

# ESD – COATING SPECIFICATIONS

## DO IT ONCE AND DO IT RIGHT

In Australia, building activity is continuing to increase, particularly in coastal areas around our capital cities. In 2001, construction material consumption was 5,226 kg per person per year.<sup>i</sup> This volume of construction activity obviously places enormous stress on our environment. Designing more ecologically sustainable commercial buildings is one way to reduce construction material consumption.

### OPTIMUM PROJECT DESIGN LIFE

From both capital investment and a sustainable point of view, today's structures should be designed to last significantly longer than they have been - to span many generations, as most European cities had.

Whilst considering recycle potential of building materials isn't a bad idea, the focus of sustainable building design should be on long-term solutions offering sustained ecological benefits. Even demolishing a virtually 100% recyclable structure and building a new one using the reclaimed materials is inherently wasteful in terms of energy inputs required to refabricate the steel, recycle the concrete and refire the glass, not to mention reusing insulation, wall linings, flooring, etc.

### DO WE NEED PROTECTIVE COATINGS AT ALL?

Some ESD rating tools actually reward specifiers for reducing or eliminating coatings on their project. In terms of sustainability, this is short-sighted. Without protective coatings, a building's steelwork, reinforced concrete and timberwork won't last very long.

Apparently, there is lack of understanding that the two most common building materials, concrete and steel, (and most others), suffer preventable atmospheric degradation without protection.

### STEELWORK

The annual cost of corrosion in Australia is estimated to be between \$5-12 billion. It is difficult to calculate, but is believed to be between 2-5% of Australia's GDP<sup>ii</sup> (\$239 billion)<sup>iii</sup>.

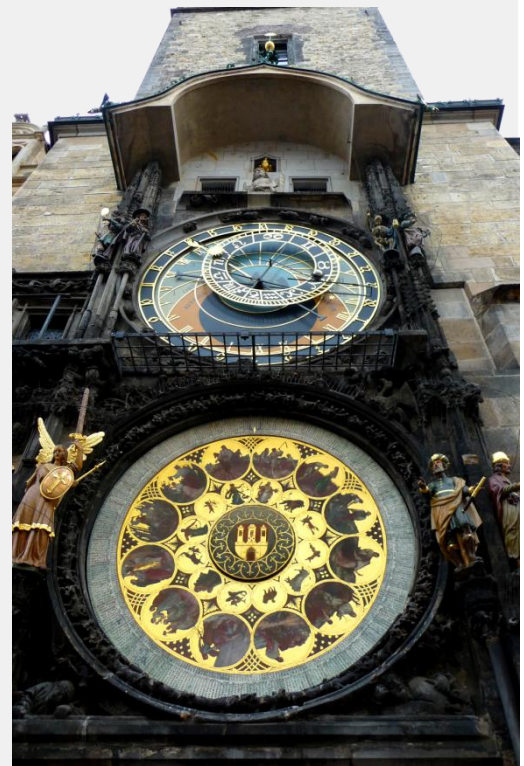
Most of our large cities are located along the Australian coastline, with its high levels of airborne salts and moisture, which accelerate the oxidation of all exposed metal surfaces, such as steel, hot dip galvanised steel, zinc, and even stainless steel and aluminium.

Therefore, it is fair to say that corrosion protection in this country is severely lacking, and in the framework of environmentally sustainable design, offers the greatest scope for improvement.

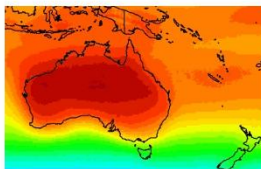
Although buildings have been designed without the use of exposed structural steel (other than as reinforcement within the concrete to improve flexural strength), from an ESD point of view, steel is a great choice of building material. Steel is lighter and stronger than concrete, and is very much faster to build with. Steel also offers the benefit of being easier to recycle at the end of its life.<sup>v</sup>



*We love our cities and bayside suburbs, but the highly corrosive environment is the major cause of corrosion and concrete spalling*



*Still ticking after installation in 1410, the Prague Astronomical Clock and the tower it resides in (and much of Prague itself) have been beautifully maintained throughout the centuries. How many of our buildings will still be standing in 600 years time?*



# ESD – COATING SPECIFICATIONS

Corrosion can be effectively controlled over the long term by the correct specification and use of Dulux Protective Coatings as selected from the Australian Standard AS/NZS 2312:2002, “Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings”.

This Guide provides guidance for architects, engineers, builders, subcontractors and suppliers on coating systems for the protection of steel work against corrosion in various environments.<sup>vi</sup>

## CONCRETE

As concrete is increasingly being left unpainted, so too is the incidence of concrete spalling. The growing concrete repair market is testament to this. In a 1998 article in the Engineering Review of The Australian, concrete spalling cost Australians \$100 million per year (this figure was attributed to the Institution of Engineers).

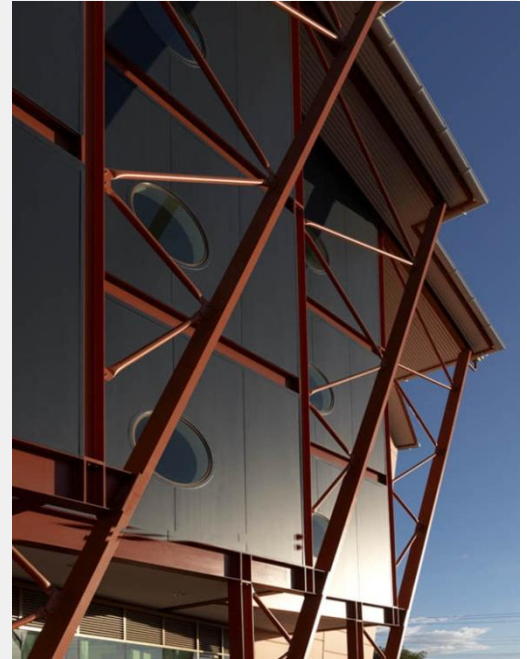
The only thing protecting reinforcing steel from rusting within concrete is the very high alkalinity of the concrete itself. Spalling is a process whereby atmospheric carbon dioxide neutralises the alkalinity of the concrete (a process termed “carbonation” (aka “alkali-aggregate reaction”), causing the steel reinforcement to rapidly corrode. Once the corrosion process commences, the corrosion products take up around eight times the volume that the original steel had, forcing the concrete around it to crack. As the corrosion progresses, the cracks widen, allowing moisture, oxygen and ions to enter and accelerate the corrosion problem.

A research paper by Srikanth Venkatesan of RMIT University, “Evaluation of distress mechanisms in bridges exposed to aggressive environments”, states that:

“Selection of a remedial action for aging/deteriorating infrastructure and designing new projects with sustainability objectives is a major challenge faced by many asset managers and designers of civil infrastructure. The fast rate of deterioration and the high cost of repair, rehabilitation, and replacement of concrete structures have become major issues in infrastructure asset management.”<sup>vii</sup>

According to The Steel Reinforcement Institute of Australia, “Carbonation is enhanced in heavily polluted atmospheres. There is a requirement in AS3600 for any area within 3km from industry to be considered as increased exposure classification. Unfortunately not all designers are aware of this. .... The carbonation of concrete is a slow and predictable process and can be markedly constrained by paint coatings; or better still, specially developed anti-carbonation products.”<sup>viii</sup>. In fact, these specially formulated “anti-carbonation” coatings can effectively arrest carbonation.

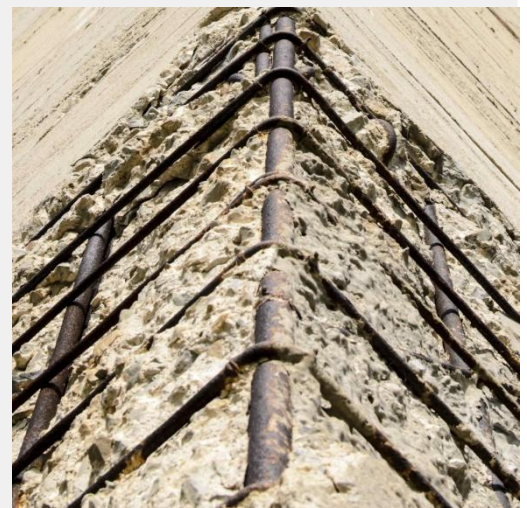
The effectiveness of an anti-carbonation coating can be measured by its equivalent air layer thickness, which can be mathematically related to its “equivalent concrete cover”. Certified laboratories, such as Taywood Engineering in WA, perform anti-carbonation tests on protective coatings to determine whether they are bona fide anti-carbonation coatings.



*Lighter, stronger and faster to erect than concrete, steel also has the advantages of recycling and reuse.*



*Concrete buildings contain almost as much steel as steel buildings*



*Concrete spalling is due to low concrete cover and absence of anti-carbonation protective coatings.*

# ESD – COATING SPECIFICATIONS

## ESD IS ABOUT PROTECTING YOUR BUILDING FROM DEGRADATION

### STEELWORK

Given that steel is lighter and stronger than concrete, faster to build with, and can be recycled at the end of its life, it is most definitely an ecologically responsible choice of building material. The challenge is to protect steelwork against corrosion from oxygen, salts (ions) and moisture.

The information below is offered as a guide only – for detailed technical information and specifications that conform to Australian Standards, we suggest you contact your local Dulux Protective Coatings Consultant.

### STEEL – HOW LONG SHOULD IT LAST?

The first reference guide you need is the Australian Standard AS/NZS 2312:2002, “Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings”. Part of Section 1 of the Guide describes coating system durability in terms of coating life to first major maintenance.

The highest durability ratings are:

- Very long: 15 - 25 years
- Extra long: 25+ years

When considering the durability requirements for your project in terms of ecological sustainability, the longer the better. The longer the durability, the less frequent the maintenance required, resulting in lower emissions, lower raw material and energy consumption and lower costs for the facility manager. It is virtually a waste of time to consider any of the lower durability ratings, unless the structure is of a temporary nature.

### STEELWORK – WHAT WILL IT BE EXPOSED TO?

Section 2, Classification of Environments describes the corrosivity categories of various environments, ranging from Category A, “Very Low” generally found in “heated or air conditioned buildings with clean atmospheres” to Category E “Very High”, generally found offshore and on the beachfront in regions of rough seas and surf beaches. The region can extend inland for several hundred metres. (In some areas of Newcastle, for example, it extends more than half a kilometre from the coast.)

### STEELWORK – CAN DESIGN DETAILS IMPROVE CORROSION RESISTANCE?

Sometimes, steelwork will rust only in certain small, isolated sections rather than uniformly throughout the section, indicating that corrosion may be due to design faults. AS2312:2002, Section 3, Planning and Design for Corrosion Protection gives extremely handy design tips for your structural steelwork to prevent water ponding and other corrosion-inducing oversights.



Yarra's Edge steelwork is protected against corrosion with both galvanic protection using a zinc rich primer and barrier protection using a high performance epoxy.

© photo courtesy Peter Minter.



Hobart Cricket Ground is very close to the sea, earning it a Category E rating

Problem	Typical application	Solution
(a) Backs of double angles cannot be easily painted and maintained Crevice Bad (narrow crevice, difficult to protect)	Double angle truss; bearing member	Design as single angle truss, or use T-section Continuous welds Closed crevice Better Best (single solid component)

AS2312:2002, Section 3 includes steel design challenges and handy solutions to minimise corrosion

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## STEELWORK – WHAT COATING SYSTEM OFFERS THE BEST CORROSION RESISTANCE?

AS2312:2002 Section 6, Paint Coating Systems For Corrosion Protection, contains a number of tables, namely, Table 6.3, which is the business end of the Guide, Painting Systems For Steel. It describes complete coating systems (primers, intermediates and topcoats) with estimated durability in years for each corrosivity category.

To save you the effort of searching for coating systems which offer very long corrosion protection in Category D (High) corrosivity environments, Table 1 is a summary of AS2312:2002 Table 6.3, along with the equivalent Dulux Protective Coating Products and reference to a Duspec Specification.

## WHAT IF I'M COMPELLED TO SPECIFY LOW VOC SYSTEMS?

A balance must be reached between VOC content (short-term ecological cost) and substrate protection and durability (long-term ecological benefits). Note that many high performance solvent-borne coatings have lower VOC levels than traditional alkyd enamels, and offer vastly superior protection.

In situations where a project must follow strict guidelines that severely restrict VOC levels, Table 2 below offers the best water-borne technology currently available for the protection of structural steel.

What you may notice in the three coat systems between the two tables is that, generally, long term durable coating systems have a total minimum dry film thickness of around 325 microns, whereas the water-borne systems are significantly lower in film build. The higher the film-build, the better the barrier protection and the longer the durability.

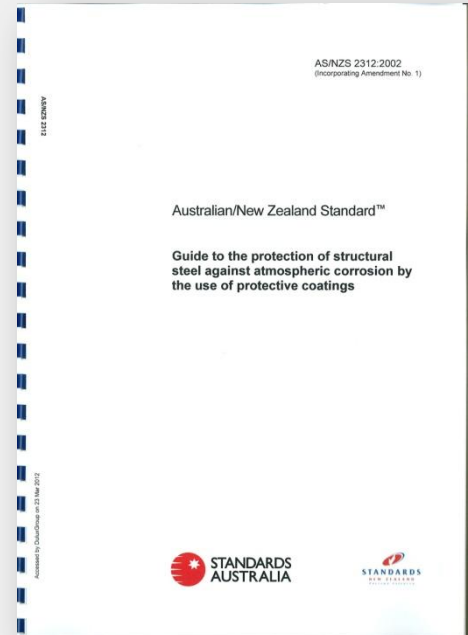
Furthermore, two pack epoxies provide extremely effective barrier protection, preventing all common atmospheric chemicals from attacking and corroding the substrate.

## CONCRETE

Protection of concrete against spalling requires the application of an anti-carbonation and chloride-ion resistant coating system to clean, new concrete.

Dulux AcraTex® manufactures a range of high-build elastomeric coatings that have independent certification verifying their suitability as anti-carbonation and chloride-ion resistant coating from Taywood Engineering in WA. The most popular and versatile of these is 955 AcraShield®. According to the certification, the application of 140 microns of 955 AcraShield® is equivalent to adding an extra 930 mm of concrete cover. So not only does the 955 AcraShield® prevent water ingress, maintain the naturally high alkalinity of the concrete, prevent chloride ion ingress and hence protect the reinforcing steel from corrosion, but also provides a self-cleaning, aesthetically pleasing low gloss or natural matt finish.

Please refer to Table 3 for specification.



*The Australian Standard AS/NZS 2312:2002, "Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings" helps select the most appropriate coating systems for steelwork in a given environment*



*Galvanised steel and as waterborne coating system were erroneously chosen strictly on VOC criteria, without regard for long term durability, nor other more serious environmental impacts*

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2.3.3

**ESD – Coating Specifications**

**TABLE 1 - Extract of AS2312 Table 6.3 With Equivalent Dulux Protective Coatings Products**  
<10 years in Category E-M (Marine) Environments

System	Surface Preparation	1 <sup>st</sup> Coat		2 <sup>nd</sup> Coat		3 <sup>rd</sup> Coat		Total Nom DFT µm	Duspec No.
		Type	Nom DFT µm	Type	Nom DFT µm	Type	Nom DFT µm		
<b>ACRYLIC - Two-pack, solvent borne</b>									
ACC6	Sa 2½	Zinc Rich Primer [Dulux Zincode® 402]	75	High Build Epoxy [Dulux Duremax® GPE]	200	Acrylic 2-Pack [Dulux Acrathane® IF]	50	325	SI3126
	Sa 2½	Inorganic Zinc Silicate, Water-Borne [Dulux Aquagalv <sup>5</sup> ]	75	High Build Epoxy [Dulux Duremax® GPE]	200	Acrylic 2-Pack [Dulux Acrathane® IF]	50	325	
<b>EPOXY - High Build (DFT: 125 to 500µm per coat)</b>									
EHB6	Sa 2½	Zinc Rich Primer [Dulux Zincode® 402]	75	Epoxy MIO [Ferrek® No. 3]	125	Epoxy MIO [Ferrek® No. 3]	125	325	SI1395
	Sa 2½	Inorganic Zinc Silicate, Water-Borne [Dulux Aquagalv <sup>5</sup> ]	75	Epoxy MIO [Ferrek® No. 3]	125	Epoxy MIO [Ferrek® No. 3]	125	325	
<b>POLYURETHANE - Two-pack, solvent borne</b>									
PUR5	Sa 2½	Zinc Rich Primer [Dulux Zincode® 402]	75	High Build Epoxy [Dulux Duremax® GPE]	200	Polyurethane Gloss [Dulux Weathermax® HBR]	50	325	SI3120
	Sa 2½	Inorganic Zinc Silicate, Water-Borne [Dulux Aquagalv <sup>5</sup> ]	75	High Build Epoxy [Dulux Duremax® GPE]	200	Polyurethane Gloss [Dulux Weathermax® HBR]	50	325	

\* Please check that the corrosion protection is adequate in Category E-1 (Industrial) or E-M (Marine) environments when specifying.

 = Water-borne, low VOC alternative to conventional solvent borne equivalent

 = Solvent-borne, high solids, lower VOC alternative to conventional solvent-borne equivalent

# ESD - COATING SPECIFICATIONS

**2.3.3**

**ESD – Coating Specifications**

**TABLE 2 - Dulux Protective Coatings Water-Borne Coating Systems**

System	Surface Preparation	1 <sup>st</sup> Coat		2 <sup>nd</sup> Coat		3 <sup>rd</sup> Coat		Total Nom DFT $\mu\text{m}$	Duspec No.
		Type	Nom DFT $\mu\text{m}$	Type	Nom DFT $\mu\text{m}$	Type	Nom DFT $\mu\text{m}$		
<b>INORGANIC ZINC SILICATE – Water-Borne</b>									
IZS2	Sa 2½	Inorganic Zinc Silicate, Water Borne [Dulux Aquagalv <sup>2</sup> ]	75						S13129
IZS3*	Sa 2½	Inorganic Zinc Silicate, Water Borne [Dulux Aquagalv <sup>2</sup> ]	125						
<b>IOZ PRIMER AND ACRYLIC TOPCOAT – Water-borne</b>									
N/A	Sa 2½	Inorganic Zinc Silicate, Water Borne [Dulux Aquagalv <sup>2</sup> ]	75	Acrylic [Dulux Enviroproxy <sup>®</sup> WBE]	40	Acrylic [Dulux Aquaname <sup>®</sup> Gloss]	40	155	S13130
N/A	Sa 2½	Inorganic Zinc Silicate, Water Borne [Dulux Aquagalv <sup>2</sup> ]	75	Acrylic MIO [Ferrexo <sup>®</sup> No. 5]	40	Acrylic MIO [Ferrexo <sup>®</sup> No. 5]	40	155	S13150

**TABLE 3 - Dulux AcraTex Concrete Protection Coating Systems**

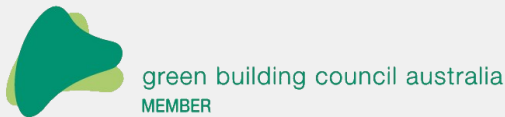
System	Surface Preparation	1 <sup>st</sup> Coat		2 <sup>nd</sup> Coat		3 <sup>rd</sup> Coat		Total Nom DFT $\mu\text{m}$	Duspec No.
		Type	Nom DFT $\mu\text{m}$	Type	Nom DFT $\mu\text{m}$	Type	Nom DFT $\mu\text{m}$		
<b>ACRYLIC PRIMER AND ANTI-CARBONATION TOPCOAT – Water-borne system</b>									
Acrylic	Refer to Duspec SA1836	Acrylic adhesion-promoting primer [AcraTex <sup>®</sup> 50111 AcraPrime <sup>®</sup> ]	20	Anti-Carbonation coating [AcraTex <sup>®</sup> 955 AcraShield <sup>®</sup> ]	75	Anti-Carbonation coating [AcraTex <sup>®</sup> 955 AcraShield <sup>®</sup> ]	75	150	SA1836

# ESD – COATING SPECIFICATIONS

## GREEN SPECIFICATIONS

When it comes to specifying coating systems for projects being designed within Green Star guidelines or you simply wish to minimise impact on the environment, call your Dulux Consultant. Many of our Consultants actively and regularly attend environmental conferences, seminars and training sessions, and can help you to specify the most environmentally responsible coating systems for your project.

**Dulux is a member of the Green Building Council of Australia.**



For more information, please contact the Dulux Protective Coatings Technical Consultant in your state.

<sup>i</sup> SoE 2001 Report (Australian Government)

<sup>ii</sup> A holistic approach to solving corrosion problems, CSIRO, [www.csiro.au/science/ps1ha.html](http://www.csiro.au/science/ps1ha.html)

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<sup>ii</sup> ABS

[www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Mar%202007?OpenDocument](http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Mar%202007?OpenDocument)

<sup>ii</sup> Corrosion and Materials, Vol 31 No 4, August 2006

<sup>ii</sup> Number 2, Market Street Sydney – A Green Steel Building.

[www.steel.org.au/\\_uploads/84ASI\\_2marketStreet.pdf](http://www.steel.org.au/_uploads/84ASI_2marketStreet.pdf)

<sup>ii</sup> Australian/New Zealand Standard™ AS/NZS 2312:2002, Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings.

<sup>ii</sup> Srikanth Venkatesan, "Evaluation of distress mechanisms in bridges exposed to aggressive environments"

[http://www.2006conference.crci.info/docs/CDProceedings/Proceedings/P101\\_Venkat esan\\_R.pdf](http://www.2006conference.crci.info/docs/CDProceedings/Proceedings/P101_Venkat esan_R.pdf)

<sup>ii</sup> The Steel Reinforcement Institute of Australia, Durability of Reinforced Steel

<http://www.sria.com.au/expertise/dur.html>

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<sup>iii</sup> ABS

[www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Mar%202007?OpenDocument](http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Mar%202007?OpenDocument)

<sup>iv</sup> Corrosion and Materials, Vol 31 No 4, August 2006

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<sup>vi</sup> Australian/New Zealand Standard™ AS/NZS 2312:2002, Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings.

<sup>vii</sup> Srikanth Venkatesan, "Evaluation of distress mechanisms in bridges exposed to aggressive environments"

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<sup>viii</sup> The Steel Reinforcement Institute of Australia, Durability of Reinforced Steel

<http://www.sria.com.au/expertise/dur.html>