Concrete Strength Development Monitoring Technique for Automatic Construction Management of Nuclear Power plants

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Summary

Recently, demands for the construction of nuclear power plants(NPP) using high strength concrete(HSC) has been increased. However, HSC might be susceptible to brittle fracture if the curing process is inadequate. To prevent unexpected collapse during and after the construction of HSC structures, it is essential to confirm the strength development of HSC during the curing process. In this study, a novel method to estimate the strength development of HSC based on internal harmonic wave measurements using an embedded piezoelectric sensor is proposed. The amplitude of propagated harmonic wave along the concrete media was tracked to monitor the strength development of NPP concrete. In addition, the strength estimation equation was derived using regression method. The results confirmed that the proposed technique can be applied successfully monitoring of the strength development during the curing process of HSC structures.

Keywords: Concrete Curing, Embedded Piezoelectric Sensor, Harmonic wave, High Strength Concrete, Nuclear Power Plant

1. Introduction

Recently, there has been increasing demand for Nuclear Power Plants(NPP) to satisfy increasing electric demands. Therefore, there is a need for high strength concrete (HSC) with a low W/C ratio and high compressive strength for construction NPP structures. However, the HSC might be susceptible to brittle fracture if the curing process is inadequate. Therefore, to prevent this, it is essential to predict the strength development of HSC during the curing process. In addition, monitoring of the curing strength is important for reducing the construction time and cost because it can determine the appropriate curing time to achieve sufficient strength to progress to the next phase safely. The in situ strength of concrete structures can be determined with high precision by performing strength testing and material analysis on core samples removed from the structure [1]. However, this method can destroy the concrete structure. Therefore, a range of methods based on the thermal, acoustical, electrical, magnetic, optical, radiographic, and mechanical properties of the test materials have been developed to monitor the strength development without damaging the host structure [2]-[4]. These methods typically measure certain properties of concrete from which the strength and/or elastic constants can be estimated. Among the many techniques, methods using

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