Title of PhD thesis: Uncertainty in condition and strength assessment of reinforced concrete bridges

Abstract

Deterioration of reinforced concrete bridges and increasing volumes and weights of traffic using the road network require bridge owners to make periodic assessments of the condition and load carrying capacity of their bridges. The general principals used to address these two types of assessment for reinforced concrete bridges are similar worldwide although the specific requirements might vary from country to country and from bridge authority to bridge authority. As a result, this thesis investigates in detail the effectiveness of the approaches used by the Highways Agency in England to assess the condition and strength of motorway and trunk road reinforced concrete bridges.

The reliability of the condition assessment is based on the accuracy of visual inspection and specific *in situ* test results. This thesis identifies and, where possible quantifies, the uncertainties in visual inspection and the non-destructive techniques, such as half-cell potential, chloride content, carbonation depth and cover depth, commonly used to investigate corrosion in reinforced concrete bridges. The effect of such uncertainties on the condition assessment is then studied in order to determine the reliability of the assessed condition. It is suggested that the Highways Agency's current inspection and assessment practice needs reviewing and an alternative inspection regime is proposed.

An audit of UK bridges classified structurally inadequate to carry the current maximum legal lorry weight found that uncertainties in the input parameters and inappropriate methods of analysis were the primary cause of the theoretical failures. This thesis investigates the uncertainties in material strengths and measurement of geometric parameters and the effect of such uncertainties on the assessed load carrying capacity. Sensitivity analyses are carried out to determine the critical bridge specific parameters that should be measured on site. This dissertation suggests that testing resources should be focused on those critical parameters identified in an initial sensitivity analysis of the effect of varying selected material strengths and geometric parameters on the final assessed capacity.