

2011 MSc Research Grant Scheme

Project title: Deterioration of Reinforced Concrete in a 100 Year Old Bridge

University: Cork Institute of Technology

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Aims of research: In October 2009 works began on the demolition and reconstruction of the historic Mizen Head Footbridge. The original reinforced concrete footbridge was constructed in 1909. During its service life, the bridge has been exposed to a harsh marine environment. At the time of writing the bridge is being demolished. The demolition of the bridge provides a unique opportunity to study the degradation of reinforced concrete over the typical lifespan of a bridge structure. The primary aim of the project is to add to the existing knowledge of the evaluation of the residual life of reinforced concrete structures in similar environments.

Description of method: The project will involve a literature review, sampling and testing of concrete and detailed analysis of test results. The literature review will involve historical papers relating to the bridge including original specifications, construction drawings and contemporaneous articles from the time of construction. The literature review will also consider published papers relating to reinforced concrete deterioration, concrete sampling and concrete testing. There is a research focus at present on the life-cycle cost optimisation of maintenance strategies of reinforced concrete structures. The maintenance strategies which have been used at the Mizen Bridge are generally well documented through the records of the bridge owner, The Commissioners of Irish Lights. Current research focus is based on the use of probabilistic reliability methods to predict the likelihood and extent of corrosion damage to reinforced concrete bridges depending on the exposure conditions. There is an opportunity here to develop a probabilistic model of the degradation of the reinforcement at Mizen based on current published methods and to examine the performance of such a model through the detailed testing of the structure. In order to determine the factors affecting the durability of the concrete and causes of reinforcement corrosion at the Mizen Bridge it will be necessary to carry out site measurements, sampling and testing. Site data will be recorded during the demolition of the structure to determine concrete cover and reinforcement make up. A large number of samples from critical bridge elements will be broken out and sent for testing.

It is proposed that the following concrete and reinforcement makeup, quality and properties be investigated through testing and observations:

- Concrete density and permeability and resistivity;
- Concrete chloride penetration;
- Concrete quality;
- Concrete pH;
- Half Cell polarisation resistance tests;
- Reinforcement composition;
- Composition of rust samples;
- Concrete petrographic analysis.

Benefits to structural engineering: This project involves high quality MSc research work with application to reinforced concrete bridge infrastructure in Ireland and the UK. The findings of the project will add to the existing knowledge of the evaluation of the residual life of reinforced concrete structures in similar environments and will assist bridge managers as to the timing of maintenance, essential repairs or replacement of ageing reinforced concrete bridges.

Proposed finish date: 09/2012