Case Study 11 Thames Barrier

Low Pollution Exposure
High Coastal Salt Exposure

London is quite vulnerable to flooding and that threat has increased over time due to the continuous rise in the high water level over the centuries and the slow "tilting" of Britain. There are twice daily 6.4-meter (21-foot) tides and during severe storms there can be surge tides. The Thames River Barrier became operational in 1982, and it is expected to protect the city through 2030. It is east of London at Woolwich Reach. **(Figure A)**

At the barrier, the Thames River is a brackish, heavily traveled, river. The water's salinity level increases during high tides and storms. The river traffic and the water turbulence caused by tides increase the level of salt in the air. Occasional salt spray or splashing is likely during storms.

Figure A The Thames Barrier's gleaming Type 316 stainless steel shortly after it opened in 1982. (Photo courtesy of the Nickel Institute)

Figure B The still gleaming Type 316 stainless steel in 2005 after 23 years of service.

Since the location was corrosive, stainless steel selection assistance was obtained from the Nickel Institute, British Stainless Steel Association, and the stainless steel producer Ugine. Type 316 (UNS S31600, EN 1.4401, SUS 316) stainless steel with a very smooth 2B finish was suggested and ultimately specified. Type 316 stainless steel with a smooth, micro-crevice free surface finish is generally the most cost-effective choice for boldly exposed, long-term applications near the coast. It contains 2% molybdenum, which helps to prevent pitting and crevice corrosion caused by salt deposits.

Exposure to saltwater spray or splashing, even if it is only occasional, is much more corrosive than simply being near the coast. Even with a very smooth finish, Type 316 stainless steel can corrode under these conditions if other factors, such as pollution or weather, make the environment more corrosive. This location has low pollution levels and the very smooth finish increases the effectiveness of rain-washing. The dramatic curves of the Thames Barrier have remained attractive for over 23 years as the result of careful stainless steel selection and design decisions. **(Figure B)**

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Stainless Steel Selection Criteria

The IMOA publication, *Which Stainless Steel Should Be Specified for Exterior Applications?*, provides stainless steel selection assistance. The site and design scores below are based on the guidelines in that brochure. Copies can be downloaded from www.imoa.info or ordered by emailing info@imoa.info.

Section 1: Environment — Score = 0

This location is considered suburban with low urban air pollution levels. The annual mean sulfur dioxide level is 5 µg/m^3, which is very low. The annual mean particulate level PM10 is 24 µg/m^3, which includes airborne salt particles.

Section 2: Coastal Salt Exposure — Score = 5

Although the barrier is somewhat inland, the Thames River is brackish. The river's salt level varies during the day and approaches the salinity of seawater during storms. Water turbulence from the twice-daily 6.4-meter (21-foot) tides and boat traffic increase the air's salinity levels. The stainless steel is elevated enough so that it is not immersed or regularly splashed with brackish water. The salt deposits visible on the concrete below the panels (Figure B) indicate that the lower sections of the stainless steel are exposed to at least occasional spray or splashing. (+5)

Section 3: Local Weather Pattern — Score = 0

This location has a temperate climate. Average daily temperatures range from 3ºC (39ºF) to 16ºC (62ºF). The average annual precipitation is 611 mm (24 inches). The average humidity level is 80%. The temperature and humidity levels are high enough to activate salt deposits on a regular basis. There are an average of 207 days with at least some fog. There is typically one thunderstorm a month but the frequency increases to as many as two storms during the summer months. The relatively low rainfall levels and fog make this location more aggressive than many temperate climates. It was classified as a temperate climate with occasional heavy rain. (0)

Section 4: Design Considerations — Score = -2

The stainless steel is boldly exposed and the design takes advantage of natural rain cleaning. The 2B finish is very smooth with a surface roughness of less than R_a 0.3 µm (12 µin). This smooth finish minimizes corrosive deposit accumulation and makes rain cleaning more effective. The design and finish lower the score. (-2)

Section 5: Maintenance Schedule — Score = 0

Although the stainless steel manufacturer recommended cleaning the stainless steel at least annually, we were unable to document that there has been any maintenance cleaning in this attractive but industrial application.

Stainless Steel Selection — Score = 3

Type 316 stainless steel is a cost effective choice for many coastal applications, particularly when the designer specifies a smooth, crevice free finish and a design that maximizes rain cleaning. Although the high coastal salt exposure and lower rainfall levels made this application aggressive, the low urban pollution levels, very smooth finish, and design reduced the score. A score of 3 means that Type 316 stainless steel is usually the most cost effective choice. The designer's decisions are reaffirmed by the attractive appearance of the stainless steel after 23 years of service. If pollution or the salt exposure levels were to increase over time, maintenance cleaning might become necessary.

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