

ABSTRACT

Carbonation of reinforced concrete elements results in the depassivation of reinforcing steel, which very often causes corrosion of the reinforcement and leads to the loss of reinforcing steel cross sections, and bonding with concrete that culminate in the reduction of the load carrying capacity, durability performance and ultimately service life of reinforced concrete structures.

In this thesis, the rate of carbonation of the most commonly used concretes on construction projects in South Africa are determined for different inland exposure conditions and are then related to the concrete mixture design and/or early-age characterisation parameters. The results obtained are expressed in the form of prediction models with concrete mixture design and/or concrete characterisation at early-age as input parameters. In addition, the binder types used in concrete, concrete curing durations and exposure conditions effects on carbonation rate in concrete are also included as predictor variables. On the basis of concrete types, processing and exposure conditions assessed in this work, carbonation have significant effect on blended concretes while concrete given prolonged curing duration and in an outdoor exposed condition present the least rate of carbonation.

The significance of the results obtained in terms of rate of carbonation for different concrete types and exposure conditions will aid in the design, repair and or maintenance of concrete structures in inland environments. The modelled rates of carbonation reflect the carbonation rates of the different binder types and inland exposure conditions in South Africa. The data obtained in the tests and the techniques used provide an effective basis for predicting the rate of carbonation in proposed and existing reinforced concrete structures made with the binder types and located in the inland environment of South Africa.