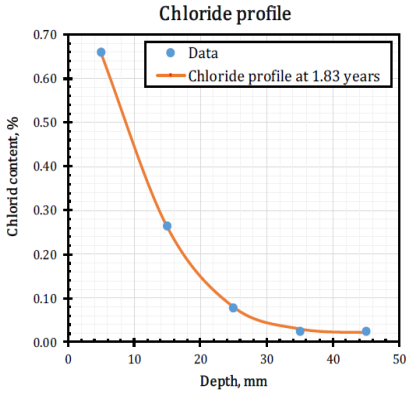
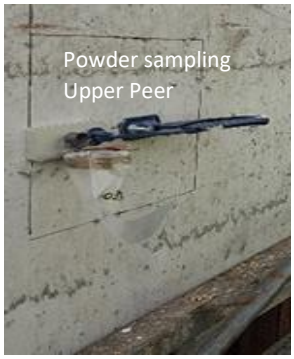
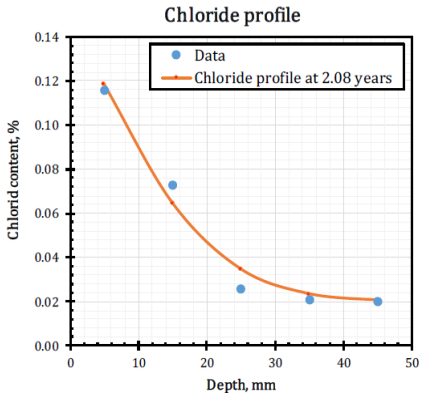
# NDTitans in action

## Case 1.2 Service life estimations in the Nuuk Container Terminal Greenland


In 2013 the construction began of the new 47,000 square meter container terminal in Nuuk, Greenland, and was opened to operation in 2017. Some months later, under suspicions of low strength concrete in some elements of the peers, investigations of chloride penetration in the cover layer were carried out using the **Germann Instruments' RCT** (Rapid Chloride Test).

In a few elements, concrete powder samples were extracted by drilling at five different depths towards the reinforcement at 50 mm depth: 0-10, 10-20, 20-30, 30-40, and 40-50 mm. The chloride content by weight of concrete at each depth was determined with the RCT method, and this chloride profile was used to estimate the service life of the steel reinforcement, understood as the estimated time at which a chloride threshold reaches the depth of the reinforcement and accelerated corrosion might initiate.

The solution for Fick's second law of diffusion was applied to the chloride profiles to obtain the apparent diffusion coefficient by regression analysis. According to the concrete mix design, the chloride threshold value was calculated by means of the HETEK Model proposed by Frederiksen J.M., Mejlbro, L. & Poulsen, and under some simplifying assumptions, the approximate remaining service life was obtained.

It turns out that the average of the estimated service life for the concrete not exposed to splashing of sea water was higher than 100 years, **but the average service life for the concrete in the splash zone was 23 years.**

**Reviews applying other models with different assumptions also gave service lives ranging from 20 to 24 years in the splash zones.**

The conclusion seems to be that, despite the low concrete water-cement ratio of 0.37, the concrete mix was improper for the exposure conditions. Simulations of predicted service life for the same concrete mix showed that additions of about 10% to 12% of silica fume or fly ash would have resulted in a service life above 50 years.

A solution for protecting the exposed concrete could be the application of high-performance coatings or silane based hydrophobic impregnations in order to limit the ingress of more chlorides and ensure a longer service life of the structure.

Report made by **NDTitan Hugo Orozco**