SERVICE LIFE PREDICTION UNDER CHLORIDE-INDUCED CORROSION BASED ON RAPID CHLORIDE PENETRATION TEST

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Concrete is a highly heterogeneous composite material that is widely used in the construction industry. At present with the development of new constituent materials, the durability of concrete is the key factor in the service life predictions of structures. The durability of concrete can be defined as its ability to resist against any sort of deterioration which depends on the interaction with the service environment. This project mainly focuses on chloride-induced corrosion and its effects on durability.

Rapid Chloride Penetration Test (RCPT) is a rapid indication of resistance for the penetration of chloride ions which depends on the pore structure and pore solution characteristics. This project examines the effect of fly ash content and curing period on RCPT. Results have shown that there is a significant effect of those two factors on RCPT. In addition, relevant compressive strength gain over a period of 28 days is also discussed. Once the RCPT was completed, the chloride profile was obtained by collecting concrete powder samples at different depths. Obtained chloride profiles were fitted into a nonlinear regression analysis, and chloride penetration depths were calculated. Thereafter, the chloride diffusion coefficient was determined from Fick's second law using chloride profile and chloride penetration depth. It was observed that the RCPT results can be directly used to determine the chloride diffusion coefficient based on the expected chloride concentration as those two parameters show a linear relationship.

Finally, a performance-based design approach was proposed to correlate RCPT values with Fib Model code 2010, in order to predict the service life of corrosion affected - uncracked concrete.

Keywords: Concrete Durability; Chloride Penetration; Rapid Chloride Penetration Test; Service Life Prediction

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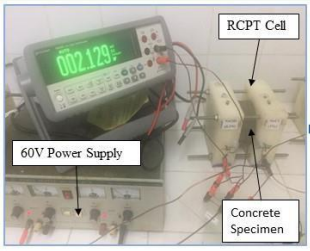
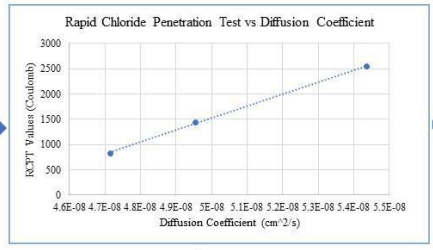
RCPT → Chloride Profile → Chloride Penetration Depth → Diffusion Coefficient → Service Life Prediction

$C = C_s \cdot \exp(-ax^2)$,

$d = (-\ln(0.01/C_s)/a)^{0.5}$.

$M_n = \frac{1}{\beta}\left(\frac{x - \alpha\sqrt{x}}{t}\right)$





Fib Model Code for Service Life Design (2006)

Full probabilistic design method for chloride-induced corrosion – uncracked concrete (Fib Model Code)

$$C_{crit} = C_0 + \left(C_{s,\Delta x} - C_0\right)\left(1 - erf\,\frac{a - \Delta x}{2\sqrt{D_{app}\,t}}\right)$$

Fly Ash Percentage	D_{app} $(mm^2/years)$	Service Life (years)
0	171.43	**20.1**
18	156.24	**22.0**
30	148.68	**23.2**

Fly Ash improves the durability of reinforced concrete

Conclusion:

RCPT results can be directly used to determine the chloride diffusion coefficient based on the expected chloride concentration. As a result, the chloride diffusion coefficient can be used in the Fib Model Code for SLD in order to predict the service life of the concrete.