

**TABLE 1. AVERAGE TIME TO FIRST MAINTENANCE AND CPI FOR BRIDGES IN NORWAY**

Environment	Sample Size	Average Time (years)	CPI (years)
C2 – Rural	17	>44	95
C3 – Urban	23	>38	56
C4 – Industrial	18	>34	37
C5 – Marine	4	27.3	27

most severe marine environment (C5) have all been repaired and so the average time to first maintenance is fixed at 27.3 years. However, the sample size for this classification is very small, two of the four bridges had premature repairs, and so the results are considered conservative.

The CPI results were surprisingly positive. For example, in a C2 environment it appears possible for a TSZ duplex coating to approach the 100-year design life with no maintenance. Similarly, bridges in the C3 environment may only need coating maintenance repair one time to reach the 100-year life. Bridges in the C4 category will meet the expected maintenance plan. More data will make the CPI more robust, especially for the C5 environment.

### Coating Quality

Thermal spraying and painting are well known processes, but both the zinc and the paint must be properly applied to achieve a long-lasting TSZ duplex coating. There are a few key quality criteria that must be fulfilled to achieve good coating quality.

For thermal spraying, skilled applicators and metallizers are needed to avoid a defect known as “spitting.” Spitting is the incomplete melting of the zinc wire, which results in peaks in the zinc coating that will penetrate the paint coating and become sites for corrosion initiation. If spitting is observed, the TSZ coating can be easily repaired with simple sanding before painting.

TSZ coatings are sealed before the application of the topcoat. The sealer coat must be applied very thin to avoid pinholes in the paint film. Ideally, the sealer should not build thickness and a maximum of 25 µm is therefore specified. If the sealer is

applied too thickly, bubbles may form. When the paint layers are applied, the bubbles break, leaving pinholes through to the base zinc layer. If bubbles are observed in the sealer coat, again, the solution is to sand the sealer coating to remove the bubbles. There is no need to remove, or reapply, the sealer coat.

The most common quality issue is the paint film thickness does not meet specification. Standard thickness gauges will only measure the total film thickness including the zinc coating. High zinc film thickness may then mask low paint thickness. Measuring the coating thickness of the zinc and the paint as they are applied is recommended to ensure adequate paint thickness that meets specifications. However, modern epoxy coatings require a certain wet film thickness before a uniform film is formed, so this will be less of an issue as the painter is now able to see when sufficient paint is applied.

### Conclusions

- TSZ duplex coatings have been used successfully for decades to mitigate corrosion in atmospheric exposures on steel bridges in Norway.
- The synergy between the two coatings provides protection beyond the expected life of each layer individually.
- The TSZ duplex coatings on average easily meet the NRPA required 35-year life before first paint maintenance in C2, C3, and C4 environments.
- The CPI shows that TSZ duplex coatings may realize their full design life in C2 environments with no maintenance.

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