FEVE based coating systems: Protecting Steel from Corrosion for over 30 years

CPD PRESENTATION

Certified System™
Quality
ISO 9001

A&I COATINGS

Learning Outcomes

At the end of this presentation attendees will be able to;

- Explain how FEVE/fluoropolymer coatings work.
- Understand the comparison between FEVE/fluoropolymer, polyurethane and polysiloxane.
- Explain how FEVE/fluoropolymer coatings save time and money over long term, that is have lower life cycle cost.
- Specify, or know where to go to specify a coating system.

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CONTENT

- **FEVE PAINT TECHNOLOGY**
- **LUMIFLON - FEVE RESIN**
- **FEVE PERFORMANCE TESTS**
- **A&I CASE STUDIES**

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FUNDAMENTAL FUNCTION OF PAINT

PAINT

The finishing touch, formulated to –

1. ***Protect the substrate***
2. ***Maintain aesthetics***

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TRADITIONAL PRIMER TECHNOLOGY

1. Protecting the substrate

- *Epoxy Zinc Rich*
- *Epoxy Micaceous Iron Oxide*
- *Epoxy Surface Tolerant*
- *Epoxy Glass Flake*

Proven technology which we endorse

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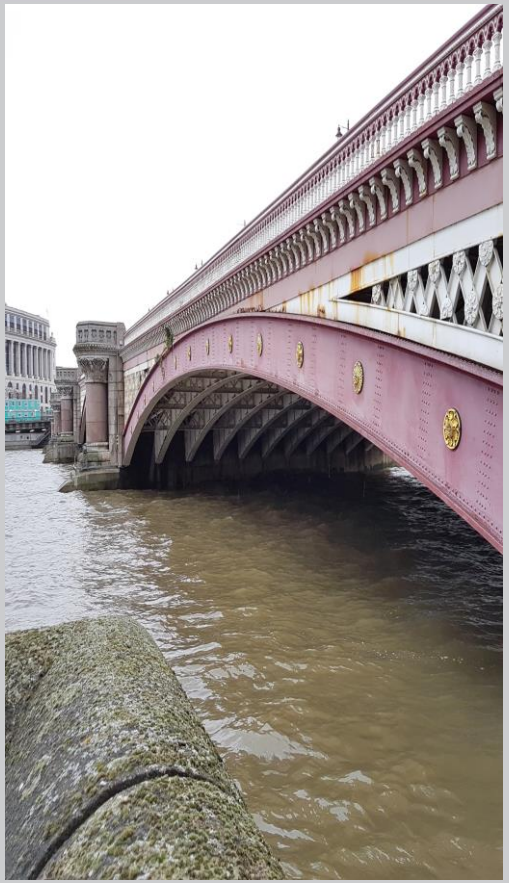
TRADITIONAL TOPCOAT TECHNOLOGY

2. Maintaining aesthetics

- *Polyurethane*
- *Polysiloxane*
- *Epoxy Acrylic*

Dated technology…rapidly fades



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TRADITIONAL TOPCOAT FAILS

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FEVE Topcoat – A New Concept

The role of the topcoat is completely re-written; Instead of being an aesthetic appendix to the paint system, it becomes a major protection asset to the primers and substrate, as well as enhancing the aesthetics all at the same time.

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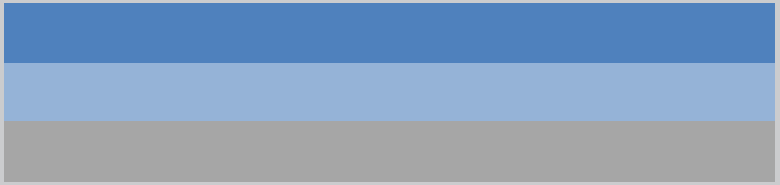
TRADITIONAL PAINT SYSTEM



POLYURETHANE TOPCOAT
EPOXY MIDCOAT
EPOXY ZINC RICH

- **Corrosion protection - Good**
- **Gloss and colour retention maintained for 5-10 years**

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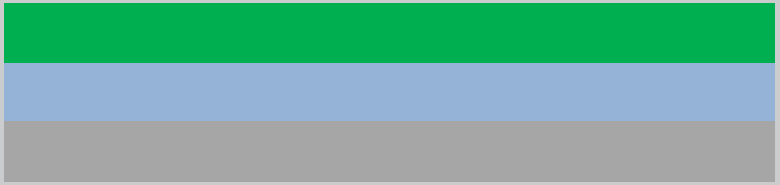
TRADITIONAL PAINT SYSTEM



FEVE TOPCOAT
EPOXY MIDCOAT
EPOXY ZINC RICH

- **Corrosion protection – ~~Good~~ Very Good**
- **Gloss and colour retention maintained for ~~5-10 years~~ 30+ years**

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Introduction of Fluoropolymers

Fluoropolymers have been in use for 40+ years as offering outstanding physical properties including –

- ✓ Weatherability
- ✓ Corrosion resistance
- ✓ Chemical resistance

The use of these Fluoropolymers however has been limited due to application constraints –

- X Very high temperatures (300°C) required to solubilise and fuse the coating
- X Limited gloss levels of 20-40%

e.g. PVDF (Polyvinlyidene Fluoride) as used for coil coated cladding

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Introduction of Fluoropolymers

Fluoropolymers have been in use for 40+ years as offering outstanding physical properties including –

- ✓ Weatherability
- ✓ Corrosion resistance
- ✓ Chemical resistance

SOLVENT SOLUBLE FLUOROPOLYMER – **FEVE RESINS**

Maintain all original attributes of Fluoropolymers plus…

- ✓ Room temp curing – can be paintshop or site applied
- ✓ Conventional application equipment and process
- ✓ Wide colour range including vibrant shades & metallics
- ✓ Choice of sheen from Matt to Full Gloss

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Introduction of Fluoropolymers

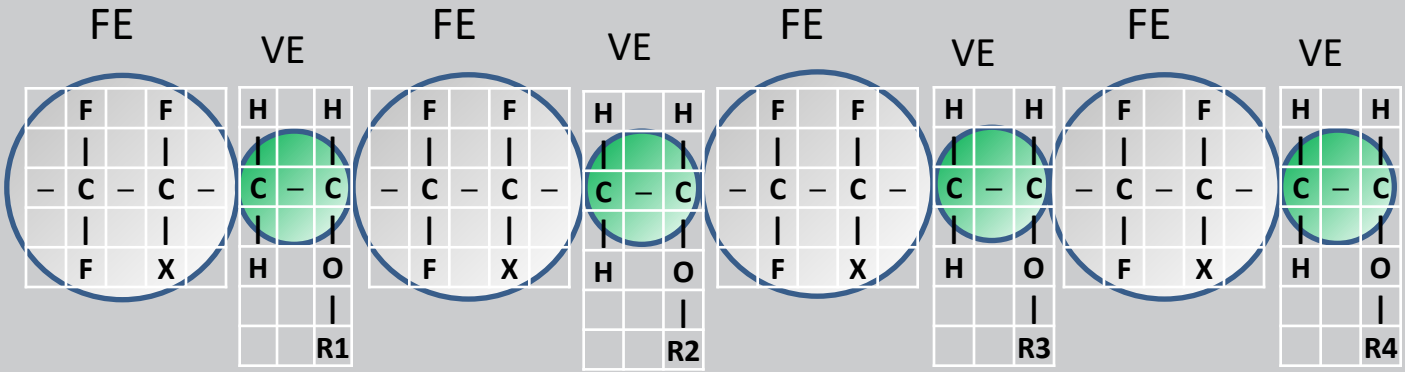
What is FEVE Technology?

The polymeric structure of an **FEVE** is a very systematic arrangement of fluoro-ethylene and vinyl-ether molecules.

This image demonstrates the arrangement and also shows that each fluoro ethylene molecule has 3 fluorine atoms as opposed to 2 in PVDF or PVF2 coatings

Fluoro Ethylene:
Durability

Vinyl Ether:
R1 = Transparency, Gloss, Hardness
R2 = Flexibility
R3 = Cross-linkability



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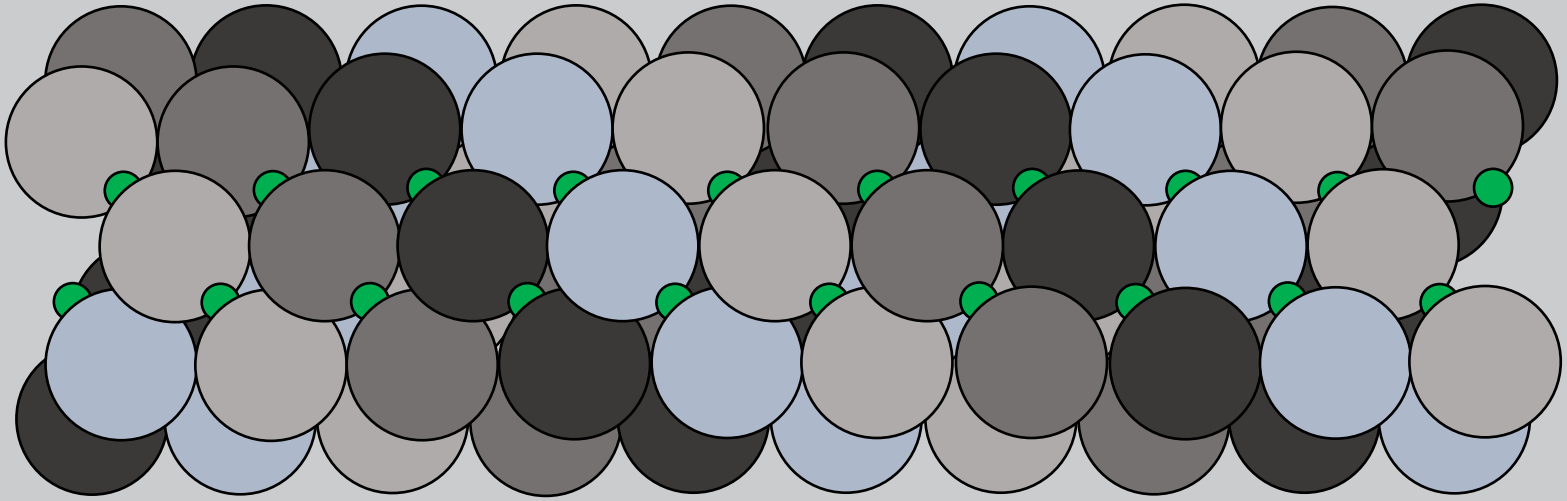
Introduction of Fluoropolymers

Why is FEVE so durable?

- The fluoroethylene and vinyl ether units are arranged in an alternating sequence – this means that the strong and stable fluoroethylene unit protects it's neighbouring vinyl ether unit.



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Introduction of Fluoropolymers

Why is FEVE so durable?

- The fluoroethylene molecule derives high integral strength from it's high frequency of fluorine atoms

Bond Energy
414-424KJ/mol

- The carbon-fluorine bond energy in the fluoroethylene section of the co-polymer is greater than the energy of UV photons.

Max UV Energy:
411KJ/mol

- General resins such as Polyurethane have a bond energy smaller than UV energy which is why degradation occurs

Bond Energy
379KJ/mol

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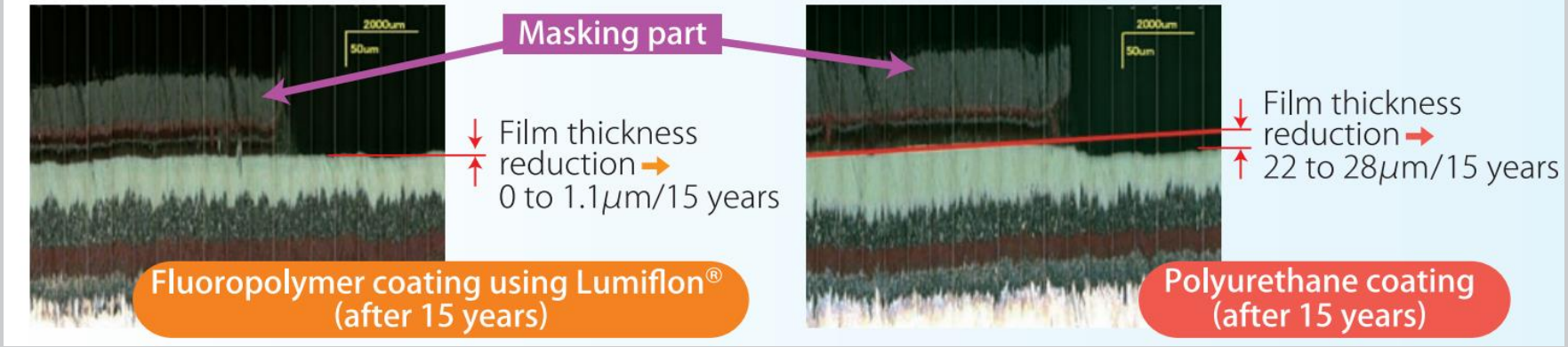
FEVE PERFORMANCE TEST RESULTS

The advantages of this uv resistant finish are two fold;

- **Aesthetics** – Colour or gloss level is maintained
- **Corrosion prevention** – There is minimal erosion of topcoat therefore protecting the underlying coats

Figure 7 Degree of coating thickness reduction seen in cross-sections of the coatings (horizontal scale 1/20)



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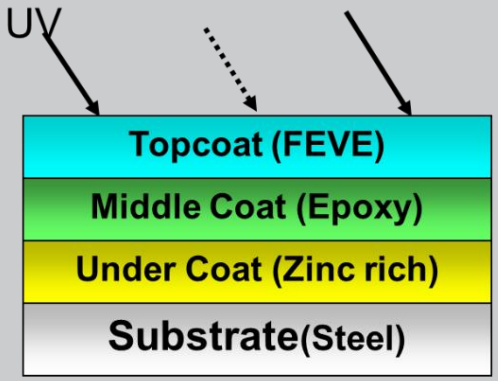
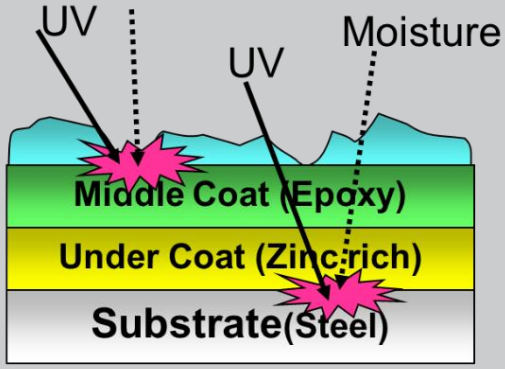
FEVE PERFORMANCE TEST RESULTS



FEVE Topcoat



Others (Conventional)

Chlorinated Rubber

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FEVE TESTING & VALIDATION

Salt Spray Chamber – Corrosion Testing

QUV Chamber – Gloss and Colour Retention and UV Stability

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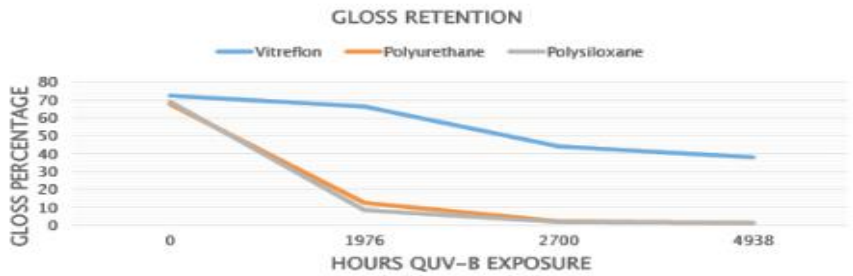
FEVE PERFORMANCE TEST RESULTS

FEVE becomes the logical choice for architects, engineers, specifiers and asset owners.

Unlimited colour and gloss availability with the assurance that it will need little or no major maintenance throughout the life of the coating – estimated up to 60 years



HOURS QUV-B EXPOSURE	GLOSS PERCENTAGE		
	VITREFLON	POLYURETHANE	POLYSILOXANE
0	72.5	67.9	69.1
1976	66.5	12.5	8.5
2700	44.1	2.2	1.9
4938	37.9	1.3	1.2

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FEVE PERFORMANCE TEST RESULTS

Gloss and colour variation readings taken at 4938 hours exposure.

	Vitreflon 700	Polyurethane	Polysiloxane
Original Gloss @ 60°	72.5	67.9	69.1
Gloss after 4938 Hours Exposure	37.9	1.2	1.3
Gloss Retention as %	52%	1.8%	1.9%
Colour Variation - dE	8.88	19.83	12.92

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FEVE PERFORMANCE TEST RESULTS

4938 Hours QUV Exposure

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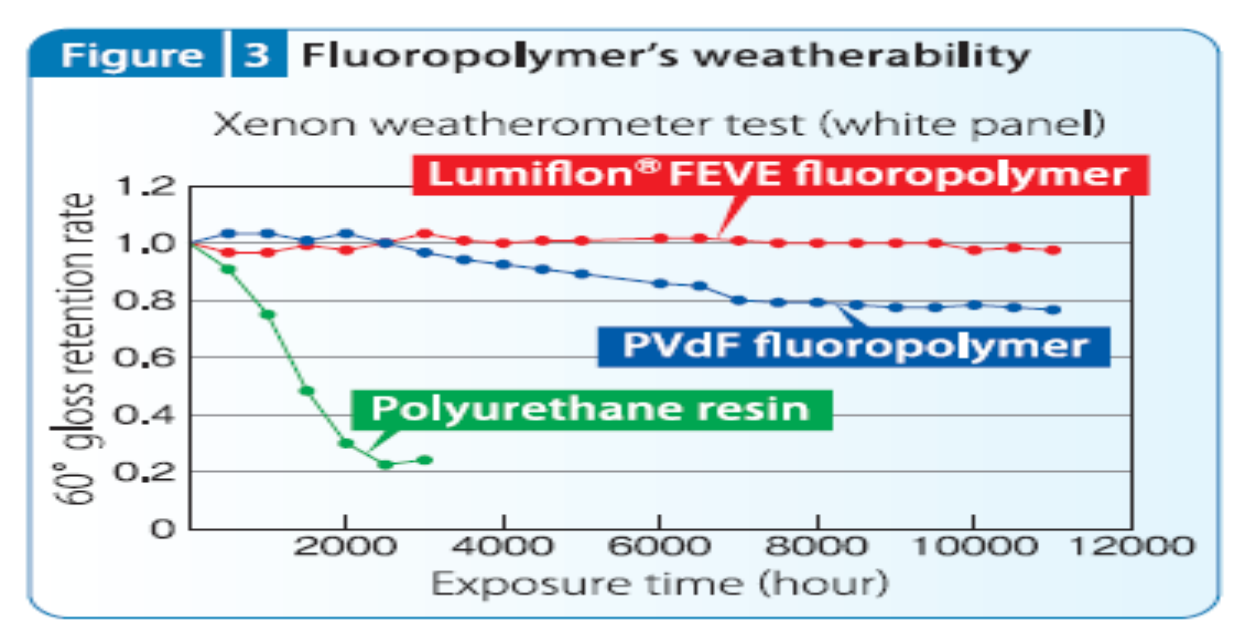
FEVE PERFORMANCE TEST RESULTS

Xenon Weatherometer Test



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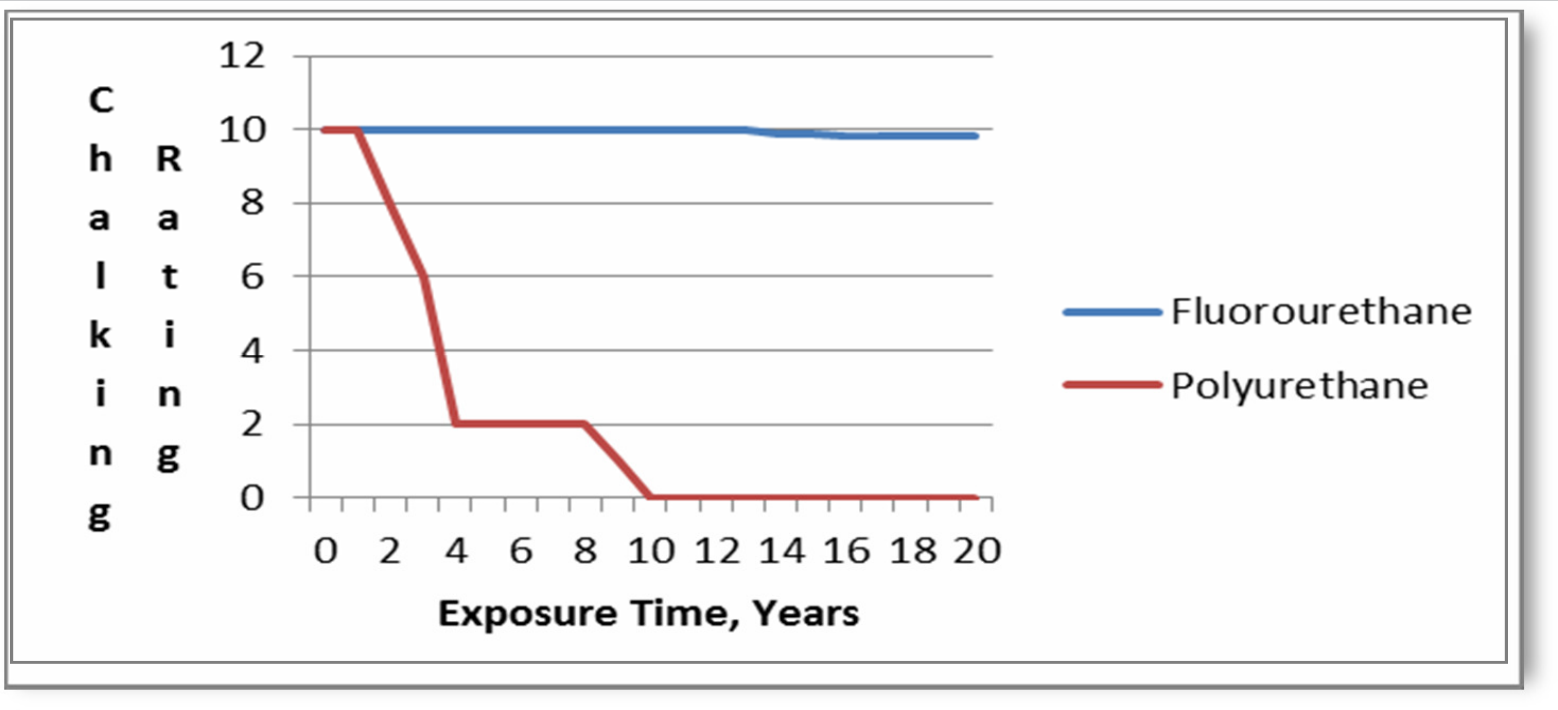
FEVE PERFORMANCE TEST RESULTS

CHALKING TEST



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FEVE PERFORMANCE TEST RESULTS

SALT FOG CORROSION TEST – 2000 HOURS

Polyurethane (2) | Fluoropolymer (6)

Polysiloxane (3) | Fluoropolymer (6)

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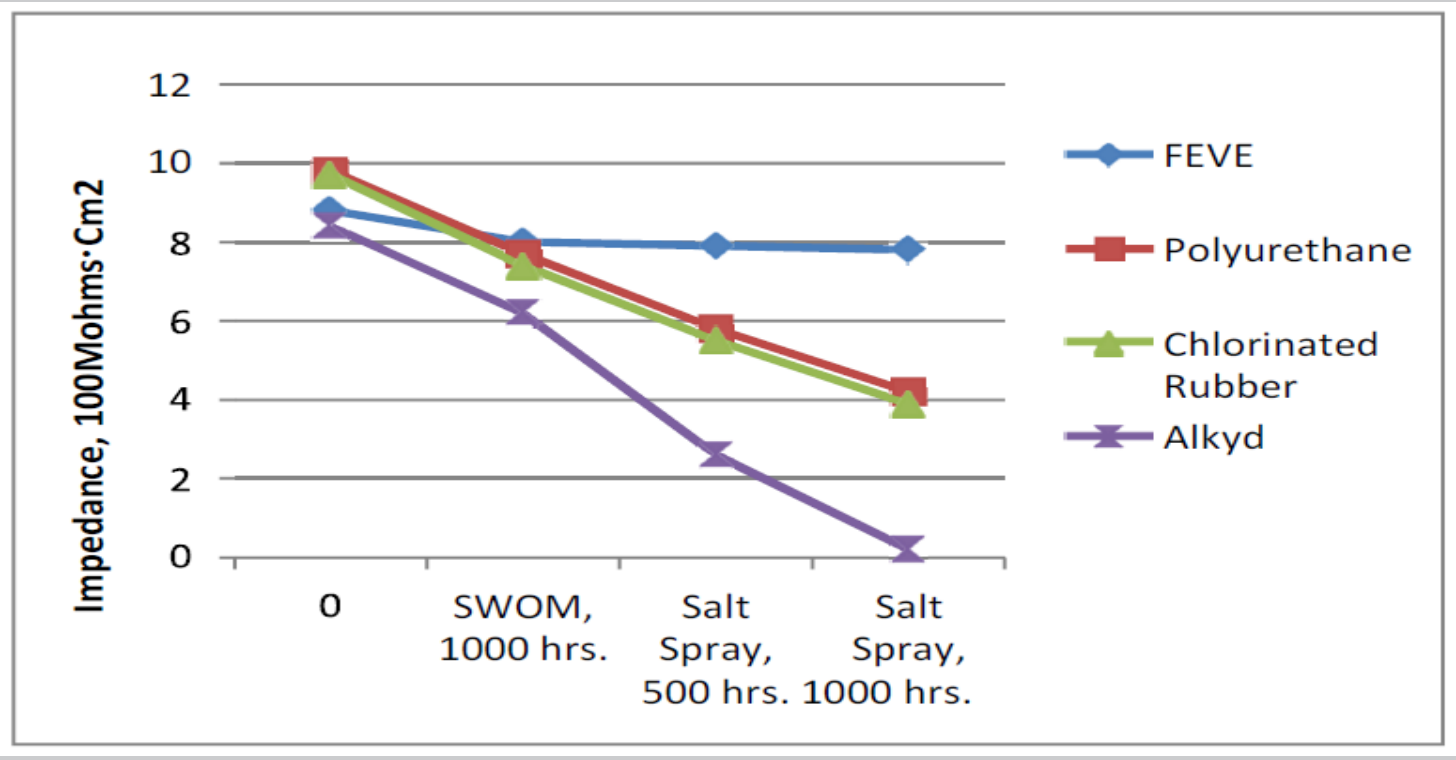
FEVE PERFORMANCE TEST RESULTS

ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY TEST RESULTS



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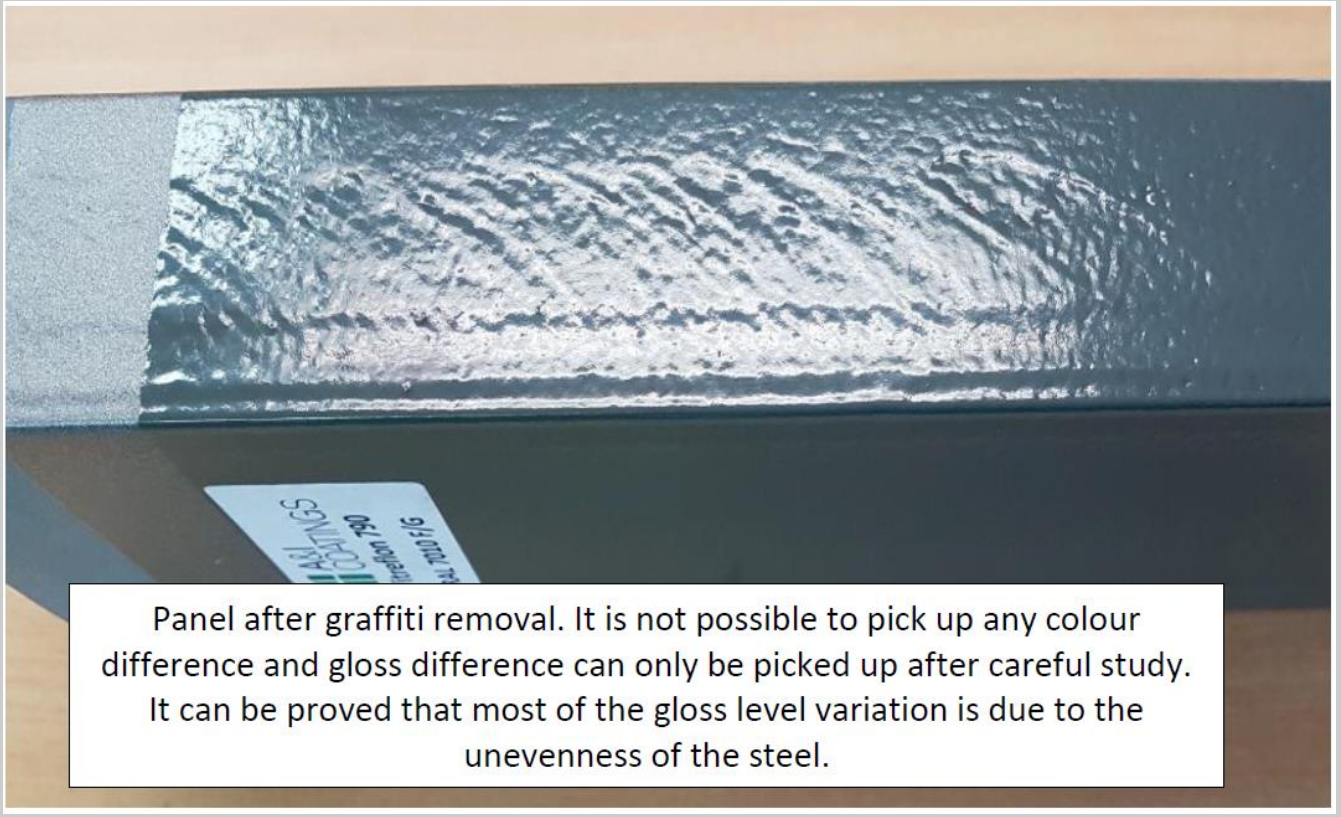
FEVE PERFORMANCE TEST RESULTS



Panel after graffiti removal. It is not possible to pick up any colour difference and gloss difference can only be picked up after careful study. It can be proved that most of the gloss level variation is due to the unevenness of the steel.

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The birth of Vitreflon

A&I Coatings in 1990 started to make polyurethane coatings because the coatings they were buying were fading.

Polyurethane will always fade and A&I's proved no better so in the 90's Graham Gillies and team went looking for the most durable coatings they could find for the growing façade coating business.

The search lead to AGC's Lumiflon. Vitreflon was borne about the year 2000. Truly the coating for the 21st century.

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The birth of Vitreflon

The first iconic project was the steel ‘Eight Women’ sculpture at Sydney Olympic Park in 2001. Still in excellent condition today.

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Daiichi-Mukaiyama Bridge

1986(New)

2016(after 30 years)

Commence Date : AUG,1986
Environment : Mountain Area
New/repaint : New construction
Painting Specifications
Surface preparation : 1st (Blasting)
Primer : Inorganic zinc-rich coating
Middle coat : Epoxy coating
Intermediate and Top coats : LUMIFLON base paint

Weatherability (after wiping)

Gloss retention	Color difference
73.8% (after 30 years)	No data

The alkyd resin topcoat showed remarkable deterioration of paint film in 16 years(2003).

Alkyd resin(after 18 years)

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Daiichi-Mukaiyama Bridge

12 years after repainting with the PU resin paint no film defect on the web plate or bolt joint was observed. However chalking was observed at a higher degree than had occurred with the original 30y old FEVE coating.

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Tokiwa Bridge – *Hiroshima, Japan*

1986(Repaint)

1993(after 7 years)

2016(after 30 years)

Commence Date : AUG,1986
Environment : Mountain Area
New/repaint : Repaint
Original coating : Chlorinated rubber
Painting Specifications
Surface preparation : ST3
Primer : Modified epoxy coatings
Intermediate and Top coats : LUMIFLON base paint

Weatherability (after wiping)

Gloss retention	Color difference
97.3% (after 30years)	2.3 ΔE (after 20 years)

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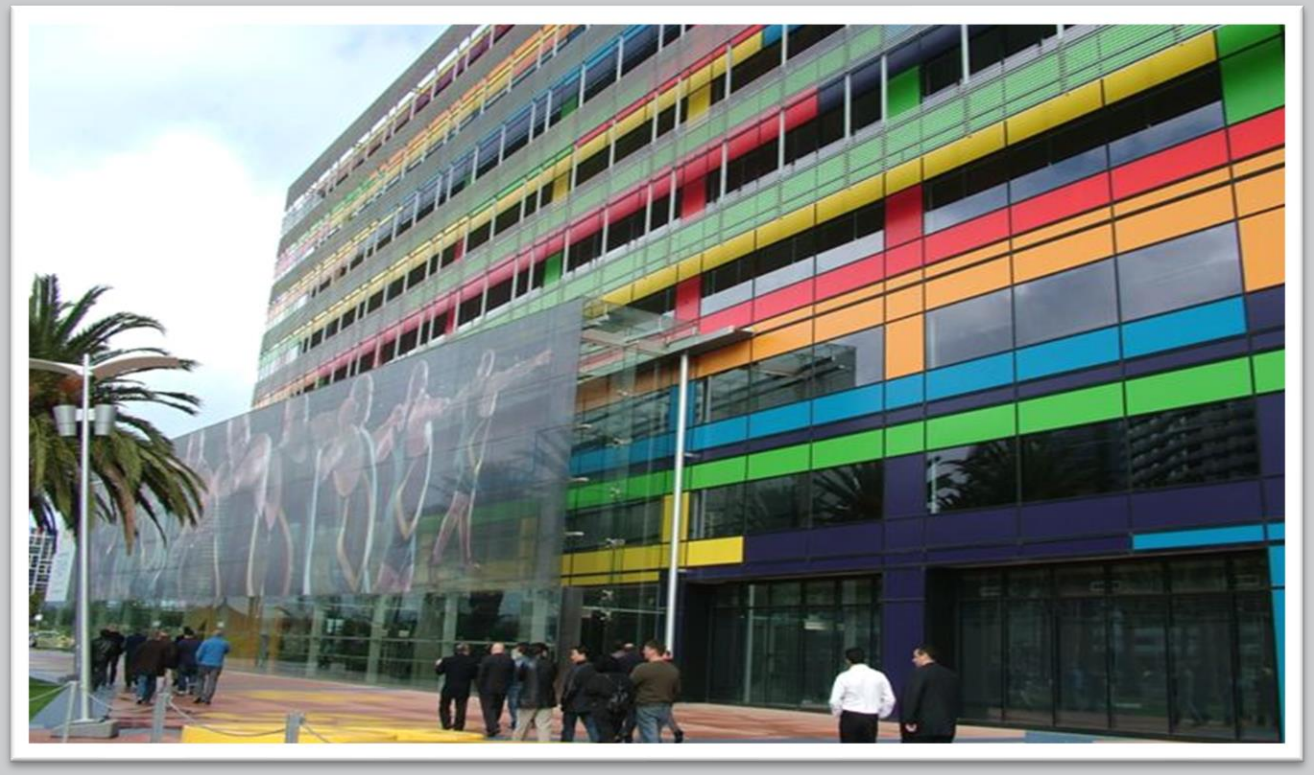
Real Life Situations

National Bank Headquarters Docklands Melbourne



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Real Life Situations

Seaford Rail Corridor

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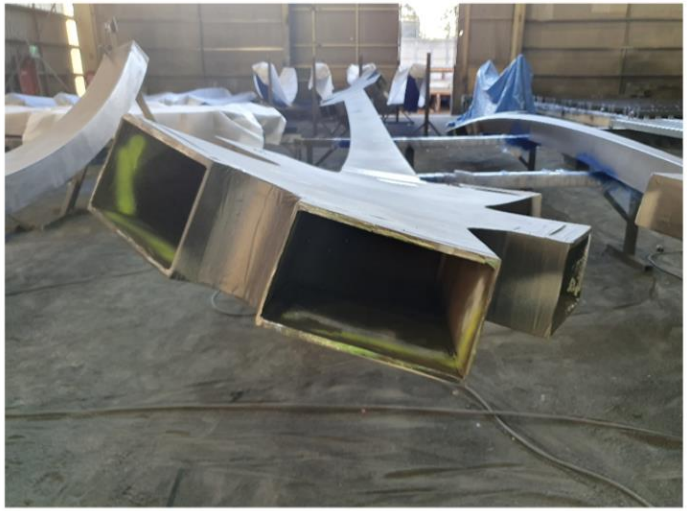
Real Life Situations

Lachlans Line Pedestrian Bridge - Sydney



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Real Life Situations

Glamis Road Bridge - Britain

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Real Life Situations

M7 Roadside Barriers- with anti-graffiti additives

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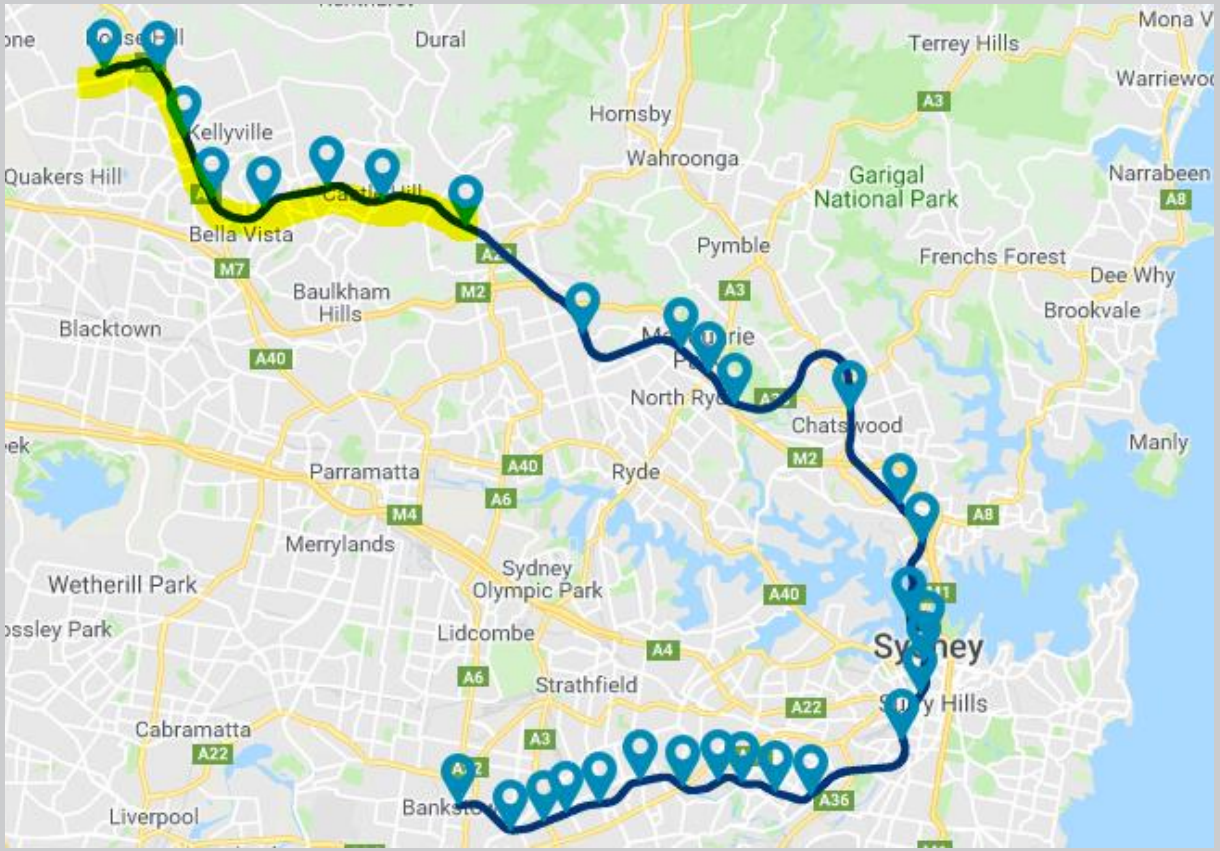
Project – Sydney Metro



Northwest Rapid Transit - Consortium

CPB CONTRACTORS

JOHN HOLLAND

MTR caring for life's journeys

UGL

Plenary

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Live Project – Sydney Metro

- Building **eight** new railway stations and 4,000 commuter car parking spaces
- Delivering Sydney's new generation of metro trains
- Building and operating the Sydney Metro Trains Facility, including train stabling and maintenance
- Installing 23 kilometres of new track and rail systems
- Converting the existing 13 kilometres of railway between Epping and Chatswood to metro status
- Operating and maintaining Sydney Metro Northwest for 15 years.

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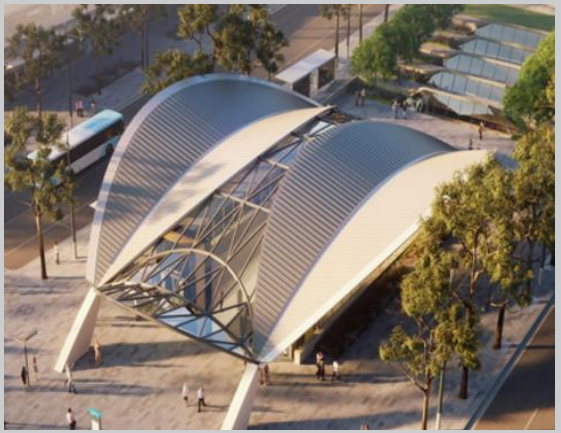
Live Project – Sydney Metro

Each station canopy is a unique structure designed to reflect the shape of a gum leaf.



For such iconic structures it was a key requirement for the asset owners that the coating system specified provided the best colour stability and the longest time to first maintenance.

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Live Project – Sydney Metro

KEY FIGURES

- 2 Product paint system Vitrezinc 586 and Vitreflon 790
- Over 100,000 square metres of steel substrate protected
- Steel fabrication and painting was carried out in New South Wales, Victoria, South Australia and Western Australia.

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Live Project – Sydney Metro

CLIENT FEEDBACK

Stakeholders involved in the paint specification and application consistently provided the following feedback:

- The coating system was user friendly
- Cure speeds and application properties were suitable across all seasons (+40°c in summer and down to 0°c in winter)
- Finish achieved was a smooth satin finish as desired by the architect (Hassell).
- Site touch up was straightforward, both products brush and roll easily.

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Live Project – Chenab Bridge

Used on many bridges round the world. Currently specified for Chenab Bridge, India - the world's tallest railway arch bridge..

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Live Projects

Vitreflon 790 has and is being used on a number of key government projects following Sydney Metro North West inc.

- Capital Metro Canberra (Rail infrastructure)
- Sydney Light Rail
- Melbourne Convention Centre
- 12 Live UK bridge projects
- One Sydney Harbour

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Durability/Life-cycle cost

THE COST OF MAINTENANCE

PAINT IS THE SMALLEST ELEMENT

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Durability/Life-cycle cost

Summary of Painting Costs:

- Feasibility and Project Evaluation
- Consultation
- Site and Structure Surveys
- Financials
- Legals
- Environmental, Ecological
- Tendering procedures
- Contractors Preliminaries
- Enabling Works
- Contract Administration
- Traffic Management – Highways and Rail
- Difficult Access
- Surface Preparation
- Waste Disposal
- Paint application

Paint

- Zinc Rich Primer 75µ d.f.t.
- Epoxy MIO Build Coat 200µ d.f.t.
- **FEVE Topcoat 75µ d.f.t.**

(FEVE IS THE ONLY VARIABLE)

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Conclusion

FEVE

- Extreme outdoor durability
- Very effective corrosion protection
- Over 30 years of application history
- Mandatory use of FEVE for bridges in Japan
- Mentioned in latest ISO 12944 standard
- 60 years or more expected life time for bridge coatings

THANK YOU

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Environmental Responsibility

Why paint every 20 Years…

When you could paint every 60 years

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