

## **6. Experimental and Numerical Analysis of Low-velocity Pipe Cooling -Application to Vertical Pipe Cooling-**

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As a means of controlling thermal cracking in concrete, pipe cooling ensures the increase of cracking index and is highly effective for controlling thermal cracking. The authors conducted a full-scale laboratory test on low-velocity pipe cooling for application to vertical pipe cooling that had been frequently adopted in recent years, and identified the relationship between the flow velocity and heat transfer for setting heat exchange effectiveness. An additional function was built into the analysis code FEAST for considering changes in water temperature in the longitudinal direction of the pipe. The function enables accurate expression of test results. The accuracy of analysis was verified by comparing the data collected when vertical pipe cooling was applied in the field with the results of analysis obtained by using the developed method. As result, an analysis method was obtained that is applicable to low-velocity pipe cooling, enables the consideration of longitudinal changes in temperature of cooling water and the modeling of heat transfer coefficient, and thereby implements effective cooling plans.

**Key words:** vertical pipe cooling, thermal stress analysis, heat transfer coefficient, mass concrete, cracking