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Performance-based Durability Indicators of Different Concrete Grades Made by the Local Ready Mixed Company: Preliminary Results

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Abstract

The durability of a material is defined as its ability to withstand environmental deterioration. The ability of a concrete structure is to withstand environmental deterioration is important to be investigated in order to enhance the service life of the reinforced concrete structure without having to incur unforeseen high cost for maintenance or repair. The quality of the concrete on durability aspect has to be evaluated through series of concrete durability experiments before the service life model has taken place rather than relies on the conventional prescriptive deemed-to-satisfy approach. Performance-based durability is thus based on durability transport properties instead of limiting particular ingredients, proportions or construction operations without predicting the service life of structure. In order to fulfill customer satisfaction with lasting and great concrete performance at reasonable grade concrete, it is important to conduct various experiments to identify the durability transport properties parameters on the earlier stage of construction. The experiments performed in this study are water absorption, volumes of permeable void (VPV) and sorptivity. The experiment was investigated using Ready mixed concrete of grades G40, G45 and G50 that has been conducted to determine the properties at different concrete zones using 150mm and 100mm for compressive strength test. The strength of G50 increases 18% in sealed curing and site cured concrete has 8% strength increments from 28-90 day of age. Concrete G40 has the highest water absorption, VPV and sorptivity properties followed by G45 and G50 in all ages of test under both curing conditions. Amongst all the different zones, top zone has highest water absorption, VPV and sorptivity followed by left and right zone for all grade. Meanwhile, the bottom zone has the lowest water absorption, VPV and sorptivity followed by middle and center zone of concrete for all grades. The sealed cured (S1) concrete condition shows relatively lower water absorption, VPV and sorptivity than site cured (S2) concrete condition.

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Keywords: ready mixed concrete; different concrete zones; durability; compressive strength; water absorption; VPV and sorptivity

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1. Introduction

Ready Mixed concrete is fresh concrete which is composed of cement, natural and artificial aggregate, water and chemical additives which is scaled and mixed in concrete centrals or transit mixers and then delivered to the customer in a freshly mix (ACI Manual of Concrete, 1994). In Kuching, the Ready Mixed concrete is one of the most versatile and popular materials in construction. The total number of registered Ready Mixed concrete companies in Kuching area is about 23 companies (Statistical Department, Suruhanjaya Syarikat Malaysia (SSM), Feb 2015). It was highly demanded in constructions project due to the ability to customize its properties for different applications and its strength and durability to withstand a wide variety of environmental conditions. The durability of cement concrete is defined as its ability to resist weathering action, chemical attack, abrasion, or any process of deterioration and its ability to perform satisfactorily in the exposure condition to which it is subjected over an intended period of time with minimum of maintenance (Nagesh, 2012). It also depends on the movement of water and gas that enters and moves through it. Moreover, the permeability of concrete depends on its pores structure which is an indicator of concrete ability to transport water more precisely with both mechanism that is controlling and transporting of water and gaseous substances into cementitious material (Vyas et al., 2013).

To determine the durability properties of the concrete, experiments such as water absorption, volume of voids (VPV) and sorptivity test for concrete are tested by using local Ready Mixed concrete. The properties of concrete are affected by the quality of ingredients, mix proportions, ways of handling and placing the concrete, curing conditions and time (age) of the concrete (Mindness et al., 1981). Hence, the objectives of this paper is to investigate the durability indicators of different concrete grades made by the local Ready Mixed concrete by studing the water absorption, volume of voids (VPV) and the sorptivity capacities to introduce performance-based durability indicator before any real structure can be constructed on ground.

2. Materials and test methods

The concrete material was collected from the most popular Ready Mixed concrete company identified from SSM record. The mix designs are shown in Table 1 below. Table 2 shows the concrete tube sizes and ages used on the tests. The adopted curing conditions are shown in Table 3. The relevant tests methods of BS 7263, ASTM C642-06 and ASTM C1585-04 are used with modification of test samples as shown in Figure 1 for water absorption, VPV and sorptivity tests.

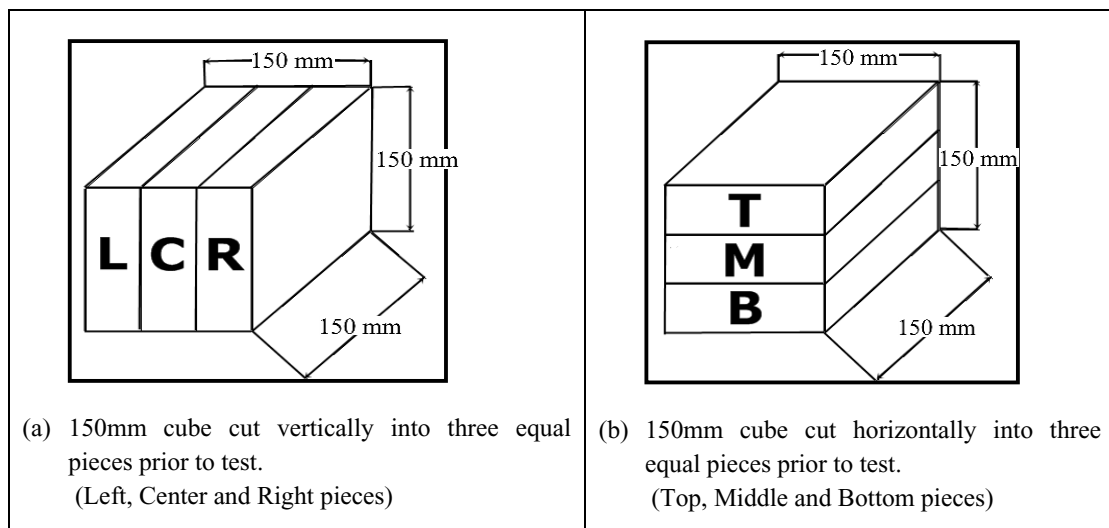


Fig.1. 150mm cube cut vertically and horizontally into three zones.

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