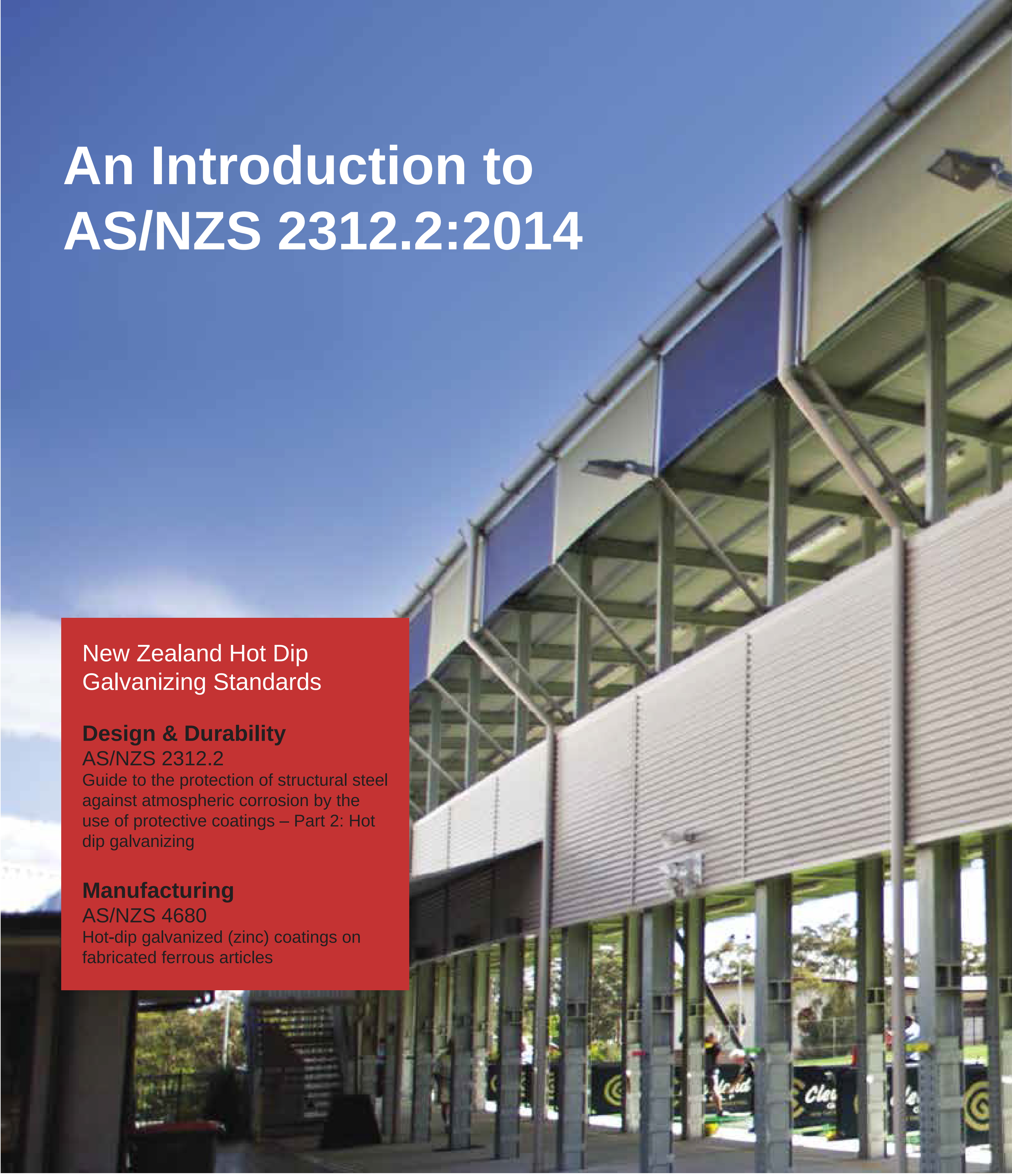

An Introduction to AS/NZS 2312.2:2014

New Zealand Hot Dip Galvanizing Standards

Design & Durability

AS/NZS 2312.2

Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings – Part 2: Hot dip galvanizing

Manufacturing

AS/NZS 4680

Hot-dip galvanized (zinc) coatings on fabricated ferrous articles

www.galvanizing.org.nz

GALVANIZING ASSOCIATION

Background

AS/NZS 2312, Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings, originated in 1967 as a guide for steel designers who needed advice on methods for the corrosion protection of structural steel. The last revision (2002) incorporated much information on the common methods of corrosion protection, including paint, hot dip galvanizing, thermal spray, powder coating and wrapping systems. Unfortunately the complexity of designing and specifying protective paint systems meant that much of the useful information on hot dip galvanizing was lost in the detail of the other systems.

During the review process, it was recognised that steel designers would benefit by separating it into product specific sections to avoid confusion. The revised Standard was released in December 2014; with Part 1 covering paint systems and Part 2 covering hot dip galvanizing (HDG). Both new parts use the same definitions from Table 14 of NZS 3404.1:2009, but now clearly recognise that the design process and durability of the two products are very different.

Designers wishing to specify HDG need only use two Standards; one covering the design and durability of HDG steel (AS/NZS 2312.2), and the other dealing with the manufacturing process and tolerances (AS/NZS 4680).

Improved durability selection

AS/NZS 2312.2 references the latest international corrosivity (ISO 9223/ ISO 9224) and design Standards for HDG (ISO 14713). This means that the design durability ("life to first maintenance") of HDG is now aligned with long term performance results from New Zealand and world recognised Standards. As a result, the estimated life for HDG coatings on structural steel has increased as shown in Table 1.

Table 1: Life to first maintenance of hot dip galvanized steel complying to AS/NZS 4680

Steel thickness mm	AS/NZ 4680 Coating mass & thickness		Designation	2014 versus 2002	AS/NZ 2312.2 Corrosivity category & Life to first maintenance (years)				
	g/m²	µm			C2	C3	C4	C5	CX*
>1.5 to ≤3.0	390	55	HDG390	2014	78->100	26-78	13-26	6-13	2-6
				2002	*25+*	*15-25*	*5-15*	*2-5*	--
>3.0 to ≤6.0	500	70	HDG500	2014	>100	33-100	16-33	8-16	2-8
				2002	*25+*	*25+*	*10-25*	*5-10*	--
>6.0	600	85	HDG600	2014	>100	40->100	20-40	10-20	3-10
				2002	*25+*	*25+*	*15-25*	*5-15*	--
>>6.0	900	125†	HDG900	2014	>100	60->100	30-60	15-30	5-15
				2002	*25+*	*25+*	*25+*	*10-25*	--

NOTES:
* "CX" is a new corrosivity category, not previously referenced in local or international Standards.
† Hot dip galvanized coatings thicker than 85µm are not specified in AS/NZS 4680, however in conjunction with the galvanizer, a specification can be written for thicker coatings.

Figure 1: With a specified minimum HDG coating thickness of 85µm, AS/NZS 2312.2 can be used to estimate this bridge rail will be protected from rust for over 50 years in a C3 (medium) environment.

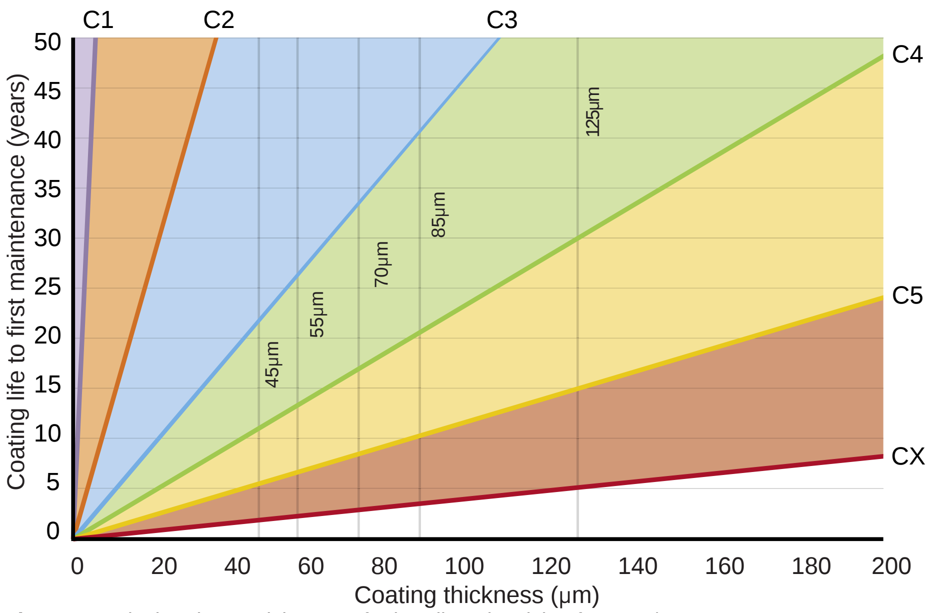

Figure 2: Calculated corrosivity rates for hot dip galvanizing from AS/NZS 2312.2 can be restated in a graphical format for quick estimates. For example, a coating thickness of 85µm can be estimated to last a minimum of 20 years to a maximum of 40 years in a C4 environment.

A single table is provided for designers to compare the expected durability of different galvanized products, including in-line galvanized steel, allowing for a faster product selection process.

The durability of a HDG coating is now calculated from the minimum average coating thickness in AS/NZS 4680, which also means non-standard HDG thicknesses can be easily assessed for estimated life to first maintenance. This can be done by using Figure 2, where the macro-environment corrosivity zone can be determined from Table 2.

Table 2: Corrosivity in New Zealand as described in NZS 3404.1

NZS 3404.1 Corrosion map zone & AS/NZS 2312.2 Corrosion category		Typically	Location
Seaspray	C5[1]	Within 200 metres from breaking surt on the West Coast of the South Island. Within 100 metres from breaking surf on West Coast of the North Island. Within 50 metres from breaking surf of all other coasts.	All coasts
		200 metres up to 500 metres or more inland from breaking surf. In the immediate vicinity of calm salt water such as harbour foreshores	West Coast of the South Island
	C4[1]	50 metres up to 500 metres or more inland from breaking surf. In the immediate vicinity of calm water such as harbour foreshores.	All coasts except West Coast of the South Island
Zone 1	C3	500 metres to 1km from breaking surf. In the mmediate vicinity of calm salt water such as estuaries.	West Coast of the South Island
			East Coast of both Islands, South Coast of North Island & all harbours
		More than 1km to 20km from salt water.	West and South Coast of South Island
		More than 1km to 5km from salt water.	East Coast of both Islands, West Coast of North Island, South Coast of North Island & all harbours.
Zone 2	C2	More than 20km to 50km from salt water.	West & South Coast of South Island.
		More than 5km to 50km from salt water.	East Coast of both Islands, West & South Coast of North Island, and all harbours.
Zone 3	C2	Inland, more than 50km from salt water.	North & South Islands.
Zone 4	C5	Close to the geothermal source < 150m	Taupo Volcanic Zone
	C2	Not closer than 150m to geothermal source.	

NOTES:
1. C4 and C5 atmostpheric corrosivity classifications may be extended inland by prevailing winds and local conditions.
2. Full details of macro climate and micro-climate atmospheric corrosivity classifications are shown in clause 5 of NZS 3404.1

New design advice

AS/NZS 2312.2 includes information on how the chemistry of some steels may cause excessively thick coatings. In addition, when initial aesthetic appearance is important, the advice can be used to provide information on the typical coating characteristics, as described in Table 3.

Table 3: The effect of silicon and phosphorus on hot dip galvanized coating characteristics

Cat.	Si and P relationship		Initial ppearance	Resistance to mechanical damage	Mass of coating
A	Hot rolled	Si ≤ 0.04% Si+ 2.5P ≤ 0.09%	Typically shiny	Excellent	Standard; generally superior to the normal requirement
	Cold rolled	Si + 2.5P ≤ 0.04%			
B	0.14% < Si ≤ 0.25%		Good, can tend to be mottled or dull with increasing steel thickness	Good	Always heavier than normal; best specification for corrosive environments
C	0.04% < Si ≤ 0.14%		Can be dark and course	Reduced	Excessively thick coatings may occur
D	Si > 0.25%				Increases with %Si

Painting over hot dip galvanizing (duplex coating)

An all new and detailed section on the design of duplex coatings (paint over HDG) is included, with two performance options for durability (aesthetic and corrosion). A duplex system will increase the service life of the HDG article beyond that of the unpainted article. Further, the total life of a properly specified, applied and maintained duplex coating system is significantly greater than the sum of the lives of the HDG coating and the paint coating alone (by 1.5 – 2.3 times, depending on the environment).

AS/NZS 2312.2 includes seven decorative and industrial paint systems suitable for most corrosivity environments.

Figure 3: The Moment by Damian Vick, showing the four key stages of fabrication, galvanizing, painting and the final structure in place. This aesthetic sculpture is an example of a complex shape with sharp edges and is therefore suited to a duplex coating.

Engineering and fabrication design details

Appendices to the Standard also cover corrosion in different environments, including bimetallic corrosion and the interaction of HDG steel with soil, concrete, water, chemicals, and wood.
For engineers and fabricators, the design details are extensive and pictorial advice on good design practice provides clear instruction, such as the examples shown in Figure 4. The effect the fabricated article's condition has on the HDG process, for example the size of the article, laser cutting and other thermal processes, and required tolerances, are clearly described.

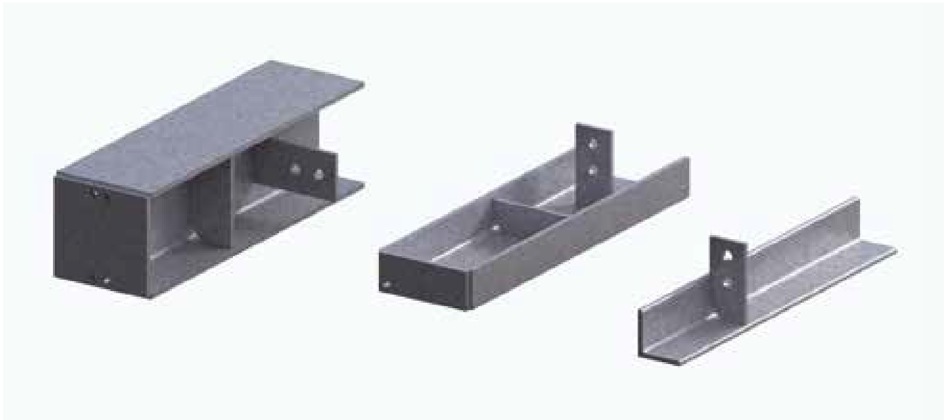

Figure 4: : Illustrations in Appendix A of AS/NZS 2312.2 allow the designer to improve zinc flow in the process, which will improve the aesthetics of the finished product, reduce the cost & eliminate danger to the galvanizing plant operators.

Summary

The new AS/NZS 2312.2 allows designers to more accurately estimate the durability of HDG coatings. In addition, the Standard provides detailed design advice for duplex coatings. It details how the steel chemistry can affect the HDG coating and also illustrates good design practice. It will serve as an essential aid for engineers, architects, specifiers and consultants for many years to come.

AS/NZS 2312.2 can be purchased from SAI Global (http://infostore.saiglobal.com/store/) or Standards New Zealand (www.standards.co.nz).

More information and free training on the use of AS/NZS 2312.2 and hot dip galvanizing in general is available from the Galvanizing Association of New Zealand (www.galvanizing.org.nz).