Development of a Deterioration Model for Concrete Material Exposed to Saltwater

Concrete is a critical building material especially in coastal and marine environments where it forms seawalls, dock pilings, and bridge piers. However, there has been little investigation into the long term impacts of tidal forces and cyclical seawater exposure on concrete structures. Developing a thorough understanding of the effects of mechanical wearing and chemical interaction with concrete is crucial to estimating the effective service life remaining in the structure. This research will examine samples taken from a bridge pier that has been continuously exposed to saltwater and tidal actions for 79 years. X-ray computed tomography will be used to develop 3-D material models for the samples.

As the concrete is subjected to the chemical action of chlorides and sulfates reacting with the cement and aggregate combined with the physical action of the water wearing on the exposed surfaces, the ratio of porosity increases. The increased number of pores allows the water to penetrate deeper into the concrete which can lead to reinforcement bar corrosion and further damage. It is obvious that the rate that the pores appear and develop is not strictly linear and their overall impact on the total strength of the system is not well understood. Thus, using 3-D material models developed based on x-ray computed tomography, the pore structure of the samples will be analyzed and the deterioration model will be developed for concrete material exposing to saltwater.