Corrosion protection of steel bridges

Svend Johnsen
ISO 12944

Coating system selector

Life cycle calculations

Experience
## Corrosion categories

### Table 1.

<table>
<thead>
<tr>
<th>Corrosion category</th>
<th>Exterior</th>
<th>Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3 - medium</td>
<td>Urban and industrial atmospheres, moderate sulphur dioxide pollution. Coastal areas with low salinity.</td>
<td>Production rooms with high humidity and some air pollution e.g. food processing plants, laundries, breweries and diaries.</td>
</tr>
<tr>
<td>C4 – High</td>
<td>Industrial areas and coastal areas with moderate salinity.</td>
<td>Chemical plants, swimming pools, coastal ship and boatyards.</td>
</tr>
<tr>
<td>C5-I – Very high industrial</td>
<td>Industrial areas with high humidity and aggressive atmosphere.</td>
<td>Buildings and areas with almost permanent condensation and with high pollution.</td>
</tr>
<tr>
<td>C5-M – Very high marine</td>
<td>Coastal and offshore areas with high salinity.</td>
<td>Buildings and areas with almost permanent condensation and with high pollution.</td>
</tr>
<tr>
<td>Surface prep.</td>
<td>Primers</td>
<td>Topcoats</td>
</tr>
<tr>
<td>--------------</td>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>St2 Sa2 1/2</td>
<td>Binder</td>
<td>Type</td>
</tr>
<tr>
<td>x</td>
<td>CR</td>
<td>Misc.</td>
</tr>
<tr>
<td>x</td>
<td>EP,PUR</td>
<td>2</td>
</tr>
<tr>
<td>x</td>
<td>EP,PUR</td>
<td>1</td>
</tr>
<tr>
<td>x</td>
<td>EP,PUR</td>
<td>1-2</td>
</tr>
<tr>
<td>x</td>
<td>EP,PUR</td>
<td>1</td>
</tr>
<tr>
<td>x</td>
<td>EP,PUR</td>
<td>1</td>
</tr>
<tr>
<td>x</td>
<td>EP,PUR</td>
<td>1</td>
</tr>
<tr>
<td>x</td>
<td>ESI</td>
<td>Zn(R)</td>
</tr>
<tr>
<td>x</td>
<td>ESI</td>
<td>1</td>
</tr>
<tr>
<td>x</td>
<td>ESI</td>
<td>1</td>
</tr>
<tr>
<td>x</td>
<td>ESI</td>
<td>1</td>
</tr>
</tbody>
</table>
The bridge coating selector is a simple flash file, that will display coating systems that are in accordance with the ISO 12944 guidelines.

All systems are designed for an expected lifetime of more than 15 years before major maintenance is required.
The life cycle calculator calculates the cost of corrosion protection per sqm per year for various paint systems.

It also calculates the lifecycle cost for the paint system all of course under a number of assumptions.
The Humen Pearl River Bridge is a suspension bridge over the pearl river in Dongguan, Guangdon, China. Completed in 1997. Main span is 888 meters. The bridge is 3,618 meters long with 5 sections. Geological conditions relatively good with bedrock overlaid with thin soil layers. Hurricanes are common so the design wind speed was established at 61 m/s.

Paint specification (exterior of the box girders):

- Zinc silicate shopprimer: 15 micron
- Zinc silicate primer: 75 micron
- Sealer: 25 micron
- Epoxy MIO midcoat: 80 micron
- Polyurethane topcoat: 80 micron
Under construction

10 years later

10 years condition interior

10 years condition exterior
Jiangyin Bridge

Jiangyin suspension bridge is the most seaward bridge to cross the Yangtze River of China. The main span of the bridge is 1,385 meters making it the fifth largest bridge in the world at the time of construction. The concrete towers are 190 meters. The main span is made from flat streamlined steel box girders. It was constructed by raising preassembled units weighing up to 500 tons with jacks.

Paint specification (exterior of the box girders):

- Zinc silicate shopprimer 15 micron
- Zinc silicate primer 80 micron
- Sealer 25 micron
- Epoxy MIO midcoat 80 micron
- Polyurethane topcoat 80 micron
Runyang Bridge consist of two bridges, a South Bridge and a North Bridge over the Yangtze river through a small island (Siyezhou) in the centre of the river downstream of Nanjing. The South bridge is a suspension bridge with a main span of 1,490 meters and the Northbridge is a cable stayed bridge with a main span of 406 meters. Both the bridges are steel box girder constructions with 6 lanes highway.

Paint specification (exterior of the box girders):

- Zinc silicate shopprimer: 15 micron
- Zinc silicate primer: 75 micron
- Sealer: 25 micron
- Epoxy MIO midcoat: 100 micron
- Polyurethane topcoat: 80 micron
View from cable

Section in yard

Quality control

Quality control
Sutong Bridge

Sutong Bridge is the longest cable stayed span in the world. It lies between Nantong City and Changshu in the eastern part of Jiangsu province in China. The total length of the crossing is 8206 meters and the central span is 1,088 meters and a height of 62 meters allowing 4\textsuperscript{th} and 5\textsuperscript{th} generation containerships to pass through in all weather. The area has 30 days of heavy fog, more than 120 days of heavy rain, typhoon and frequent tornados with high wind speeds.

Paint specification (exterior of the box girders):

- Zinc silicate primer: 75 micron
- Sealer: 25 micron
- Epoxy MIO midcoat: 140 micron
- Polyurethane topcoat: 80 micron
During construction

Assembly of sections

Quality control of coatings

Quality control of coatings
Conclusion

- Corrosion protection of steel bridges can be extended by selecting the paint system based on corrosion category, expected lifetime and an intelligent choice of paint system.

- Practical experience over a number of years show that the expected lifetime of 25 – 30 years are obtainable.
Some new construction references in Hungary
Pentele-bridge

Presently this is the longest bridge (1682 meter) in Hungary over the river Danube between Dunaújváros and Dunavecse. This is part of the new highway called M8. It was built between 2005-2007.

Paint specification (Standard):

- Reacor 2K EP 50 ZN 80 micron
- Reacor 2K EP 57 EG 80 micron
- Megatop 2K PUR DB687.71 80 micron
Ready to use
Megyeri-bridge

This is one of the newest bridge in Hungary. Part of the M0 ring-road of Budapest. This is the North Danube bridge of the highway. Exactly this project contains 5 bridges with the totally 1862 meter length. Of course part of the project the first cross cable bridge section in Hungary.

Paint specification (standard):

- Reacor 2K EP 50 ZN 80 micron
- Reacor 2K EP 57 EG 80 micron
- Megatop 2K PUR DB687.71 80 micron
During construction
North Connective Railway-bridge

This bridge is under construction now. The project contains 3 bridges where 2 refurbishments and over the river Danube a new construction steel bridge. This is the biggest steel Railway bridge in Hungary with more than 600 meter length.

Paint specification (Standard):
- HEMPADUR ZINC 87260 80 micron
- HEMPATHANE TOPCOAT 87480 80 micron
- HEMPATHANE TOPCOAT 87481 80 micron
Under construction
Pedestrian Flyover at Szemerételep

This flyover was constructed in 2007. It helps to reach Ferihegy 1 airport by train. It gives safety pedestrian transport over the airport main road.

Paint specification (Standard):

- HEMPADUR ZINC 17360
  - 90 micron
- HEMPADUR 15570
  - 90 micron
- HEMPATHANE TOPCOAT 55210
  - 60 micron
Thank you for your attention!