Yoshida prize winning thesis in 2008

Evaluation of Scaling Progress in Harbor Concrete Structure in Hokkaido During Approximately 10 to 40 years

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Physical and chemical surveys of concrete were conducted on the upper crests of approximately 10 to 40 year old harbor breakwaters on coastal areas in Hokkaido to analyze the progress of scaling. These surveys indicated that concrete with a compressive strength of 35MPa or more has high resistance to scaling. By integrating the results of the multiple regression analysis of surveyed data and affectors multiplied by weighting factors, we propose a scaling progression index (γ). Breakwaters with a log γ of approximately 0 or more show large scaling, confirming its effectiveness as a deterioration prediction method. This paper also discussed important points regarding the assessment of internal damage of concrete structure.

The relationship between the physical properties of concrete and the degree of scaling by regression analysis

$$\gamma = \left(\frac{W/C_i}{58.9}\right)^{5.77} \times \left(\frac{W/C_s}{65.2}\right)^{1.32} \times \left(\frac{F}{27.6}\right)^{-2.66} \times \left(\frac{A}{3.2}\right)^{-0.43} \times \left(\frac{L}{0.5}\right)^{0.73} \times \left(\frac{T}{4.3}\right)^{0.51} \times \left(\frac{t}{28}\right)^{1.28}$$

Where, γ : The scaling progression index

W/C_i : The water-cement ratio (mix proportion estimation) at a depth of 0.35 to 0.40 m (%)

W/C_s : The water-cement ratio (mix proportion estimation) at a depth of 0 to 0.05 m (%)

F : The compressive strength (MPa)

A : The air content of hardened concrete(%)

L : The spacing factor(mm)

T : The local index

$$T = -t_{amin}\left(1 - \left[\frac{D_f}{D_w}\right]\right)$$

Where, t_{amin} : The lowest temperature(°C)

D_f : The number of days of freezing

D_w : The sum of the number of days of freeze-thaw and the number of days of freezing

t : The elapsed number of years

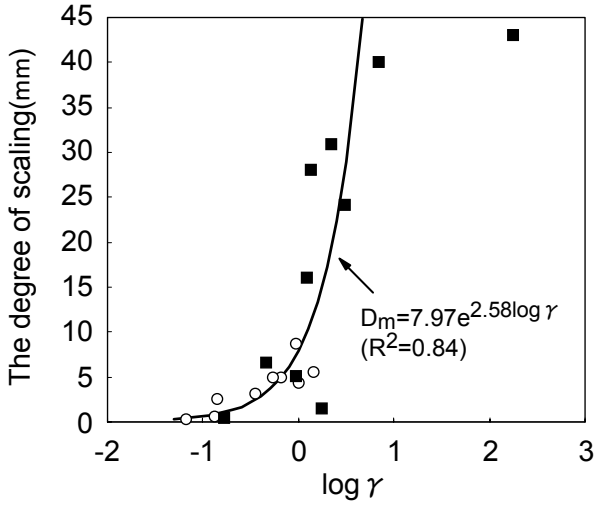

Figure - The relationship between log γ and the degree of scaling (D_m)