

How to Specify a Corrosion Protection Coating System

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Introduction

This article provides a summary of the steps to specify a coatings system for a desired time to first maintenance. An example is given including maintenance recommendations.

Specifying a Coating System

This comprises the following steps:

1. Determine the design service life of the structure
2. Determine the atmospheric corrosion category for the surface under consideration.
3. Determine the required years to first maintenance for that surface.
4. Determine an appropriate coatings system for that surface that meets these performance requirements.

General Comments on Coating Selection

The Guide to the Protection of Structural Steel Against Atmospheric Corrosion by the Use of Protective Coatings, AS/NZS 2312, (SAA/SNZ, 2004), provides the authoritative basis for coatings selection in New Zealand. The New Zealand Corrosion Coatings Guide (Clifton and El Sarraf, 2005) provides useful guidance on how to apply AS/NZS 2312 including the determination of atmospheric corrosivity at a site.

Where possible select a single coat system for minimum cost, however colour options for many single coat systems are limited. If a single coat system is not available, consider a 2-coat system in preference to a 3-coat system. If the coating will need to be repaired or replaced during the service life of the building, make sure this is feasible, see section 12 of the NZCCG. Be realistic in the number of painting systems considered for any structure, for example by treating all external steelwork as one exposure atmospheric corrosivity category, all visible internal steelwork as another exposure atmospheric corrosivity category and all hidden steelwork as a third exposure atmospheric corrosivity category.

Determination of Time to First Maintenance

The design service life for buildings may be determined from Clause B2 of the New Zealand Building Code (NZBC, 1992), being typically 50 years. It may be a longer period as directed by the owner, or a shorter period as agreed between the owner and the Territorial Authority. If the design is for a steel bridge then a 100 year design life is specified in Transit's Bridge Manual (Transit, 2003).

The design life of the structure specified by the New Zealand Building Code is not usually the same as the durability rating of the coating system which is the years to first maintenance. This point is made in clause 1.6 of AS/NZS 2312:2002 and in clause C2.3 of NZS3404:1997 (SNZ, 2007). The protection offered by the coatings systems is usually shorter than the design service life of the structure, which means due consideration must be given to maintenance or renewal requirements at the planning and design stage. It is only when components of the structure are not accessible for maintenance after assembly that the corrosion protection system must have a durability rating equal or better than the design service life of the structure.

For typical commercial and retail buildings, the most economic solution is around 15 years, to a maximum of 20 years. These times also suit the typical refurbishment periods for buildings. For most industrial, warehouse and storage applications appearance is secondary, in-service damage is likely and a time of 5 -10 years is more suitable. For public road bridges, Transit New Zealand require a time to first maintenance of 35 years (Transit, 2003). How to achieve this is covered in Section 8 of the NZCCG. Private bridge owners will generally prefer around 15 years or may leave the bridge unpainted that is dependant on the owner. The coating

warranty/guarantee periods cannot exceed the durability ratings given in Sections 5 and 6 of AS/NZS 2312. Finally, Section 12 of the NZCCG provides maintenance guidance for coating systems.

Example of Coatings Selection

Steel sections support a roof canopy is to be built in downtown Manukau City. This steelwork will be sheltered from rain but open to the wind and in a sunny location. A time to first maintenance of around 15 to 20 years is desired by the building owner. High gloss appearance, resistance to weathering and graffiti resistance is required. The site is located 5km from the sea, which is to the south west of the site.

Step 1: Determine the design life

This is nominal 50 years to NZBC.

Step 2: Determine the atmospheric corrosion category

Macroclimate corrosion rate

2.1 In accordance with section 4.2.1(1) using Appendix A3 of NZCCG. This gives 28 $\mu\text{m}/\text{year}$.

Microclimate adjustments

2.2 Shaded locations- Using section 4.3.1 NZCCG, not applicable as is in a sunny location

2.3 Unwashed area – Using section 4.3.2 NZCCG, site is 5km upwind from Manukau Harbour, hence regime (3) applies. The value of $C_{uw} = 1.2$

2.4 Wet locations - section 4.3.3 NZCCG is not applicable as will detail to suppress this

2.5 Steel in contact with timber – section 4.3.4 NZCCG, not applicable

2.6 Steel to concrete – section 4.3.5 of NZCCG would need to consider in practice but beyond the scope of this example

2.7 First year steel corrosion rate. This is 30 $\mu\text{m}/\text{year}$ for washed and 35 $\mu\text{m}/\text{year}$ for unwashed surfaces (these are rounded to the nearest 5 $\mu\text{m}/\text{year}$).

2.8 Atmospheric Corrosion Category – from Table B1 of AS/NZS 2312, this is in C 40% of the way towards D (the B/C boundary is 25 $\mu\text{m}/\text{year}$ and the C/D boundary 50 $\mu\text{m}/\text{year}$).

Step 3: Determine the required years to first maintenance

This is the owner specified range of 15 to 20 years.

Step 4: Select suitable coatings systems

See tables 8.22 and 8.2.3 of NZCCG which are based on Tables 6.1, 6.3 and Appendix D of AS/NZS 2312. These show that there is no single coat system that delivers the combination of durability and appearance within a suitable cost. Hence consider a 2 coat system. From these the best solution is a PSL1 system, which, from section 7.3.8 of NZCCG will give a time to first maintenance comparable to the more expensive 3 coat PUR4 system. For an atmospheric corrosion category of C40%D, from Table 6.3 of AS/NZS 2312, this is 19 years.

Maintenance of the Coating

For the above example, noting from section 7.3.8 of NZCCG that the polysiloxane system application and compatibility is the same as the polyurethane systems, Table 12.4 of NZCCG shows that PSL1 is compatible as a maintenance topcoat.

Achievement of a 50 year design life:

Initial coat at time of application (0 year) including touch up (allow 3% area for costing)

Replacement of coating at 19 years and 38 years including touch-up

Inspection of coating at 75% of the coating time to first maintenance and repair as required; these operations will be at 14 years, 33 years and 52 years (allow 5% area for costing)

This maintenance regime may be extended as required.

References

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