

Effects of Finishing Materials against Carbonation and Corrosion Condition of Model Building Exposed to Outdoor Conditions for 30 Years

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1 Introduction

In this study, a model building made out of concrete block specimens whose surfaces were coated with various finishing materials was constructed for the outdoor exposure test. After 30 years of outdoor exposure, the deterioration of finishes and their carbonation and corrosion inhibition effects were investigated.

2 Experiment Overview

Figure 1 shows a photo of the model building. It was constructed on a premise of the Building Research Institute (BRI) in Tsukuba City, Ibaraki Prefecture. The model building was constructed with concrete specimens piled up in a boxy shape, whose outer surfaces were coated with 7 types of finishing materials (Table 1). It had a box-shaped metal roof inclined to the north side. Inside of the building was sheltered from rain, and its room air temperature and humidity were not controlled.

The deterioration of finishing materials was evaluated by peeling, cracking, dirt, and chalking. It was graded by multiple experts, using a 6-degree scale from 0 (no deterioration) to 5 (severe deterioration). Also, carbonation depth and corrosion depth were measured. Note that, corrosion depth was measured by the corrosion indicator method (Senbu *et al.*, 1987).



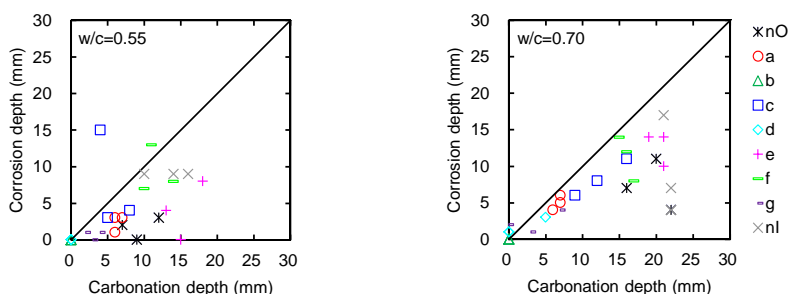
Figure 1. A photo of the model building.

Table 1. Finishing materials.

Mark	Finishing material	Species and dosage (kg/m ²)			Luster
		Sealer	Main material	Top coating	
a	Thin coating material E	0.08	1.1 Spray	-	N
b	Multi-layer coating material E	Water-based 0.08	2.35	Acrylic 0.22	Y
c	Acrylic resin enamel	-	-	0.29	Y
d	Waterproof thin coating material E	Water-based 0.08	1.43	-	Y
e	Silane-type surface penetrants	0.20	-	-	-
f	Waterproof thin coating material E (Air permeability type)	-	1.52	-	Y
g	Thick coating material E	Water-based 0.08	3.65 Spray	-	N

3 Results and Conclusion

- Though the deterioration levels differed depending on their types and thickness, all finishing materials showed some kind of deterioration after 30 years' long-term outdoor exposure.
- The progress of carbonation is prevented when the surface is coated with finishing materials of sufficient thickness or waterproof effect. However, the carbonation inhibition effect cannot be obtained when using air-permeable finishing materials or there is a peeling finish on the surface.
- The progress of corrosion is prevented when the surface is coated with finishing materials of sufficient thickness or waterproof effect.
- Regarding the relationship between corrosion depth and carbonation depth, corrosion is initiated after the carbonation front reaches. It usually takes a while to initiate corrosion in the carbonated area, not immediately after the carbonation reaction (Figure 2).
- When the concrete surface is properly coated with finishing material, corrosion may not be initiated in non-carbonated area in concrete where the pH level is not lowered.

**Figure 2.** Relationship between corrosion depth and carbonation depth.

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