

## **Institution of Structural Engineers Research Award 2011**

**Project title:** Detecting delamination in FRP retrofitted concrete structures using nonlinear ultrasonics.

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### **Aims of research:**

Fibre reinforced polymers (FRP) are increasingly used to retrofit concrete structures due to their many desirable characteristics and the simplicity of the strengthening method. A major concern in FRP retrofitted structures is the weakening of the bond between FRP and concrete and, subsequent delamination due to ageing or environmental conditions. This results in a brittle failure and could have catastrophic consequences. The goal of this project is to investigate the application of nonlinear elastic wave spectroscopy (NEWS) for the early detection of delamination in FRP retrofitted concrete structural elements.

The objectives of this research are as follows.

- Perform a series of laboratory experiments on reinforced concrete beams with externally bonded FRP to study whether NEWS measurements are able to detect debonding occurring before failure due to delamination.
- Develop an approach to evaluate a condition index - a measure of the bond strength between FRP and concrete, from NEWS measurements.

### **Benefits to structural engineering:**

This work could lead to a new non-destructive approach for assessing the integrity of externally bonded FRP systems. Results from this study would be of interest to the highway agency, local county councils and companies involved in structural management. The method could enable better evaluation of the quality of retrofit and provide a measure of the bond between FRP and concrete. Consequently, this method could be a condition assessment method that could improve structural safety and also enable preventive maintenance by detecting onset of delamination. The study has potential to enhance the knowledge and understanding of the interaction at the FRP-concrete interface. While this research focuses on flexural delamination, results would also be relevant to other forms of FRP retrofit.

**Proposed finish date:** August 2012