The Transition Zone between the Cement Paste and the Normalweight and the Lightweight Aggregates

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Abstract

In this study, the influence of aggregates on the aggregate-cement interfacial zone of concrete mixtures were discussed. Lightweight concrete can be produced with a combination of fine and coarse lightweight aggregate or coarse lightweight aggregate and normalweight fine aggregate. In this study, coarse lightweight aggregates were fully replaced with normalweight aggregate in concretes. In order to investigate the aggregate-cement matrix interfacial transition zone (ITZ), SEM observations were performed. The interface zone was in tight and locking bond between the two phases of all concretes. Cold bonded lightweight aggregates strengthened and narrowed the transition zone because of consuming the calcium hydroxide.

Keywords: Interfacial zone, Aggregate, SEM.

1. INTRODUCTION

While LWA concrete may be 20-30% lighter than conventional concrete, it may be just as strong. Even when it is not as strong as conventional concrete, the LWA concrete may have reduced structural dead loads enabling the use of longer spans, narrower cross-sections, and reduced reinforcement in structures. The lower weight of the LWA concrete facilitates handling and reduces transport, equipment, and manpower costs. LWA concrete may be particularly useful in construction slabs in high rise buildings and in concrete arch bridges, for example. LWA concrete may also have improved insulating properties, freeze-thaw performance, fire resistance, and sound reduction. LWAs can also be used in the construction of other structures, in highways, and as soil fillers.

In any composite material, the properties of the constituents and the interactions between them determine the behaviour of the material [1]. Concrete is a composite material with coarse and fine aggregates embedded in a cement paste matrix. As such, the aggregate and the cement paste as well as the interfacial zone between them affect the mechanical behaviour and permeability, thus durability of concrete. In concrete, it is generally not the porosity but the pore structure that is essential in establishing the permeability. In addition to that, microcracks in the matrix may contribute significantly to the permeability. Figure 1 shows the difference between porosity and permeability schematically, and it indicates that the connectivity of the pore system is a prerequisite for permeability (i.e. an open pore system). A material can be porous and still perform tight as long as the pores are not interconnected (i.e. closed pore system). However, it is not clear if LWC has similar advantage over the NWC at high-strength levels as the interfacial zone of the high-strength NWC can be improved substantially by the reduction of water/cement ratio (w/c) and by the incorporation of silica fume.

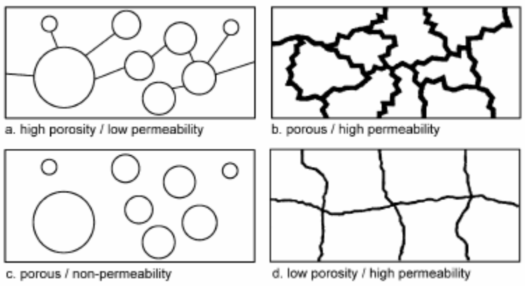

Figure 1. Schematic diagram showing differences between porosity and permeability [1]