Image analysis of concrete surface for investigating the influence of aggregate distribution and load induced damage on the chloride permeability of concrete measured using RCPT (ASTM C1202)

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Abstract

In the present study, the influence of aggregate distribution and load induced damage on chloride permeability of the concrete, was investigated using image analysis of concrete surface. Two mixes of water to cement ratio of 0.45 and 0.55 were used. Chloride permeability of the concrete, measured using RCPT (ASTM C1202), was modelled considering the three phases- mortar, coarse aggregate and ITZ. Image analysis program *ImageJ* was employed to analyse the geometrical parameters of the aggregates and load induced damage measured at the concrete surface. Damage in concrete disc specimen (dia. 100 mm and depth 50 mm) were introduced using compressive and splitting tensile stress. Results showed that the prediction of chloride permeability, based on 3 phase modelling, agreed well with the experimental data. The present approach can be utilized for quick and economical assessment of in-situ concrete durability and local variations due to the influence of aggregate distribution and load induced cracks.

Keywords: Chloride permeability, RCPT, Interfacial transition zone, ImageJ, cracking, aggregate distribution, concrete.

1 Introduction

The durability of concrete structures such as bridges, buildings, highways, ports etc. are governed by the deteriorating mechanism in the service environment. Corrosion of steel in reinforced concrete (RC) structure is one of the major concerns for premature deterioration of RC structures. The chloride ions (from sea water or salts used in thawing application) damage the protective layer (or passive layer) of rebar resulting in the corrosion initiation. Chloride's concentration required to initiate corrosion and corrosion rate are the function of metallurgical and mechanical properties of the steel [1] whereas the transport of ions depends on medium (i.e., concrete) permeability. The penetration of ions is often described by various mechanisms such as adsorption, permeation, and diffusion. According to diffusion, being the predominant mechanism, the flow of ions is directly proportional to the concentration gradient. Fick's law describes the chloride concentration in space and time [2] and widely utilized in designing the service life of structures. The Coefficient of diffusion (COD) is the material property that becomes the controlling parameter for the durability design and selection of material. Various laboratory test methods are used for evaluating the COD of chlorides in concrete. Most of these methods are long term duration test

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