The Institution of Structural Engineers

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Project title: Corrosion-damaged RC beams repaired in shear with embedded FRP bars

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Aims of research:
The corrosion of steel reinforcement is one of the serious problems facing the owners and managers of existing reinforced concrete (RC) infrastructure. In the case of RC bridges, the corrosion of internal steel stirrups can have a detrimental impact on the shear strength of bridge beams, and may lead to catastrophic brittle failure. There is thus pressing need for safe, practical, and durable shear strengthening methods. The aim of this project is to investigate the use of non-corrosive fibre reinforced polymer bars as embedded shear reinforcement for existing corrosion-damaged RC beams.

Description of method:
This project will comprise three tasks:

1. A literature survey will be conducted to review and critically evaluate relevant published work on the behaviour of reinforced concrete (RC) beams with corroded steel shear links. The effect of corrosion on the strength and ductility of steel reinforcement bars will be examined as well. The literature survey will also provide insight into accelerated corrosion techniques and corrosion levels that can be used to represent practical situations.

2. An accelerated corrosion technique will be used to corrode the shear links of two RC beams. The first beam, which will serve as a control specimen, will be designed to fail in shear to create a baseline reading for the second beam. The second specimen will be precracked to model the state of damage that may exist in RC structures requiring strengthening. It will then be retrofitted with embedded fibre reinforced polymer bars and loaded up to failure. Both specimens will be T-shaped beams having a significant difference between their unstrengthened shear capacity and their flexural capacity. The T-shaped cross section is favoured because it adequately simulates the slab-on-beam construction method. The gap between the shear capacity and the flexural capacity is deemed necessary to provide a sufficient range over which the level of shear enhancement can be measured. It will be important to have a means of recording strain and deflection in tested specimens throughout the loading regime. The measuring strategy will include conventional devices such as strain gauges and linear resistance displacement transducers (LRDTs). A digital camera will also be used to record crack propagation.

3. The experimental results will be used to evaluate the accuracy of current design approaches such as the IStructE “Interim guidance on the design of reinforced concrete structures using fibre composite reinforcement”.

Benefits to structural engineering:
The results of this project will identify the influence of embedded fibre reinforced polymer (FRP) bars on the shear behaviour of corroded RC members, and will represent a unique opportunity to simulate and understand aspects of the in-service behaviour of strengthened RC infrastructure including precracking and strengthening under load. Hence, the outcomes of this project will be of direct relevance to owners and managers of corrosion-damaged RC infrastructure. Evaluation of current design approaches of RC structures using FRP composites will facilitate, and provide an informed platform for, future work on developing rigorous design guidelines. .

Proposed finish date: May 2013