

In this one-hour course, we will discover the strengths and advantages of FEVE fluoropolymer topcoats. We will evaluate coating performance tests including accelerated weathering and real-time weathering and what the implications are for the life of different coatings.

We will explore the many design possibilities that FEVE technology provides and assess the sustainability benefits of FEVE topcoats despite their higher initial cost compared to other topcoat formulations.

City Centre 1 – Surry BC Photo courtesy of Howard Waisman

Course Objectives

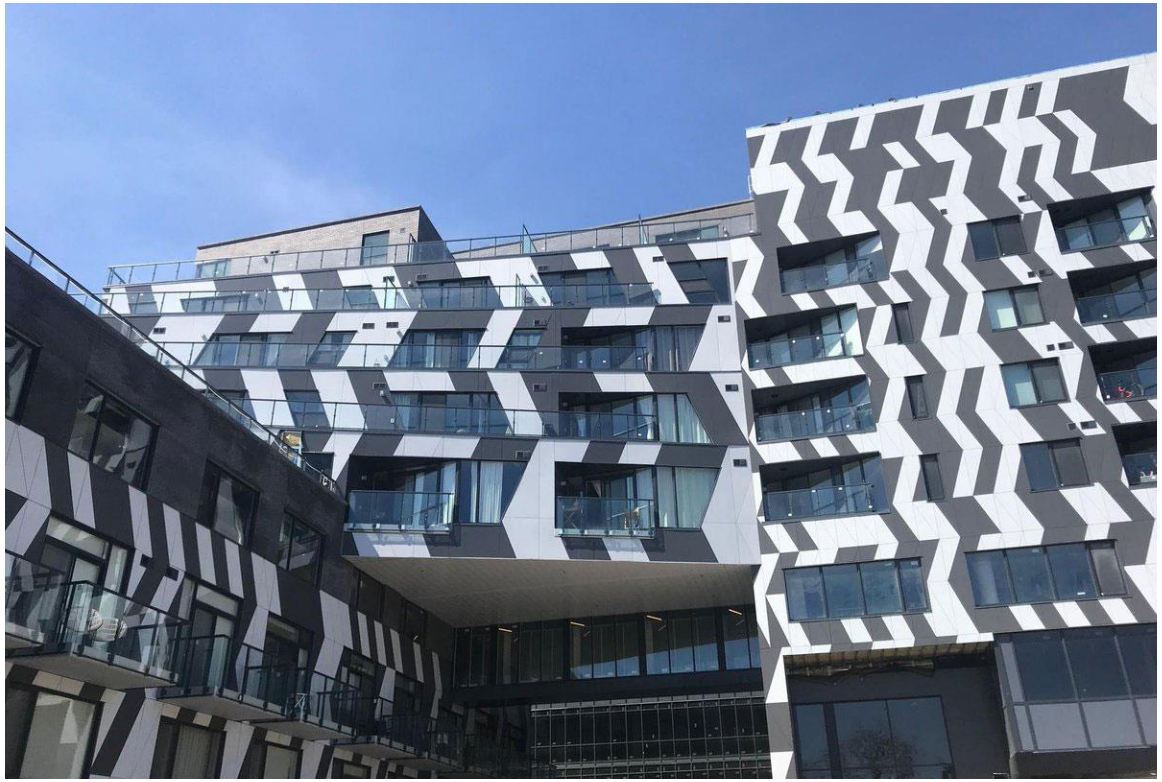
By completing this course, the design professional will be able to:

- ***Define FEVE coating technology, history, and unique weatherability properties as well as its ease of application in the architectural market***
- ***Discuss the importance of the form of coatings including color, finish, and gloss range***
- ***Discover the function of a fluoropolymer coating in terms of performance, substrates, and types***
- ***Describe the sustainability and environmental impact of long-life coatings***

Function: **Fluoropolymer Coating Performance**

Considerations When Selecting A Coating

- Mechanical strength
- Weatherability
- Durability
- Corrosion Resistance



Enigma on the Park – Toronto Photo courtesy of Quadrangle Architects

High Performance Coatings

Fluoropolymer Coating Types:

PVDF - Polyvinylidene Fluoride

- Thermoplastic fluoropolymer
- Traditional solvent-based PVDF requires high application temperatures, limiting field applications
- Often used in blends with acrylic resins (70/30)
- Withstands UV exposure 2-3 times longer than conventional coating resins

FEVE - Fluoroethylene Vinyl Ether

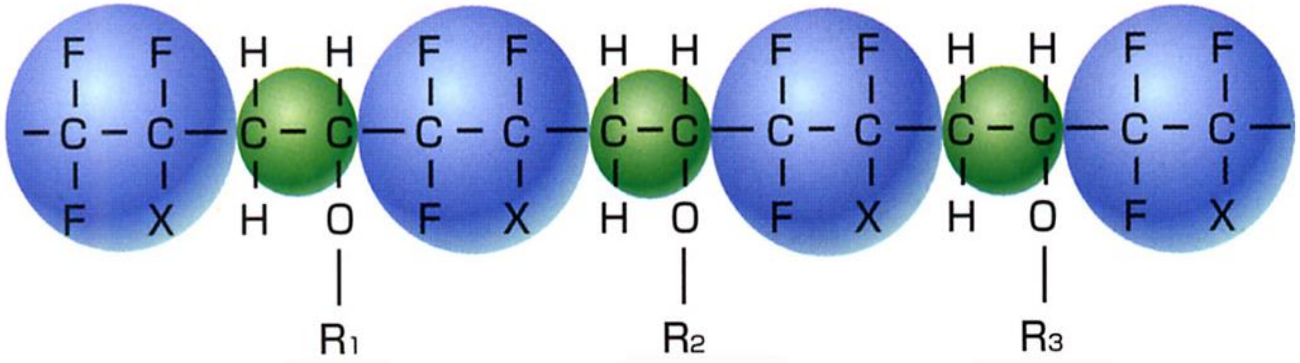
- Thermoset fluoropolymer topcoats developed in the early 1980s; *In wide use by the 1990s*
- Withstands UV exposure 2-3 times longer than conventional coating resins
- Used for both new construction and structural rehabilitation in the field

FEVE Resins

- **F**luoro**e**thylene **V**inyl **E**ther

- Alternating copolymer; not a blend

- Amorphous structure – not crystalline



Fluoroethylene
- Weatherability
- Durability
- Chemical resistance

Vinyl Ether
- Gloss
- Solubility
- Crosslinking

FEVE Characteristics

Characteristics of FEVE Coatings:
- Outstanding UV protection
- Excellent gloss/color retention and chalk resistance
- Good adhesion directly to metal substrates
- Shop or field applied
- Standard painting equipment & application
- Resistant to cleaning solvents
- Meets strictest air quality regulations

Perth Arena – Australia Photo courtesy of Carol Darby

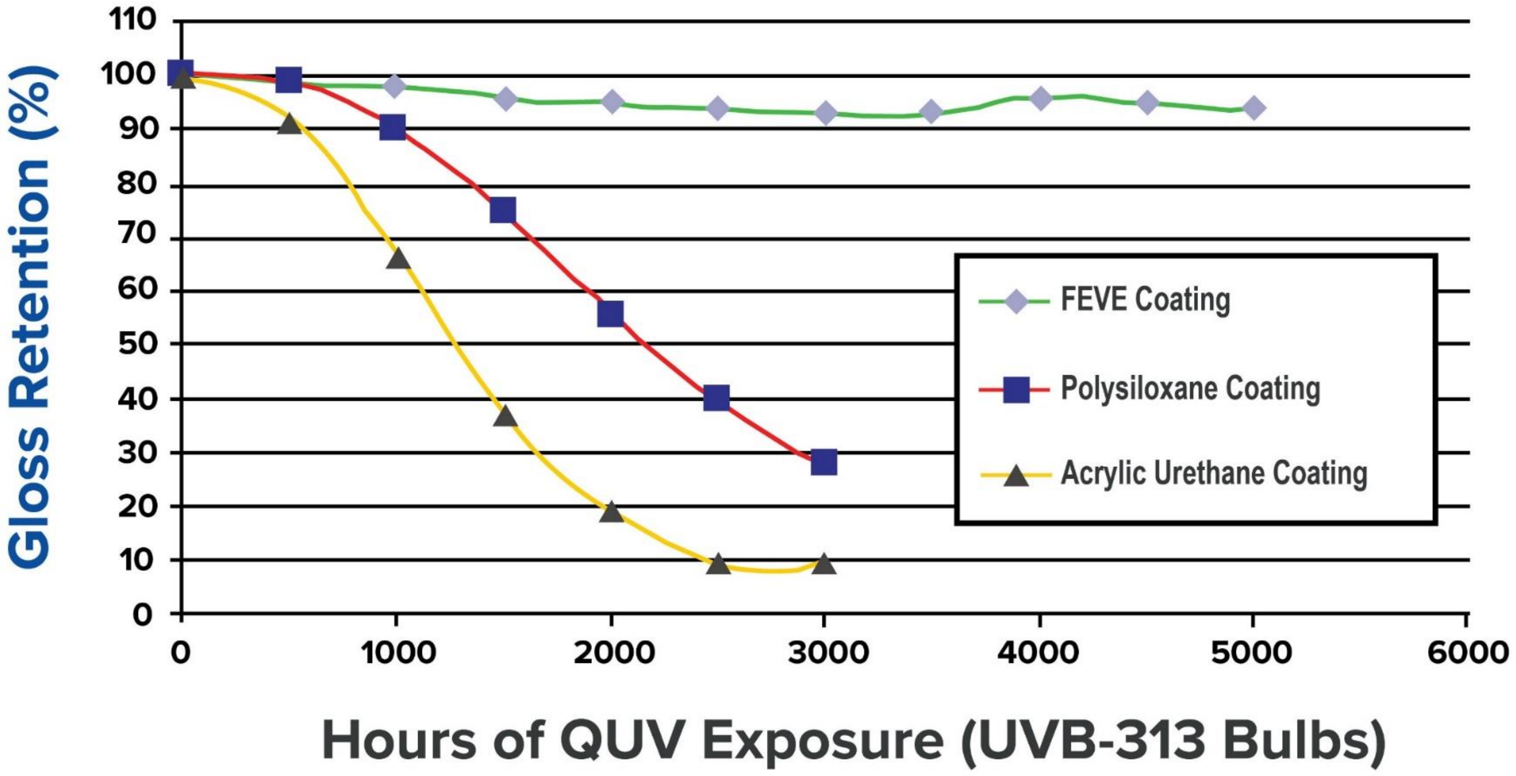
FEVE Benefits

Benefits:

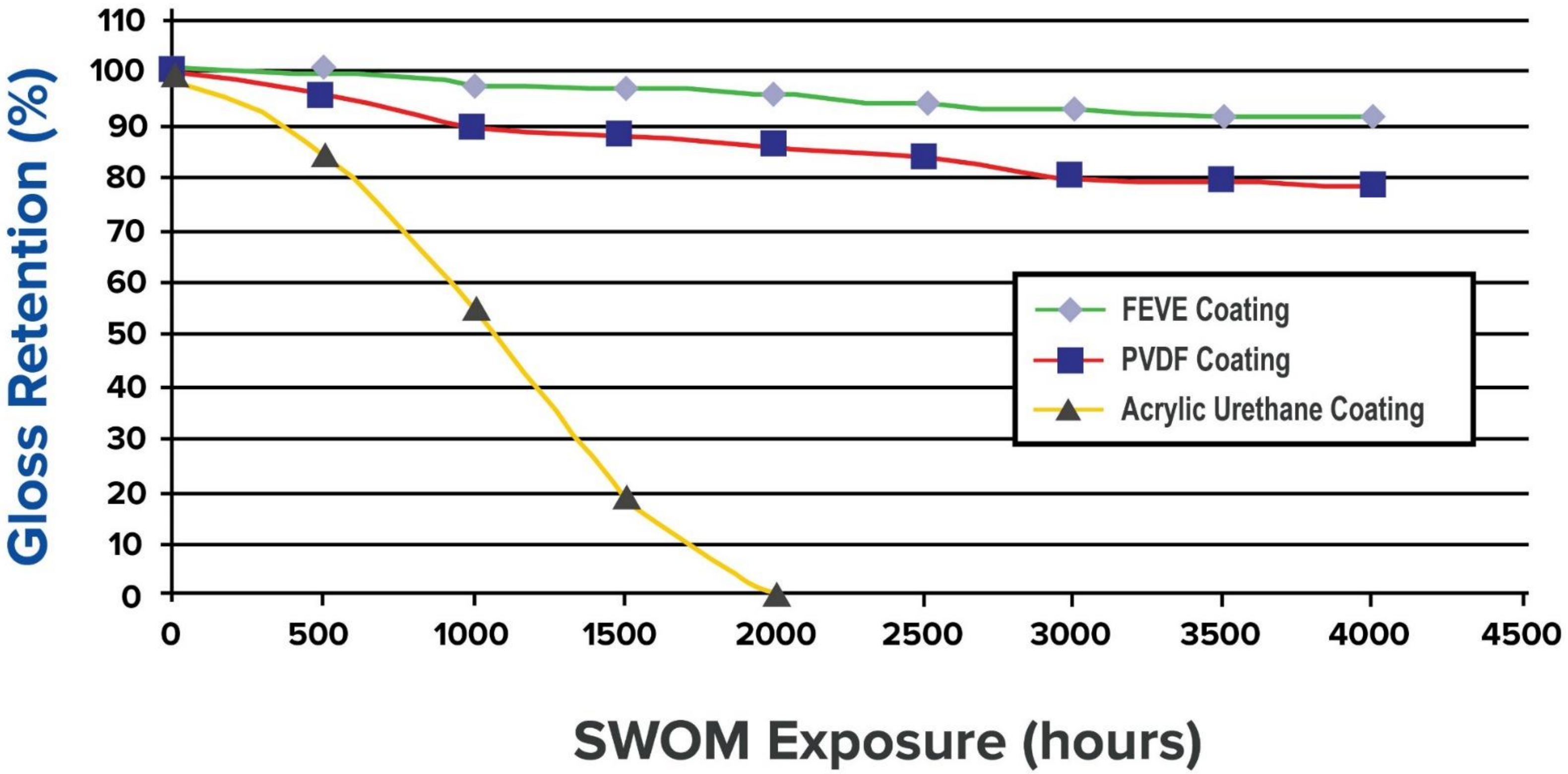
- Meets performance requirements of AAMA Standard 2605
- Excellent weatherability
- Mar and scratch resistance
- Corrosion resistance
- One or two component coatings
- Primer optional for some applications
- Ideal for curtain walls, facades, bridges, etc.
- Useful for new construction and repainting existing structures

55 Hudson Yards – New York Photo courtesy of Raimund Koch

Accelerated Weathering:
QUV Weatherometer Exposure Testing



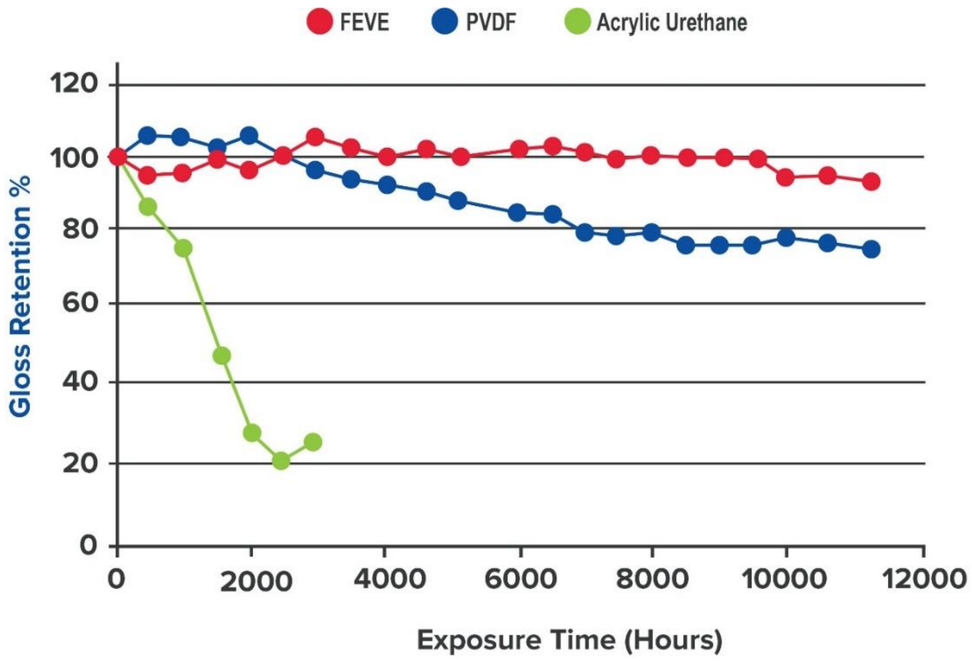
Accelerated Weathering:
Sunshine Weatherometer Exposure Testing



Accelerated Weathering:
Xenon Arc and EMMAQUA Tests

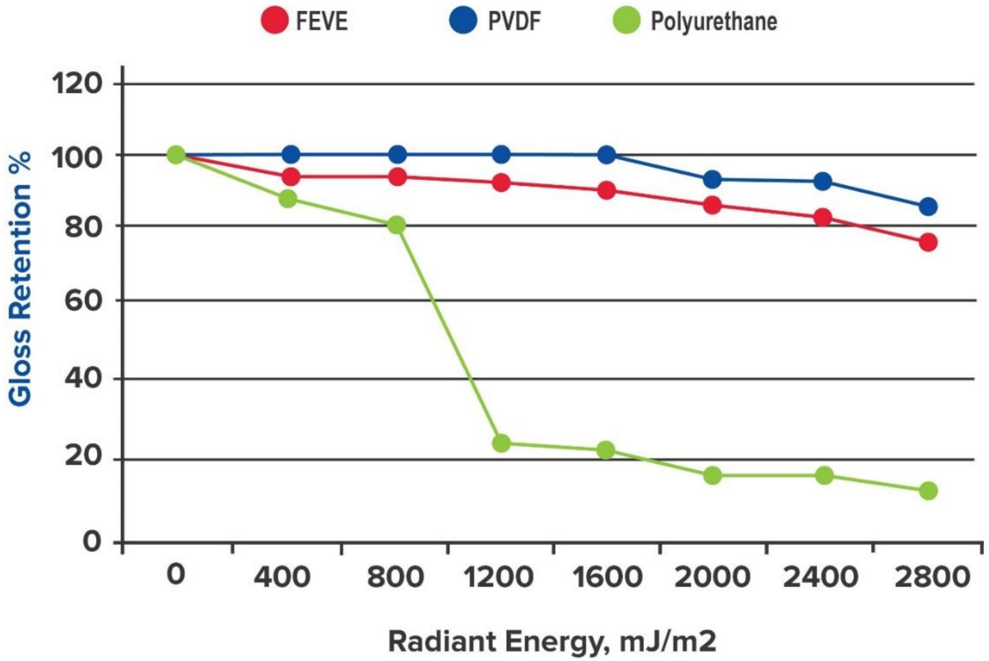
Xenon Arc Test of White Enamels

ASTM G155



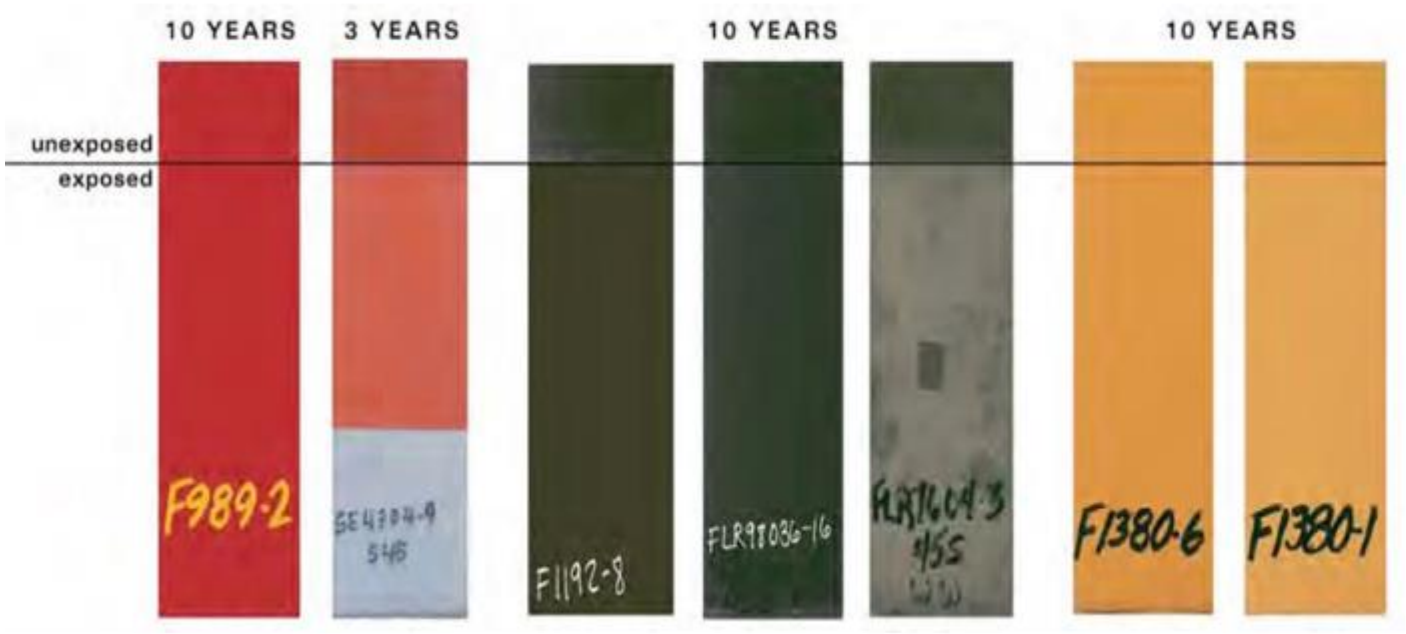
EMMAQUA® Test

ASTM G90



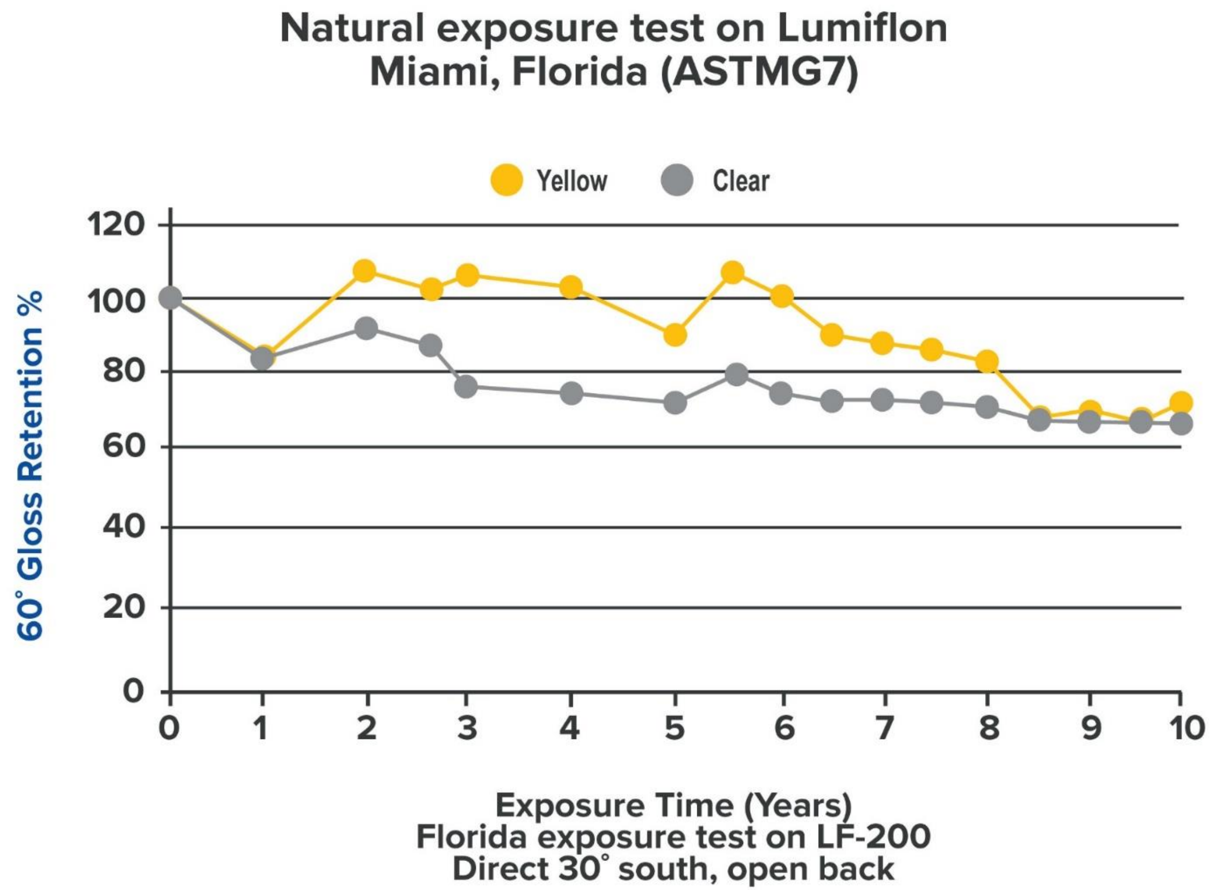
Real Time Weathering

Modified South Florida ASTM D1014

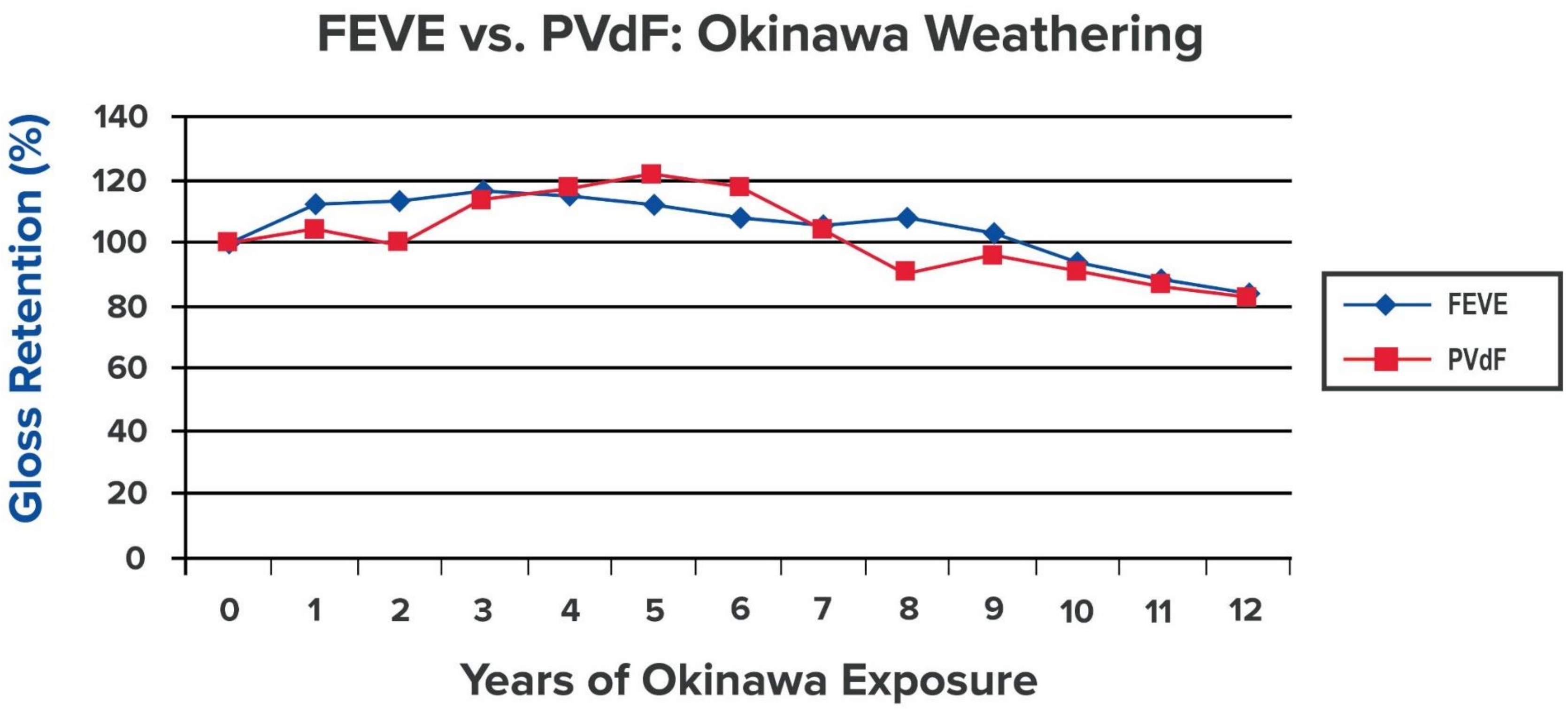


FEVE | High Performance Polyester | FEVE | PVDF | Polyester | FEVE | PVDF

Real Time Weathering: South Florida Exposure

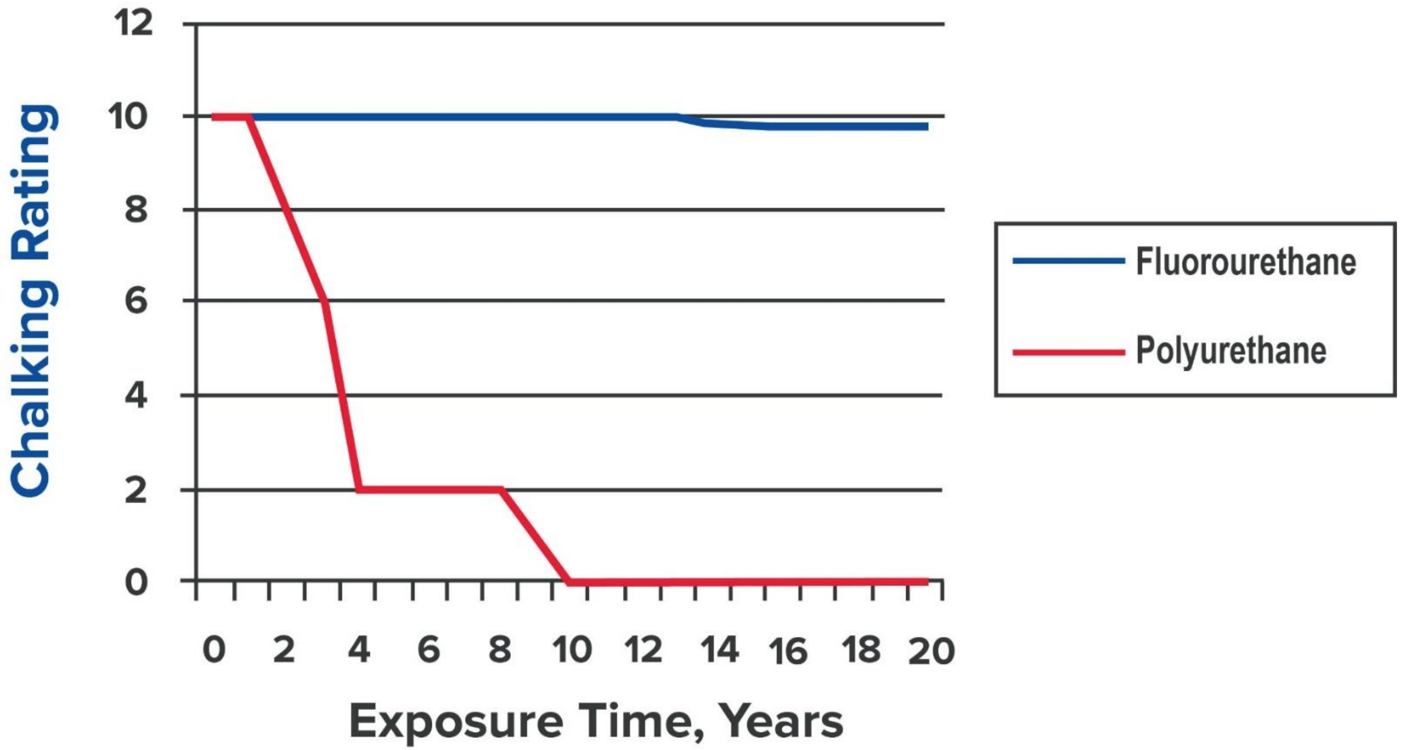


Real Time Weathering: Okinawa, Japan



Real Time Weathering Test: Chalking Test

Offshore Marine Testing Station in Japan



Corrosion Resistance of FEVE Coatings

Corrosion adds to life-cycle costs

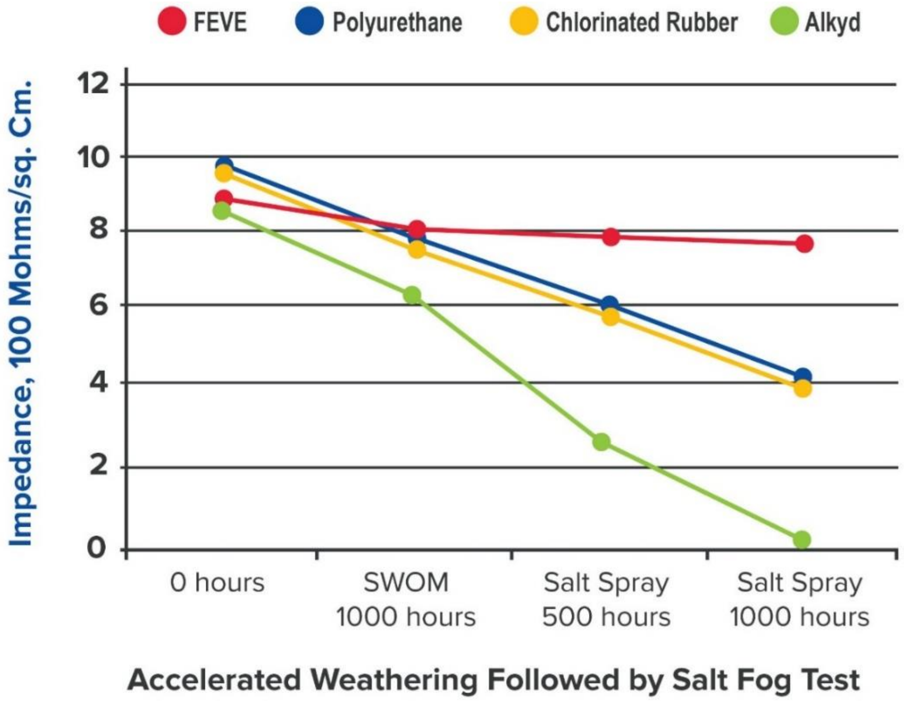
Coatings are used on structures primarily to prevent corrosion

Primary corrosion resistance is provided by zinc primer which corrodes before steel after coating damage

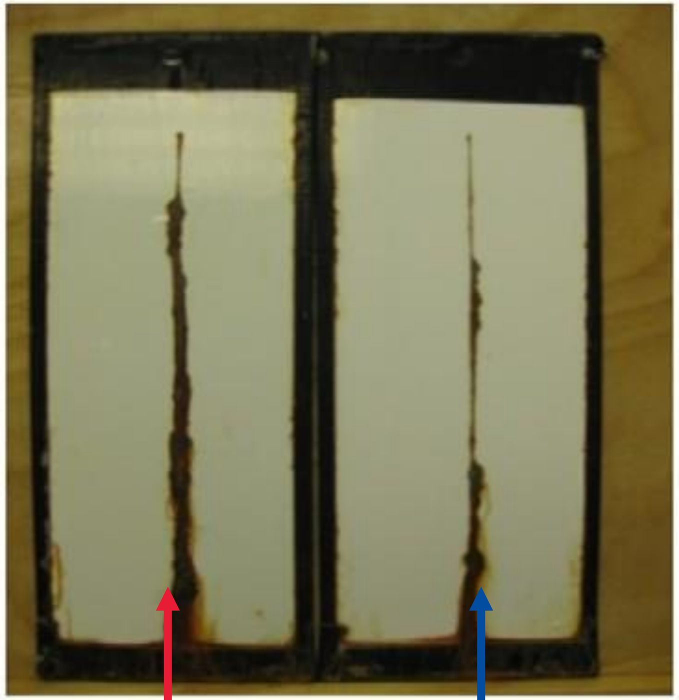
FEVE coatings resist degradation by UV light and corrosives

- *Topcoat serves as a barrier to prevent/slow moisture intrusion*

Electrochemical Impedance Spectroscopy (EIS) Test



Corrosion Resistance of FEVE Coatings: Salt Fog Test



Polysiloxane Topcoat FEVE Topcoat

Polyurethane Topcoat FEVE Topcoat

Types of FEVE Resins

Four main types of FEVE resins are available to meet varied application environments and air quality regulations

1. Solvent based for factory OEM or air dry, field-applied coatings

2. Resins for low VOC and HAPS free liquid coatings

3. Water-based

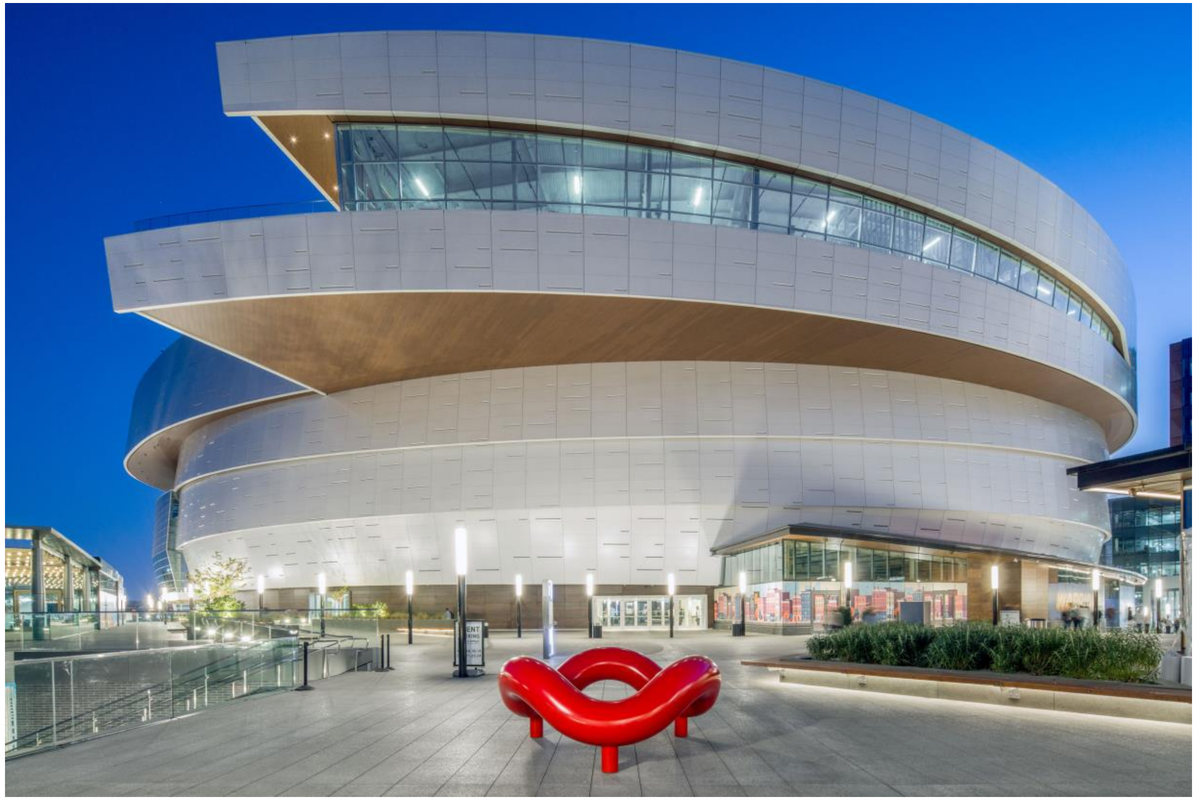
4. Powder coating resins

Central Library – Canada Photo courtesy of Snohetta

Types of FEVE Resins

- **Solvent based for liquid coatings**
  - Traditional form
  - Primarily used in factory settings with thermal oxidizers to convert VOC
  - Solvent-based coatings can still be used in much of the U.S.

- **Resins for low VOC and HAPS free liquid coatings**
  - Solid flake resins that can be dissolved in many different solvents
  - Can be dissolved in VOC exempt solvents



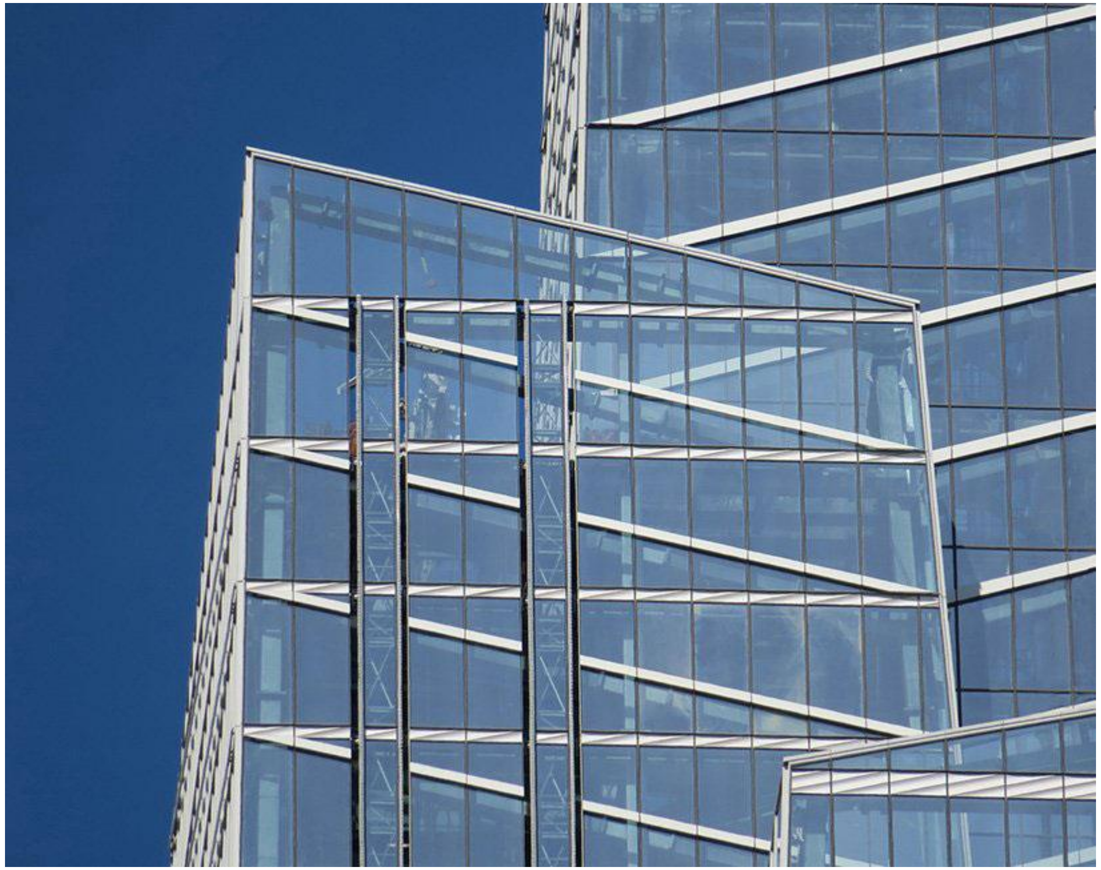
Chase Center – San Franciso

Photo courtesy of Jason O'Rear

Types of FEVE Resins Cont.

- **Water-based**
  - Low VOC option
  - Minimal solvents may be needed for optimal appearance and properties

- **Powder coating resins**
  - No VOC
  - Uses ovens for cure



One Vanderbilt – New York Photo courtesy of Paul Clemence

Performance Characteristics of FEVE Liquid Coatings

- Air dry, field-applied coatings are used to repair curtain walls and other architectural components including metal roofing, panels and handrails as well as infrastructure applications such as bridges

- Factory applied coatings are used on aluminum coils for various building components like ACM panels and are also spray applied on composite pultrusions

- Same performance characteristics as FEVE powder coatings including superior gloss retention, resistant to chalking and airborne chemicals/acid rain

- **Excellent color and gloss retention for 30+ years**

Application of FEVE Liquid Coating Systems

- **FEVE field-applied coatings can be either solvent or water-based and one or two components**
  - Epoxy or polyurethane primer coat applied prior to FEVE topcoat for most environments
  - Zinc rich primer with epoxy or urethane middle coat can be used in corrosive environments
  - FEVE coatings can be applied by spray, brush or roller
- **FEVE factory applied coatings can be spray applied or applied via a coil coating process**
  - FEVE coil coatings offer high gloss to ACM panels
  - FEVE spray applied coatings offer low-temperature cure for heat-sensitive substrates like vinyl and fiberglass

Nassau Coliseum – New York

Photo courtesy of Jamey Price

Performance Characteristics of FEVE Powder Coatings

- Used for OEM coating of aluminum extrusions

- 30+ year life as a topcoat, with superior gloss and color retention, chalking resistance, and resistance to airborne chemicals and acid rain

- Ideal for new construction for curtain wall, windows, and other architectural elements

- No solvents used; **Zero VOCs**

- Minimal coating waste:
    - *“What’s in the bucket goes on the wall”*

Erie on the Park – Chicago

FEVE Powder Application

FEVE powder coatings are applied to clean, prepared aluminum susbstrate via electrostatic spray deposition (ESD)

923 Folsom St Apartments – San Francisco

FEVE Substrates

Used in a wide range of projects and surfaces such as:

- Metals
    - Aluminum
    - Steel
    - Copper
    - Zinc
- FiberGlass
- Glass
- Virgin and recycled plastic
- Concrete
- Fiber Cement
- Wood

Form: **Colors and Finishes**

Form

- FEVE resins offer the ability to use a wide range of crisp, clean colors

- FEVE resins can be used with bright/vivid pigments

- FEVE products offer a wide range of gloss from completely flat to matte to semi-gloss to high gloss

- FEVE can be used in field touch up paints to repair damaged areas

45 Fremont Building – San Francisco

Form

High Gloss

- FEVE resins are inherently transparent and high in gloss.

- This unique trait amongst other fluoropolymer resins allows metallics to shine brighter and vivid pigments to pop.

565 Great Northern Way – Vancouver, BC

Form

Metallic

- The transparent nature of FEVE resins allow metallic and mica pigments to shine and sparkle brighter.

- FEVE resins have good adhesion directly to metal substrates allowing them to be used as transparent or tinted clearcoats for a natural metal look.

108 Chambers Street – New York Photo Courtesy of Brennan Photo & Video

Form

Special Effects and Functions

- Color shifting pigments
- Texture
- Speckle
- IR reflective pigments

Pelizaeus Reismann Canteen– Germany
Photo Courtesy of Matern Wäschle Architekten, Paderborn

Form

Matte Finishes

- FEVE resins can be formulated in matte finishes.

- FEVE coatings can be formulated to a range of gloss from full matte to semi-gloss allowing the designer to create a tailored aesthetic.

Seminole Hardrock Hotel & Casino – Florida
Photo courtesy of Miami In Focus, Inc.

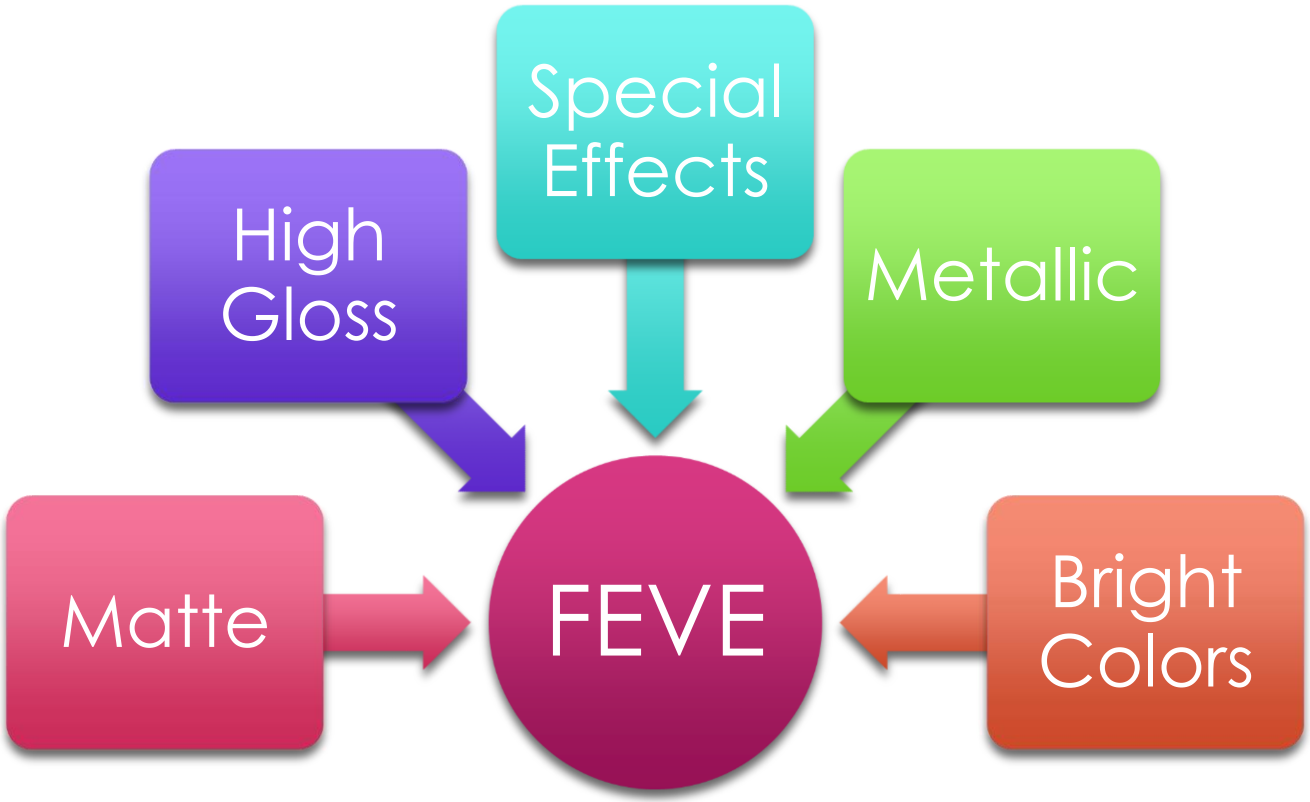
Form

Bright Pigments

- FEVE resins are completely transparent and allow bright and vivid pigments to pop.
- The extreme durability of FEVE technology will keep the pigments brighter longer.

Gurallar Business Center – Istanbul Photo courtesy of Studio Majo

Form


Special Effects
High Gloss
Metallic
Matte
FEVE
Bright Colors

Sustainability: **Environmental Impact Reduction Using FEVE Coatings**

Sustainability: Environmental Considerations

FEVE resin reduces environmental impact over the life of the structure associated with:

- Coating production
- Transportation
- Waste reduction
- Traffic
- VOCs off-gassed during the repainting or recoating process

The Gallup Technology Center – New Mexico

Sustainability

Low VOC Coatings with FEVE Resins		
Low VOC Solventbased Coatings	Powder coatings	Waterbased Coatings

FEVE Powder Coatings for Environmental Performance

Low VOCs – No solvents

Single coat – Powder achieves excellent performance in a single coat

Reclaim and reuse – Powder over spray may be reclaimed/recycled

Reduced energy use – Powders cure at lower temperatures than PVDF liquid coatings

Reduced carbon dioxide emissions – Powder has lower VOC and lower carbon emissions than liquid

No hazardous waste – No toxic landfill with powder coatings

Non-hazardous disposal – No toxic waste

EPA - Recommends powder coatings as a sustainable coating option

Pretreatment – Can choose a non chrome (non toxic) pretreatment and benefit from AAMA 2605 performance levels

No chrome based primer required – Most liquid coatings require chrome primer on aluminum

LEED – Helps with LEED credits and certification of a building (*more on following slides*)

Sustainability

Possible LEED v4 Credit Contributions:

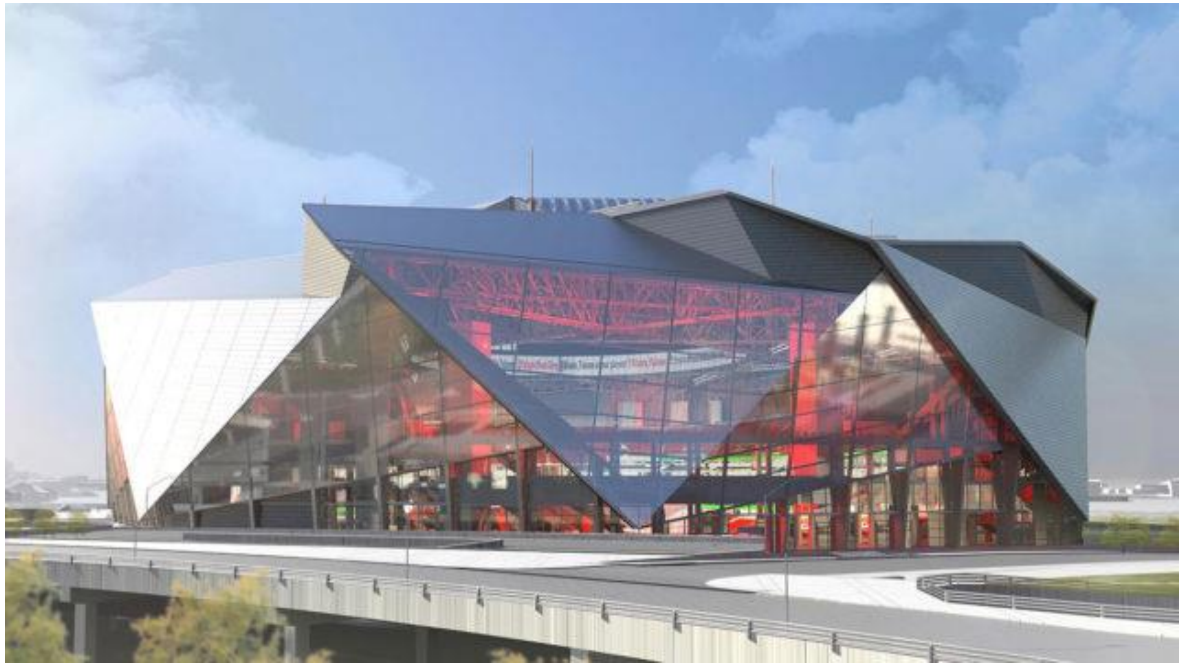
Building Product Disclosure and Optimization - Environmental Product Declarations:
- EPD for FEVE Coatings

Materials and Resources Credit:
- Building Life Cycle Impact Reduction

Sustainable Sites Credit:
- Heat Island Reduction

Energy and Atmosphere Prerequisite
- Minimum Energy Performance

Innovation in Design
- Heat Island Reduction



Mercedes-Benz Stadium – Atlanta Photo courtesy of Arch Daily

Sustainability

Possible Sustainable Sites Credit: Heat Island Reduction

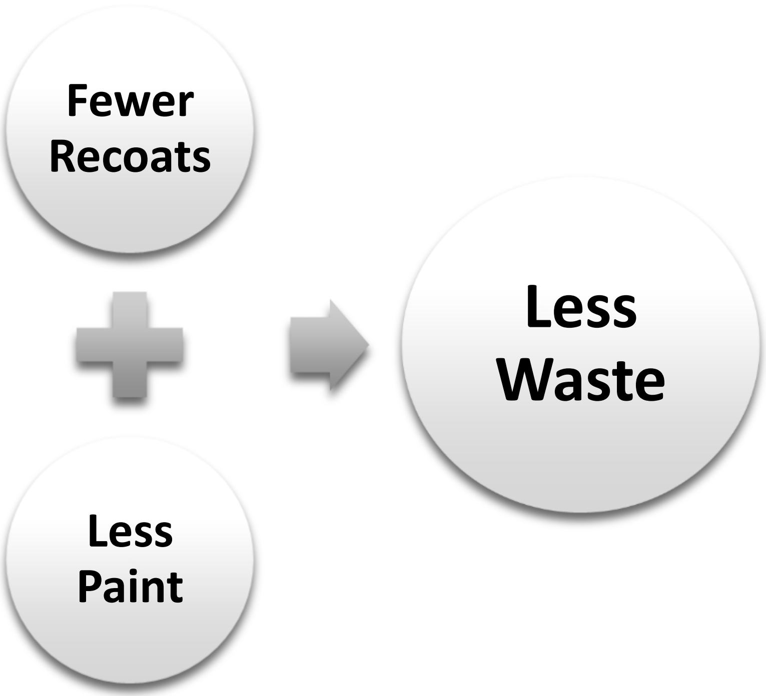
- **Intent:** *minimize effects on microclimates and human and wildlife habitats by reducing heat islands*

Possible Energy and Atmosphere: Optimize Energy Performance

- **Intent:** *reduce the environmental and economic harms of excessive energy use by achieving a minimum level of energy efficiency for the building and its systems*

Sustainability

Life Cycle Cost Analysis



Topcoat Type	Topcoat Thickness, µm	Coating Cost, $/m^2$
Alkyd	50	1.47
Polyurethane, PU	55	4.08
FEVE	55	12.01

	Alkyd	PU	FEVE	
Total Repainting Cost, $/m^2$	69.48	85.65	93.87	
Estimated Coating Life, Years	7	18	30	60
Total Applied Cost, $/m^2/Year	**9.93**	**4.76**	**3.13**	**1.56**

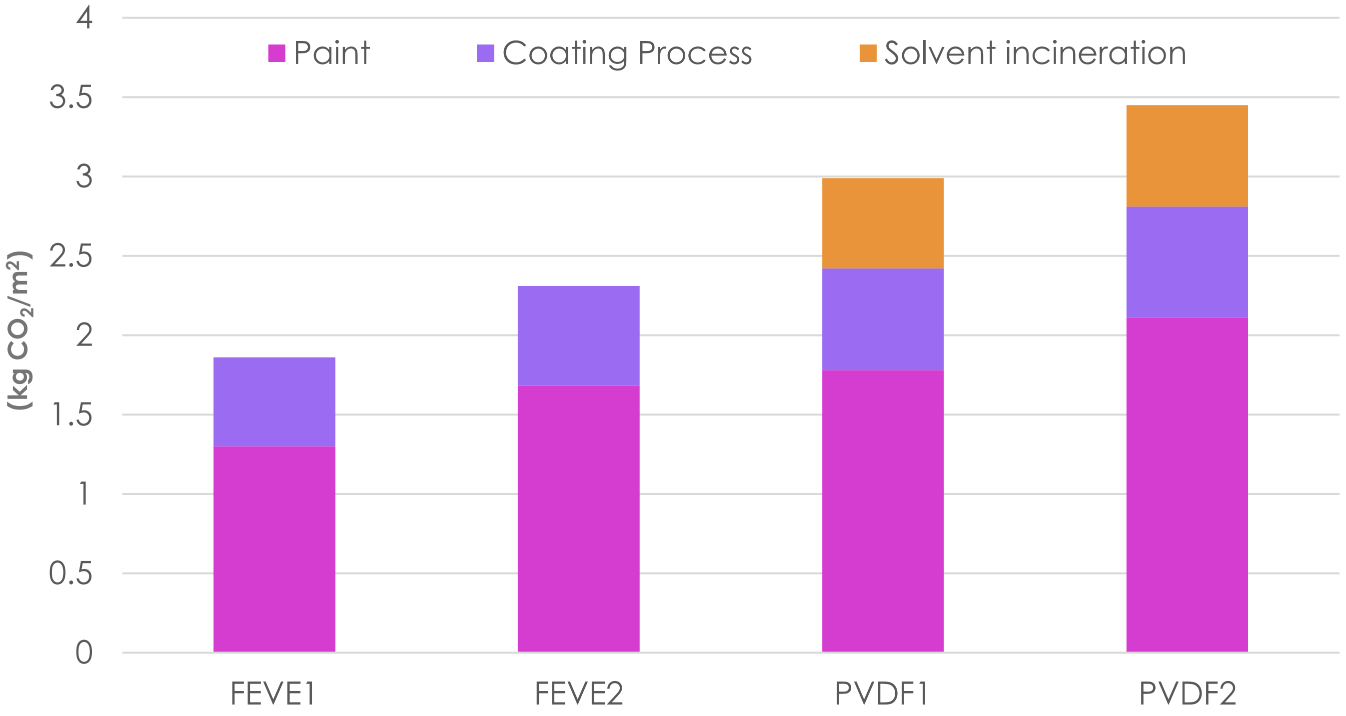
Carbon Footprint Analysis

Life cycle assessment study

- **Contracted out to consulting firm**
- **Scope**
  - FEVE powder paint
  - PVDF liquid paint
- **Results**
  - FEVE powder paint has a significantly reduced carbon footprint
    - Powder has high transfer efficiency
    - Powder uses no solvent
    - Powder cures at lower temperatures

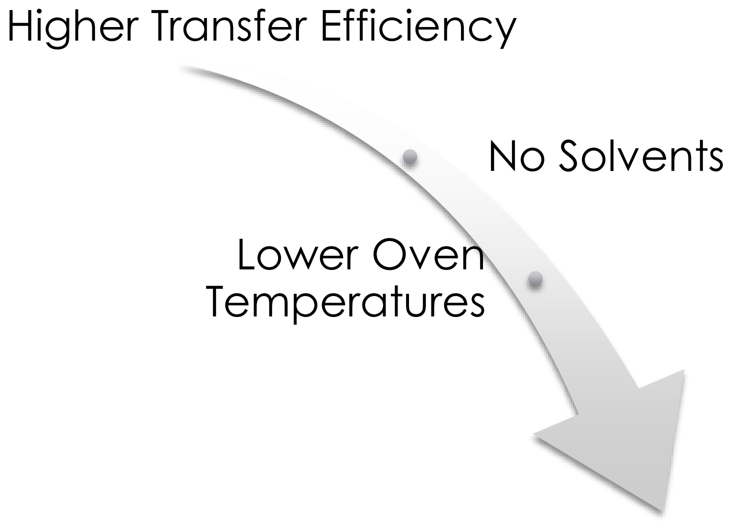
Paint	Transfer Efficiency	DFT, µm	Cure Temp	Cure Time, minutes
FEVE1	90 %	60	392 F	15
FEVE2	70 %	60	392 F	15
PVDF1	80 %	35	464 F	15
PVDF2	60 %	35	464 F	15

Carbon Footprint Analysis



Paint	Transfer Efficiency	DFT, µm	Cure Temp	Cure Time minutes	Paint	Transfer Efficiency	DFT, mm	Cure Temp	Cure Time minutes
FEVE1	90 %	60	392 F	15	PVDF1	80 %	35	464 F	15
FEVE2	70 %	60	392 F	15	PVDF2	60 %	35	464 F	15

FEVE POWDER



Lower Carbon Footprint

Case Studies

Specifying FEVE Coatings

FEVE resins are used in paints produced by reputable paint manufacturers

- FEVE resins are not sold by license so the paint manufacturer may not state that FEVE resins are used in their paints- even if they are
- It is recommended to consult with the paint manufacturer when writing a specification

FEVE resins are used in coatings that adhere to many industry standards

- ✓ **AAMA 2605- Architectural Aluminum**
- ✓ **AAMA 625- Architectural Fiberglass**
- ✓ **Qualicoat Class 3- Architectural Aluminum**
- ✓ **ISO 12944- Industrial Steel**
- ✓ **AAWA D102- Industrial Steel**
- ✓ **MIL PRF85285**

Specifying FEVE Coatings

- 100% FEVE Fluoropolymer Resin
- Ultra Durable
- 2K Fluoropolymer
- Field- Applied
- One Coat Fluoropolymer Powder Coating
- Fluorocarbon Polymer Chemistry
- Hyper Durable
- Thermosetting Fluoropolymer

NASA Measurement Systems Laboratory – Virginia

Aluminum Composite Material

Project: NASA Laboratory
Location: Virginia
Substrate: Aluminum Composite
Application: Factory Applied Coil Coating – 2 & 3 Coat FEVE Based Fluoropolymer Systems

Photos courtesy of Scott Wertz

Harwyn – Australia

Aluminum Composite Material

Project: Harwyn Office Pods
Location: Australia
Substrate: Aluminum Composite
Application: Factory Applied Coating-Top Coat FEVE Based Fluoropolymer System

Photo courtesy of Harwyn

HSBC Center – Australia

Aluminum Composite Material

Project: HSBC Center
Location: Australia
Substrate: Aluminum Composite
Application: Factory Applied Coating-Top Coat FEVE Based Fluoropolymer System

Photos courtesy of Mike Chorley

Independence Library & Apartments – Chicago

Aluminum Composite Material

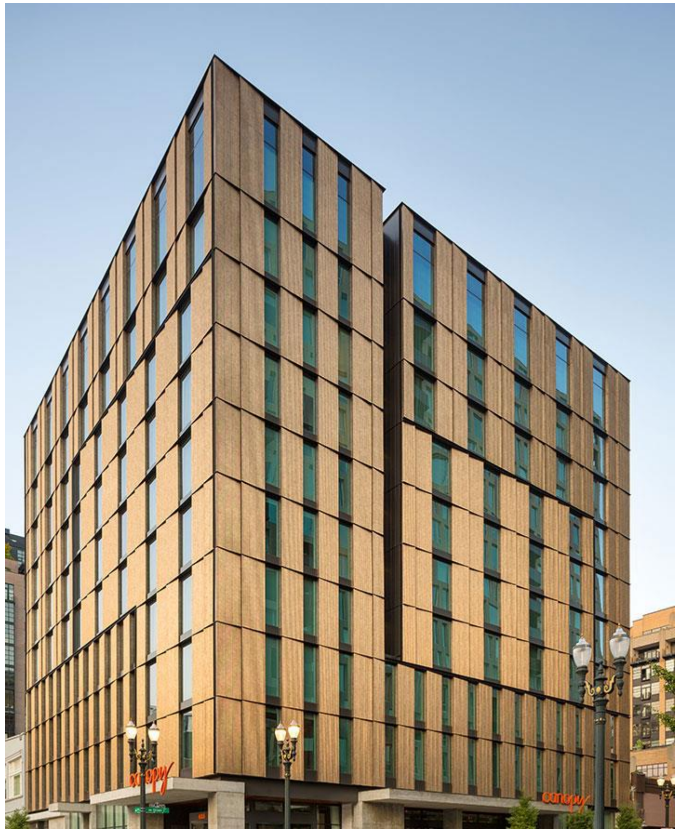
Project: Independence Library & Apartments
Location: Chicago
Substrate: Aluminum Composite
Application: Factory Applied Coating-2 Coat FEVE Based Fluoropolymer System

Photos courtesy of James Florio

Canopy by Hilton – Oregon

Single Skin Aluminum

Project: Canopy by Hilton
Location: Oregon
Substrate: Single Skin Aluminum
Application: Factory Applied Offset Gravure Printing Process-Top Coat FEVE Based Fluororpolymer System

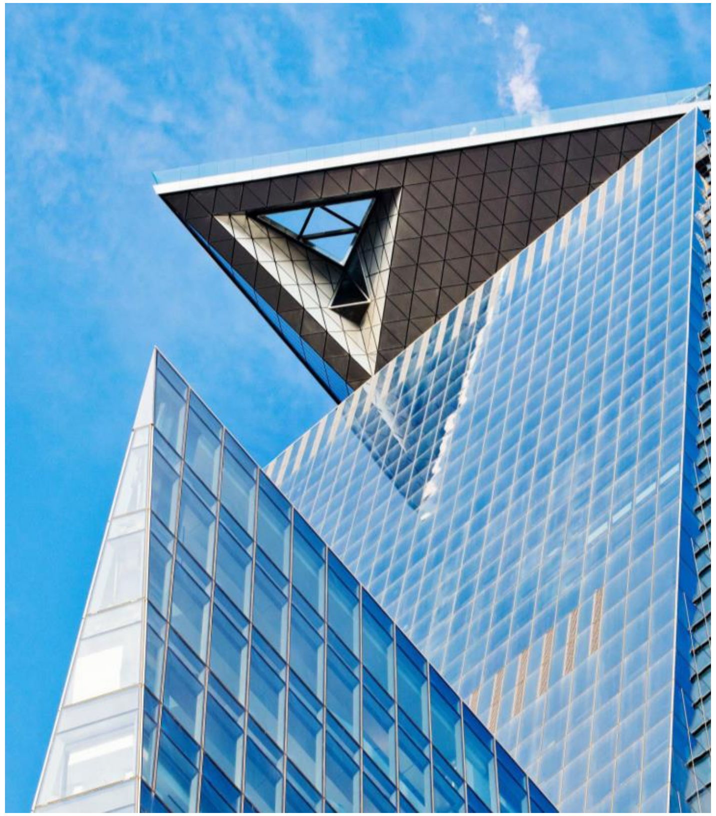


Photos courtesy of Josh Partee

30 Hudson Yards – New York

Steel

Project: 30 Hudson Yards
Location: New York
Substrate: Steel
Application: Factory Applied Powder-1 Coat FEVE Based Coating System

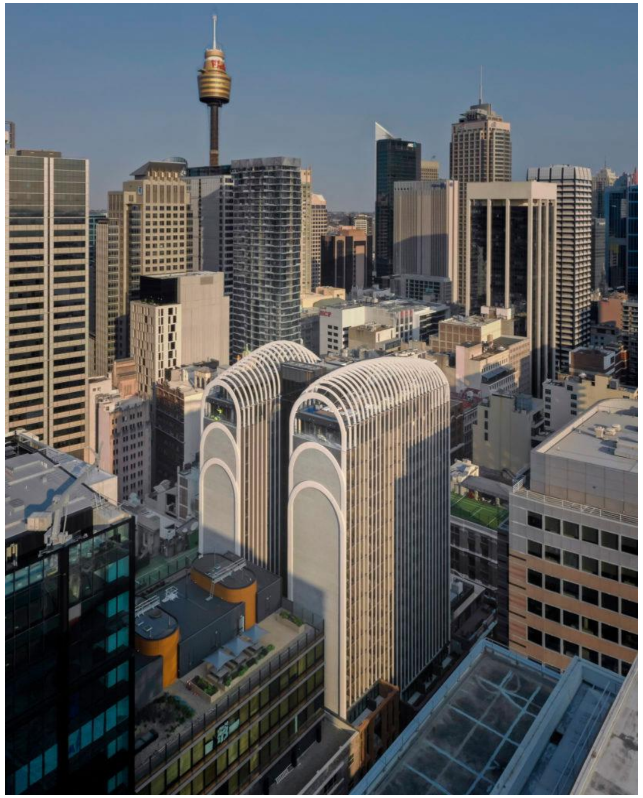


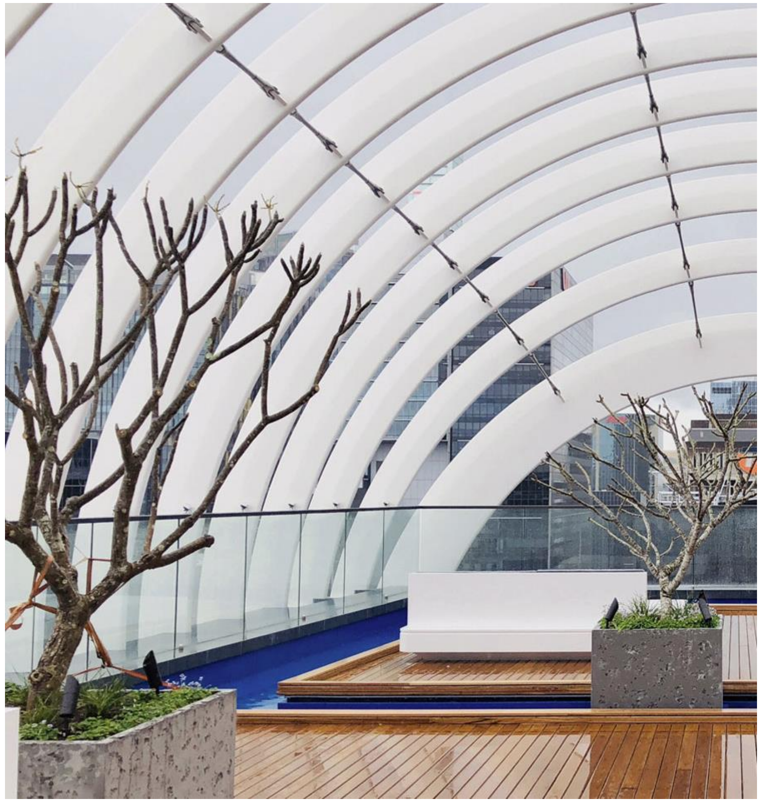
Photos courtesy of New Hudson Facades

Sydney Apartments – Australia

FiberGlass

Project: Sydney Apartments
Location: Australia
Substrate: Fiber Glass
Application: Factory Applied Liquid-3 Coat FEVE Based Fluoropolymer Resin (Polyurethane or Epoxy Primer)





Photos courtesy of Martin Seigner via Koichi Takada Architects

Parklands – Australia

FiberGlass

Project: Parklands Pavilion
Location: Australia
Substrate: Fiber Glass
Application: Factory Applied Liquid-3 Coat FEVE Based Fluoropolymer Resin (Polyurethane or Epoxy Primer)

Photos courtesy of ARM Architecture

Wahroonga School – Australia

Fiber Cement

Project: Wahroonga Prep School
Location: Australia
Substrate: Compressed Fiber Cement
Application: Factory Applied Liquid-3 Coat FEVE Based Fluoropolymer Resin (Polyurethane or Epoxy Primer)

Photos courtesy of Arch Daily

PathWest Laboratory– Australia

Fiber Cement

Project: PathWest Laboratory
Location: Australia
Substrate: Compressed Fiber Cement
Application: Factory Applied Liquid-3 Coat Feve Based Fluoropolymer Resin (Polyurethane or Epoxy Primer)

Photos courtesy of JCY

Course Objectives

By now, the design professional should be able to:

- ***Define FEVE coating technology, history, and unique weatherability properties as well as its ease of application in the architectural market***
- ***Discuss the importance of the form of coatings including color, finish, and gloss range***
- ***Discover the function of a fluoropolymer coating in terms of performance, substrates, and types***
- ***Describe the sustainability and environmental Impact of long-life coatings***

Questions?

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