Maintenance Control of Concrete Structures with Consideration of Water Migration

Hiroshi UEDA
Senior Chief Researcher,Laboratory Head, Concrete Materials, Materials Technology Division

1. Introduction

Among many causes of degradation to concrete structures such as corrosion of rebars by carbonation or salt attack, freezing damage, alkali-silica reaction and so on, the presence of "water" has a significant influence on each of them. Accordingly, to conduct satisfactory maintenance control of a concrete structure, knowing the behavior of water in the concrete is extremely important. For example, rebar corrosion due to carbonation is frequently observed where water is splashed (Fig.1). In such a case, when water penetrates into concrete and reaches a rebar, it accelerates the rebar corrosion. Thus preventing water penetration to rebars is essential and knowledge of the depth of water penetration is required.

2. Measuring the Depth of Water Penetration

As a result of conducting various experiments by preparing test pieces of concrete each embedded with a water sensor, the variation of water penetration time into concrete (Fig.2) was successfully determined. Experiments were also conducted by varying concrete parameters. From the measured results, it was determined that water penetration resistance varied with changes in mix proportion, although for each mix proportion a high-quality curing process significantly increased the water penetration resistance. Further, for fly ash-mixed concrete specimens, a sufficient degree of curing was found to provide more resistance to water permeation than that of concrete using ordinary Portland cement only.

3. Improving the Durability in the Interface of Concrete and Repair Members

In a study to improve the durability of repaired concrete structures, the state of water penetration in the interface between the concrete and the cross-sectional repair member was examined. The results indicated the following: the water penetration resistance of the concrete mass near the interface significantly differs with the substrate treatment method before applying the repair member; the use of a primer enhanced the water penetration resistance; and when the concrete surface was chiseled off by using an electric pick gun, the water migration resistance decreased presumably due to fine cracking in the concrete mass. Thus the repairing performance is critically affected by differences in the substrate treatment method (Fig.3).

Judging from the above-mentioned results, we are confident that we can develop maintenance control technology taking the effect of "water" into consideration. We can predict degradation behavior depending on the condition of subject structures and take necessary measures based on reality.

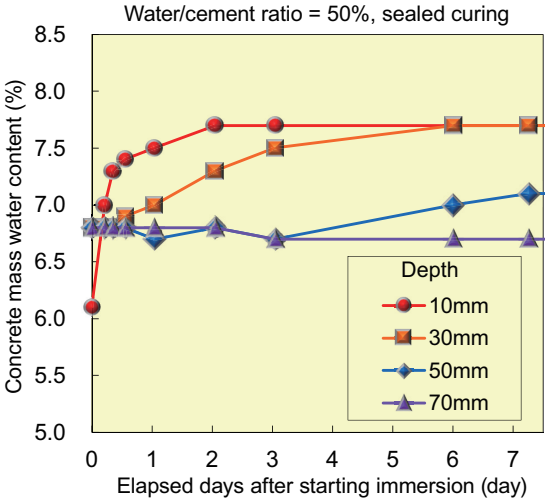

Fig.2 Example results of water permeation test

Fig.1 Exposed rebars where water splashes

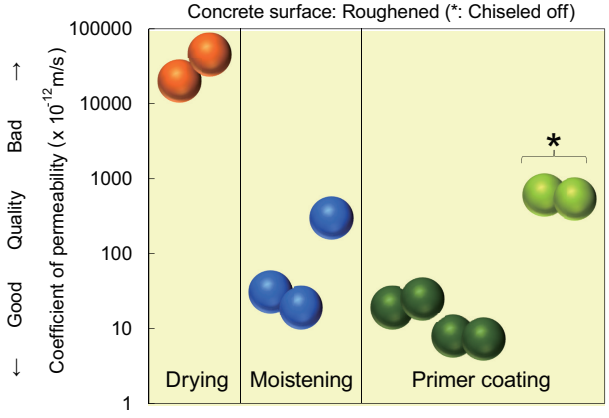

Fig.3 Effect of substrate treatment before repair material application on the suppression of water migration