Relationship Between Compressive Strength and Ultra-Sonic Pulse Velocity (UPV) of Local Fly Ash Concrete

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Abstract: Non-destructive method monitoring or service life prediction of concrete structures is becoming crucial interest to engineers. The good conceptual understanding between non-destructive method and destructive method is essential to ensure that optimum concrete performance is achieved before a costly repair to the structure becomes necessary. This study was conducted to determine the relationship between the compressive strength and the Ultra-sonic Pulse Velocity (UPV) on the concrete partially replaces the cement content (by mass percentages) with local fly ash. Furthermore, R^2 was indicating the advantages of UPV against compressive strength. The experiment was investigated using grade concrete of G35 and G45 supplied by local ready mixed concrete in Kuching Sarawak. The cement content for each concrete grade was replaced with fly ash about 10% percentage increment from 20-60%. Waste material (Fly ash) used as cementitious material were collected from single main local supplier in Pending Sarawak. The specimens used in the studies were made of 150 mm concrete cube. Specimens tested for UPV then followed by compressive strength at the age of 14, 28, 56, 90 and 180 days. In which curing age extended to 56 and 90 days to participated delay setting time of ready mixed concrete enhance by fly ash. Meanwhile, 180 days conducted for long term correlation between compressive strength and UPV purpose. Based on the compressive strength and UPV tests conducted in both concrete grades, clear linear regression relationship was drawn to describe highly agreement between two parameters measured. Compressive strength vs. UPV correlation curves were recorded R^2 values of 0.776 and 0.807 for G35 and G45, respectively. Therefore, the higher values of R^2 indicate using UPV as non-destructive method was develops greater confidence to replace destructive method (compressive strength) for long term strength monitoring with fastest and low cost testing method.

Key words: Ultra-sonic pulse velocity, fly ash, ready mixed concrete, non-destructive test, strength monitoring, compressive strength

INTRODUCTION

There is a growing interest at an international level in non-destructive testing of cement based materials such as Ultrasonic Pulse Velocity (UPV), Rebound Hammer (RH) and etc. The UPV test is frequently used in order to estimate the quality of concrete by transmitting an irrational pulse to travel at known distances (Long *et al.*, 1945). It is usually very helpful in detecting the presence of cracks in a structural (Kar *et al.*, 2013). Includes assessing the durability where amplitude, velocity and frequency variations depending on the age of the material can be observed during the hardening process. Based on previous studies, there is a good correlation between UPV and the compressive strength of concrete (Sounthararajan and Sivakumar, 2012). The correlation, however is not unique but rather depends particularly on the mix proportions, cement type and type of aggregate used (Panzera *et al.*, 2011). Moreover, there is some study also concluded that if the UPV is measured at different locations in a structure, the compressive strength values can be predicted (Kar *et al.*, 2013). Moreover, this method has been shown for some time in providing a reliable means of estimating properties and offers a unique