Case Study 08 São Paulo Building Exterior

High Urban and Industrial Pollution
No Salt Exposure

Bank Boston's new South American headquarters in São Paulo, Brazil was completed in 2002. The 30-story building was designed by the international architecture firm Skidmore Owings & Merrill, LLP in conjunction with the Brazilian architecture firm Escritório Técnico Júlio Neves. **(Figures A and B)** It was designed using "green" building concepts, making material service life an important consideration.

Three different stainless steel finishes were used on the exterior. Black electrochemically colored stainless accentuates building details. A coined cambric finish was used for spandrel panels and a No. 4 polished finish was used for the entrance canopy, column covers, and other details.

Figure B All three stainless steel finishes can be seen around the building's park-like entrance. (Photo Courtesy of Núcleo Inox)

Figure A Careful stainless steel selection, design and maintenance ensure that the exterior will remain beautiful over time. (Photo Courtesy of Núcleo Inox)

Although Brazil has made a tremendous effort to reduce pollution emissions, a corrosion map published in 2001 still identifies São Paulo's environment as extremely severe.[1]

Coastal salt is not a factor because the building is about 80 km (50 miles) inland. Construction material corrosion in São Paulo is caused by air pollution (sulfur and nitrous oxides, ozone, particulate) and acid rain (sulfuric acid, nitric acid, ammonia, etc.). High typical ambient temperatures and humidity accelerate corrosion.

In order to obtain excellent performance in this corrosive environment, the architects sought the advice of experts. They obtained stainless steel selection assistance from two industry associations, the Nickel Institute and Núcleo Inox, and the Brazilian stainless steel producer Acesita.

Stainless steel is more resistant to corrosive pollution than other common architectural materials and only sulfur compounds, particulate and rain acidity (pH) are important factors. It was assumed that the stainless steel would be washed regularly and that smooth finishes would be specified.

Type 316 stainless steel (UNS S31600, EN 1.4401, SUS 316) was selected because it contains 2% molybdenum, which helps to prevent pitting and crevice corrosion caused by corrosive pollution.

INTERNATIONAL MOLYBDENUM ASSOCIATION

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 = 4

The building is only a few miles from an industrial area, Santo Amaro, and other industrial areas are upwind of the site. The average annual sulfur dioxide and total suspended particulate (TSP) levels are 20 µg/m^3 and 83 µg/m^3, respectively, and maximum TSP levels for a 24-hour period can exceed 300 µg/m^3. The sulfur dioxide level is moderate but the particulate level is high. The primary particulate sources are industrial and motor vehicle emissions. Acid rain also contributes to the environment's corrosiveness. The location was given a high industrial pollution rating based on these data and a study that identified São Paulo as an extremely severe corrosion environment.[1] This is the most severe rating that can be assigned to an environment.

Section 2: Coastal Salt Exposure — Score = 0

The building is approximately 80 km (50 miles) from the ocean. Surfaces were tested and there is no coastal salt exposure.

Section 3: Local Weather Pattern — Score = 1

The corrosiveness of tropical environments varies with the rain pattern and humidity levels. São Paulo has average low and high temperatures of 16°C (61°F) and 28°C (82°F). Its 1303 mm (51 inches) of annual rainfall makes it a dry tropical region. The high temperatures and high average monthly relative humidity levels of between 74 and 80% make this environment corrosive. The storms with heavy enough rain to clean surfaces are mainly between November and February. The occasional light rain that falls in the drier months does not remove corrosive deposits. The rain also leaves acidic deposits on surfaces. Both light rain and high humidity dampen and activate corrosive deposits on surfaces. This weather pattern makes São Paulo more corrosive than a typical tropical environment and increases the score by 1 point.

Section 4: Design Considerations — Score = -1

Three different stainless steel surface finishes were used, and it is assumed that all of them are smooth with a surface roughness of less than R_a 0.5 µm (20 µin), which decreases the score (-1). Corrosive substances have to remain on a surface for corrosion to occur, and there are fewer deposits on smooth surfaces. Rough finishes and horizontal surfaces retain rainwater longer providing more time for the rain to evaporate. This increases surface concentrations of acid and prolonged surface wetness extends the time period in which corrosion can occur.

Section 5: Maintenance Schedule — Score = -2

If surface deposits are allowed to accumulate, they can cause corrosion and can make a building look dirty. The stainless steel panels and windows on Bank Boston are cleaned every 3 to 4 months. This regular cleaning prevents surface deposit accumulation and helps to keep the building beautiful.

Stainless Steel Selection — Total: Score = 2

Type 316 stainless steel can be used in areas with high levels of urban or moderate-to-high levels of industrial pollution as long as smooth surface finishes are specified and there is regular washing. The high levels of corrosive air borne particulate in this environment make occasional cleaning necessary to maintain a pristine appearance. The score indicates that the stainless steel could probably be washed less frequently (once or twice a year) and still remain corrosion free, but there would be more unattractive particulate accumulation between cleanings and the building could look dirty. The owner's decision to wash more frequently ensures a sparkling appearance, but it also protects against the possibility that the atmosphere might become more corrosive before pollution regulations improve air quality or that the environment is more corrosive than what the data indicated. If the owner had not planned to clean the building regularly, a more corrosion resistant stainless steel would have been needed.

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1 "Atmospheric Corrosion of Copper in Ibero-America" by M. Morcillo, E. Almeida, M. Marrocos, and B. Rosales, Corrosion, Vol. 57, No. 11, pages 967-980, November 2001

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