Reliable Prediction of Service Life Model of HPC Bridge Decks

The chloride induced corrosion of steel reinforcement embedded in concrete is a significant issue that threatens anticipated service life of concrete structures. Until recently, such models of service life have concentrated on estimation of corrosion initiation. Very little research has been done for computation of corrosion propagation time for High Performance Concrete (HPC). In addition, there are some unresolved questions regarding probabilistic modeling of corrosion propagation time. The increased electrical resistivity of concrete with supplementary cementing materials has the potential to reduce corrosion rate after active corrosion initiation has started. Over the life of a bridge deck and other highway structures, improved serviceability performance is achieved with the use of HPC by delaying the cracking, spalling of concrete cover due to chloride induced corrosion propagation and unacceptable condition of the reinforced concrete structure. The inclusion of the corrosion propagation time of HPC concrete in service life model becomes important in order to provide accurate methodology for estimation of service life and life cycle cost of nation's infrastructure.

This research will indicate the road map to formulation of accurate service life model of HPC bridge decks with respect to chloride ingress in harsh chloride environments. Evaluation of the propagation period would allow comparison of the effect of several HPC mixture designs on overall durability performance of the concrete structures. Concrete resistance of supplementary cementitious materials against chloride penetration retracts the corrosion initiation and slows down active corrosion propagation. Electrical resistivity data of HPC mixture designs would be an essential added component in service life model and this model is aimed to provide first insight into the beneficial effect of High Performance Concrete (HPC) mixtures in delaying corrosion induced cracking. Incorporation of the service life into public infrastructure requires advanced knowledge of degradation mechanisms, construction materials, reliability assessment, quality control, and engineering practices. Despite the obvious need to design concrete structures with a long life, user friendly tools and aids to achieve this goal are still under the process of development.

For this project, I will need 2 students in summer 2017 for numerical analysis. They will analyze short and long term resistivity and diffusion coefficient data and incorporate in modeling software to predict service life of reinforced concrete bridges.