

## 2013 MSc Research Grant Scheme

**Project title:** Passive Lock-in Thermography for internal defects and moisture mapping in masonry arch structures

**University:** Nottingham Trent University

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**Student:** t.b.a

**Aims of research:** Water ingress threatens some 120,000 UK railway masonry arches, potentially valuable premises. Long-term water ingress creates extensive voids through washout and promotes surface frost damage. Effective remedial measures are hampered by hidden information.

This project will be the first structure related investigation using 'Passive Lock-in Thermography' for mapping voids and water related issues. It differs from conventional thermography which uses only single image shots. It exploits different warming and cooling rates to identify water, for example. It also provides potential to cover wide and inaccessible areas compared to the existing localised intrusive method.

The method works by tracking and comparing the temperature-time variation of each image pixel, typically over 2-4 hours, using the sun's natural warming, for example.

### **Description of method:**

#### Objective

To prove that the 'Lock-in Thermography Method', a time dependent form of conventional thermography, can be used to identify hidden defects and mapping internal moisture in masonry arch structures

#### Activity

1. Prepare pixel processing software for video images.
2. Agree access to arches with Network Rail (agreed, awaiting outcome of this bid).
3. Collect digital images of the site (for report).
4. Install surface thermometers to determine optimum time frame for surface e.g. 6am to 10am (a high resolution Infrared Camera provided by the university).
5. Capture thermographic video images sequences (three sessions allowed for).
6. Undertake image processing of thermographic video files to extract boundaries.
7. Undertake radio frequency moisture detection survey (buried water) for targeted locations identified with hidden water, and compare findings.
8. Drill holes to verify voiding (by Network Rail).
9. Produce report and present findings.

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

- Better understanding of NDT based evaluation covering large area using an emerging technology like thermography.
- Enhanced knowledge on internal moisture condition and severity of defects in masonry arch structures.
- Possible transfer of this technology in other areas of structural engineering, for example, condition assessment of interface debonding in CFRP retrofitting, locating shallow delamination in concrete structure and condition of external coating in steel structures etc.
- A potential tool for practicing engineer for NDT based monitoring.

**Proposed finish date:** 08/2013