

3. Development of Flow Control System for Pipe Cooling for Mass Concrete

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Pipe cooling is an effective method for preventing cracks in mass concrete. However, current pipe cooling methods do not always result in the flow control required to suppress cracks. In addition, in cases in which the overall length of the cooling pipe is significant, the heat generated by the hydration of cement heats the cooling water, impairing cooling effects on the downstream side. Based on advance calculations, our system automatically controls flow rates to maintain the appropriate temperatures needed to suppress cracks. Under certain conditions, to counter the loss of cooling effects on the concrete due to the rising temperature of the cooling water, the system can also reverse the flow of the cooling water.

We performed extensive experiments to confirm the following with respect to the operating conditions and effects of the system thus developed:

- i. The system achieved the desired concrete temperature control performance by controlling the flow rate of the cooling water.
- ii. Reversing the direction of flow kept differences in concrete temperature between the cooling water outlet side and inlet side within 2°C, thereby maintaining the cooling effects on concrete.

Key words: mass concrete, pipe cooling, flow control, flow direction control