

Abstract

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Non-destructive electrical resistivity measurement technique: evaluation of concrete strengths

ABSTRACT: The process of controlling concrete quality has proven to be a vital and essential procedure in concrete construction to ensure the quality of the constructed facility. The quality control procedures generally depend on the results of compressive strength testing for standard concrete specimens manufactured during the concrete construction process. The results of these specimens do not represent the whole sources of variations in the actual concrete strength because these samples are taken extracted in the middle of the concrete construction process just before casting, compaction and curing which does not represent the actual condition in the real structure as stated by the ACI 214R-02 committee report. This fact calls for the need of a performance based quality control system that depends on the actual concrete strengths in the concrete structure under real construction conditions. Concrete electrical resistivity measurements are one of the promising techniques that can be used to evaluate concrete strength. This technique can be considered as a simple and low cost technique for evaluating the actual concrete quality during the construction process and also for actual inspection of the concrete structure. This research aims to understand the relation between the concrete Surface Electrical Resistivity Measurements (SERM) and the different concrete strengths (such as compressive strength, tensile strength and flexural strength). Moreover, it is targeted to study and appraise the concrete SERM as a Non Destructive Test (NDT) for evaluation of the concrete strength and comparing it with other NDTs. These objectives are achieved through designing and conducting an extensive experimental program. The parameters involved in this research are water-to-cement ratio, age and the presence of silica fume as a replacement of cement content. Eight concrete mixes were designed and cast and more than 135 specimens were tested in compression, splitting tension and flexure. SERM were collected for these samples at different ages using Wenner technique just before strength testing, and Schmidt rebound hammer was also used for comparison purposes. The results of this study illustrated the sensitivity of the SERM to both age and water-to-cement ratio, while the effect of silica fume was less pronounced. It was shown that the higher the water-to-cement ratio for all the mixes, the lower the SERM, while age had the opposite effect. Moreover, relations between SERM and different concrete strengths were observed. In this research, linear statistical regression models were developed to represent the relation between the SERM and the different concrete strengths. Also the effect of the shape of the specimens on SERM was investigated.