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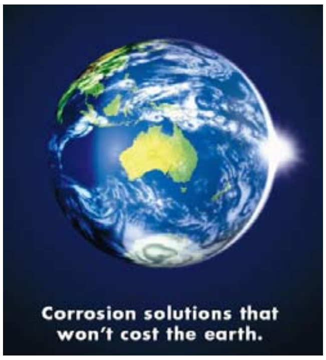
Do It Once And Do It Right



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.[i] 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**.

Do We Need Protective Coatings At All?

Some ESD rating tools actually reward specifiers with extra credits for reducing or eliminating coatings on their project. **In terms of sustainability, this is perverse!** Consider what would happen to a building's timberwork, steelwork and concrete if no protective coatings were used? The building would last a couple of decades, not a couple of centuries, before commissioning extensive repairs or a bulldozer.

It is not widely known or understood that **many common building materials** are subject to **preventable atmospheric degradation**, and not protecting them will severely reduce their service life. Two of the most commonly used commercial building materials are discussed below.

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[ii] ($239 billion)[iii].

Most of our large cities are located along the Australian **coastline**[iv], and the coastal atmosphere has **high** levels of airborne **salts** and **moisture**, which accelerate the **oxidation** of exposed metal surfaces, such as **steel**, **hot dip galvanised steel**, **zinc**, **copper** and even **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.[v]

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.[vi]

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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.[vii]

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."[viii]

According to the Steel Reinforcement Institute of Australia, "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." [ix]. In fact, these specially formulated "**anti-carbonation" coatings** can 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". Independent authorities exist that can perform tests on protective coatings to determine whether they are bona fide anti-carbonation coatings.

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.

Now the challenge is to protect steelwork against corrosion from oxygen, salts (ions) and moisture.

There are two ways for you to approach the task of writing steel specifications; contact your local protective coatings consultant and get them to do it, or "DIY". Given that you are reading this and not on the phone, we can assume that you want to do it yourself at this stage.

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Steelwork – How Long To We Want It To 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 **two most durable 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**. **Section 3**, **Planning and Design for Corrosion Protection** gives extremely handy design tips for your structural steelwork to prevent water ponding and other corrosion-friendly oversights.

Steelwork – What Coating System Offers The Best Corrosion Resistance?

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 dry film thickness of around **325 microns**, whereas the water-borne systems are significantly lower in film build. The reason is thus: **high solids**, solvent-borne coatings lend themselves to **high build application** without sagging or dripping.

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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	1st Coat		2nd Coat		3rd Coat		Total Nom DFT µm	Duspec No.
		Type	Nom DFT µm	Type	Nom DFT µm	Type	Nom DFT µm		
ACRYLIC - Two-pack, solvent borne									
ACC6	Sa 2½	Zinc Rich Primer [Dulux Zincanode® 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®]	75	High Build Epoxy [Dulux Duremax® GPE]	200	Acrylic 2-Pack [Dulux Acrathane® IF]	50	325	
EPOXY - High Build (DFT: 125 to 500µm per coat)									
EHB6	Sa 2½	Zinc Rich Primer [Dulux Zincanode® 402]	75	Epoxy MIO [Ferreko® No. 3]	125	Epoxy MIO [Ferreko® No. 3]	125	325	SI1395
	Sa 2½	Inorganic Zinc Silicate, Water Borne [Dulux Aquagalv®]	75	Epoxy MIO [Ferreko® No. 3]	125	Epoxy MIO [Ferreko® No. 3]	125	325	
POLYURETHANE - Two-pack, solvent borne									
PUR5	Sa 2½	Zinc Rich Primer [Dulux Zincanode® 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®]	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-I (Industrial) or E-M (Marine) environments when specifying.

[light blue box] = Water-borne, low VOC alternative to conventional solvent borne equivalent

[yellow box] = Solvent-borne, high solids, lower VOC alternative to conventional solvent-borne equivalent

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TABLE 2 - Dulux Protective Coatings Water-Borne Coating Systems

System	Surface Preparation	1st Coat		2nd Coat		3rd Coat		Total Nom DFT µm	Duspec No.
		Type	Nom DFT µm	Type	Nom DFT µm	Type	Nom DFT µm		
INORGANIC ZINC SILICATE – Water-Borne									
IZS2	Sa 2½	Inorganic Zinc Silicate, Water Borne [Dulux Aquagalv®]	75						SI3129
IZS3*	Sa 2½	Inorganic Zinc Silicate, Water Borne [Dulux Aquagalv®]	125						
IOZ PRIMER AND ACRYLIC TOPCOAT – Water-borne									
N/A	Sa 2½	Inorganic Zinc Silicate, Water Borne [Dulux Aquagalv®]	75	Acrylic [Dulux Enviropoxy® WBE]	40	Acrylic [Dulux Aquanamel® Gloss]	40	155	SI3130
N/A	Sa 2½	Inorganic Zinc Silicate, Water Borne [Dulux Aquagalv®]	75	Acrylic MIO [Ferreko® No. 5]	40	Acrylic MIO [Ferreko® No. 5]	40	155	SI3150

TABLE 3 - Dulux AcraTex Concrete Protection Coating Systems

System	Surface Preparation	1st Coat		2nd Coat		3rd Coat		Total Nom DFT µm	Duspec No.
		Type	Nom DFT µm	Type	Nom DFT µm	Type	Nom DFT µm		
ACRYLIC PRIMER AND ANTI-CARBONATION TOPCOAT – Water-borne system									
Acrylic	Refer to Duspec SA1836	Acrylic adhesion-promoting primer [AcraTex® 501/1 AcraPrime®]	20	Anti-Carbonation coating [AcraTex® 955 AcraShield®]	75	Anti-Carbonation coating [AcraTex® 955 AcraShield®]	75	150	SA1836

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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.

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.

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

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

green building council australia MEMBER

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[i] SoE 2001 Report (Australian Government)
[ii] A holistic approach to solving corrosion problems, CSIRO, **www.csiro.au/science/ps1ha.html**
[iii] ABS **www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Mar%202007?OpenDocument**
[iv] Corrosion and Materials, Vol 31 No 4, August 2006
[v] Number 2, Market Street Sydney - A Green Steel Building. www.steel.org.au/_uploads/84ASI_2marketStreet.pdf
[vi] Australian/New Zealand Standard™ AS/NZS 2312:2002, Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings.
[vii] Srikanth Venkatesan, "Evaluation of distress mechanisms in bridges exposed to aggressive environments" **http://www.2006conference.crcci.info/docs/CDProceedings/Proceedings/P101_Venkatesan_R.pdf**
[viii] The Steel Reinforcement Institute of Australia, Durability of Reinforced Steel http://www.sria.com.au/expertise/dur.html
[ix] The Steel Reinforcement Institute of Australia, Durability of Reinforced Steel **http://www.sria.com.au/expertise/dur.html**