Hot Dip Galvanized Case Study No. 26
Cape Peninsula – Corrosion rates

The Application

The application of hot dip galvanized steel used for corrosion control is wholly dependent on the environment in which it is required to operate.

This case study examines the environments across the Cape Peninsula and the application of hot dip galvanizing and duplex systems to provide a predictable maintenance free service life.

Environmental Conditions

Environmental conditions across the Cape Peninsula vary dramatically from the False Bat coast to that experience in Cape Town and the Table Bay area.

In terms of the corrosive categories given by ISO 9223 specification, Muizenberg would be a CX environment described as follows. Zinc corrosion rates are greater than 8µm per year.

Subtropical to tropical, extended time of wetness, very high industrial pollution (SO2 >250pg/m^3) or significant and extended chloride effect/deposits, e.g. highly industrialised and polluted areas, jetties and offshore structures, within a few hundred metres of the ocean with extended periods of on-shore prevailing winds and certain exposed areas along the coastline and within the splash zone of salt water.

The Cape Town city area and fore shore would have a corrosion rate far less and be categorised as a C3 with a zinc corrosion rate of between 1 and 2µm per year.

Temperate zone with medium (SO2 5 to ≤ 30pg/m^3) or some effect of chlorides, e.g. urban areas, between one to thirty kilometres (depending on prevailing winds, buildings, vegetation and topography) from the ocean, or within one hundred metres of sheltered coastal areas with low chloride deposits

The Site

Sketch map of the Cape Peninsula showing the prevailing winds during the course of the year

The South Easterly winds (no rain) carry moist salts from over False Bay and deposit these onto steel structures along the Muizenberg coast line and are extremely corrosive. Gordons Bay is somewhat protected due to the high topographical features behind the town area.

The North Westerly and Westerly winds (rain) carry salts from the Atlantic, deposit these onto steel structures, but also has the washing effects from the rain. It is also significant that the topographical features (Table Mountain) also provide protection from the South Easterly winds.

Findings

Muizenberg Coast

A railway sign post photograph taken in 2007

Corrosive attack on the area face on to the South Easterly is extremely severe

A 2015 close up photograph of the same post showing the advanced state of corrosion to the point where the steel has been perforated

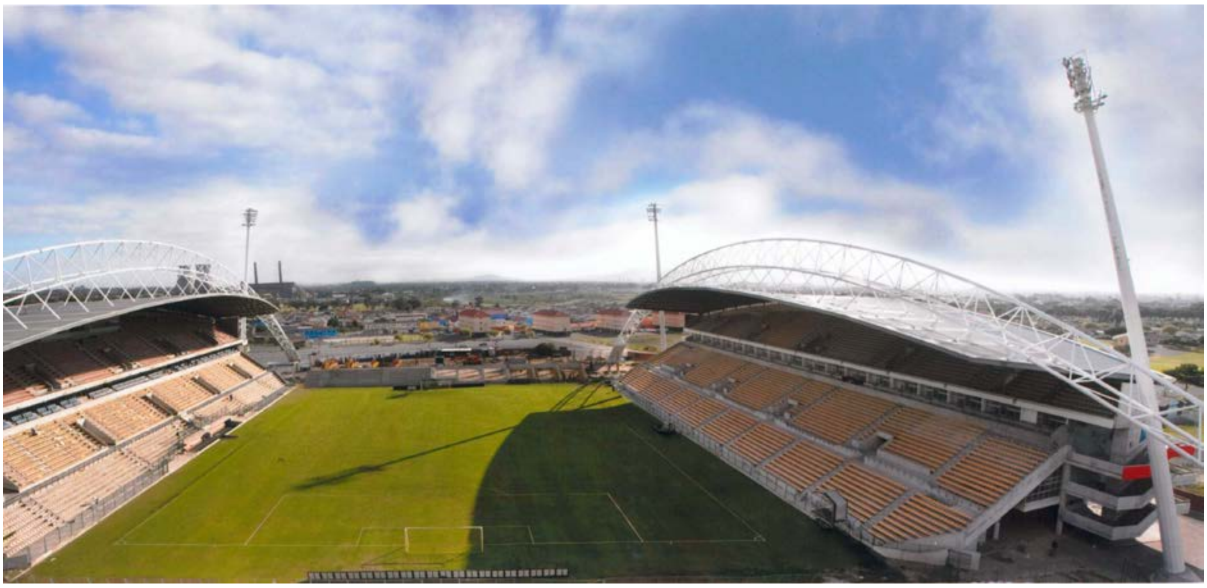
It is of interest that the sides of the sign post and particularly the on the lee side remains effective and provides corrosion control against the general atmospheric conditions. The area face on to the South Easterly is severely corroded due to moist salts (chlorides) that are retained within the shaded area away from the drying effects of the sun.

Cape Town Water Front

The corrosion within the City area and the Water Front area do not suffer the same degree of corrosive attack. Hot dip galvanized steel provides adequate corrosion control and provides for a maintenance free service life. A typical galvanized steel component with say 65µm (as is the case in the photograph) corroding at say 2 microns (µm) per year will have a service life of approximately 34 years before rusting of the carbon steel substrate.

Cape Flats

The Athlone soccer stadium is situated mid-way between Muizenberg and Cape Town. The effects of the South Easter are less severe than on the railway post as the sea salts tend to fall off across the Cape Flats. However, the corrosion rate is still server, estimated as a C4 or C5 in terms of ISO 9223. For both such conditions it is advisable to specify a duplex (hot dip galvanized plus paint) coating system.



Athlone soccer stadium situated mid-way between the False Bay coast and Table Bay

Using a duplex system at the Athlone stadium and within the known atmospheric conditions the estimated service life was calculated as

Duplex service life = 1.5 x (life of the zinc + life of the paint system)

Using this formula, the estimated life of the corrosion control system used was calculated as follows;

Assuming a C4 category

Service life = 1.5 x (20 + 10) = 45years to the 1ST 5% red rust.

Assuming a C5 category

Service life = 1.5 x (10 + 8) = 27years to the 1ST 5% red rust.

Refer to the Association's web site www.hdgasa.org.za under technical and information sheet No. 8 "Corrosion of Zinc – Corrosivity of Atmospheres"

Conclusion

Designing for corrosion control of carbon steel structures, it is important to not only important to select an appropriate corrosion control system, but also to investigate and understand the environment in which such components are required to perform in terms of service life requirements.

The Cape Peninsula is an excellent example to illustrate how atmospheric conditions and are dependent on a number of different factors.

Site conditions in terms of prevailing winds, time of wetness, topographical features, relative humidity, rainfall and even vegetation the life of an installation.