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Investigation of chloride ion penetration resistance of silica fume mix concrete

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Sri Lanka, being an island with well developed coastal areas, has a large number of reinforced concrete (RC) structures in the coastal zone. Chloride attack on such concrete structures has become a significant issue in the construction sector and it has become necessary to curtail the adverse effects of chloride ions which lead to corrosion of reinforcing steel and subsequent reduction in the strength, serviceability, and aesthetics of structures and finally the failure of structures. The level of chloride ion penetration is related to concrete permeability and with increasing permeability, an increase of chloride ion penetration occurs. Studies have indicated that the addition of materials such as fly ash, ground granulated blast furnace slag and silica fume in certain proportions in the mix reduces the penetrability of concrete. Hence, a possibility exists for the retardation of chloride ion penetration under such conditions. In this study, the chloride ion penetration resistance of silica fume mix concrete was examined.

The physical properties of silica fume (fineness, specific gravity and water absorption) were determined in the study. Concrete mix of Grade 25 was tested according to the BS Mix Design Method. Specimens with Ordinary Portland Cement (OPC) concrete and specimens with OPC replaced by silica fume at the levels of 5%, 10% and 15% by weight of cement were tested. Compressive strength tests (according to BS 1881-116-1983) were carried out on concrete cubes of size 150 mm x 150 mm x 150 mm. Workability was measured by the slump test, compacting factor test and VB test. Chloride Ion Penetration test was carried out according to the procedure given in ASTM C-1202. The results indicated that the workability reduces with the increase of silica fume for Grade 25 concrete. The compressive strength of silica fume mix concrete decreased with the increase of silica fume content in the concrete. However, the results of Chloride Ion Penetration test revealed that the addition of silica fume reduced the chloride ion penetration indicating a reduced level of chlorine attack in concrete.

Keywords: Chloride penetration, silica fume, concrete

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