Establishing Condition of Hidden Critical Elements

What is the situation?

Exposing hidden critical elements(HCE) during detailed bridge examinations to ascertain their condition.

63,857 Recorded HCEs, which equates to approximately 10,500 examinations per year.

A HCE is a primary structural member that cannot be observed from at least one side throughout its extent and it is not protected by a material which is known to preserve the condition of the part.

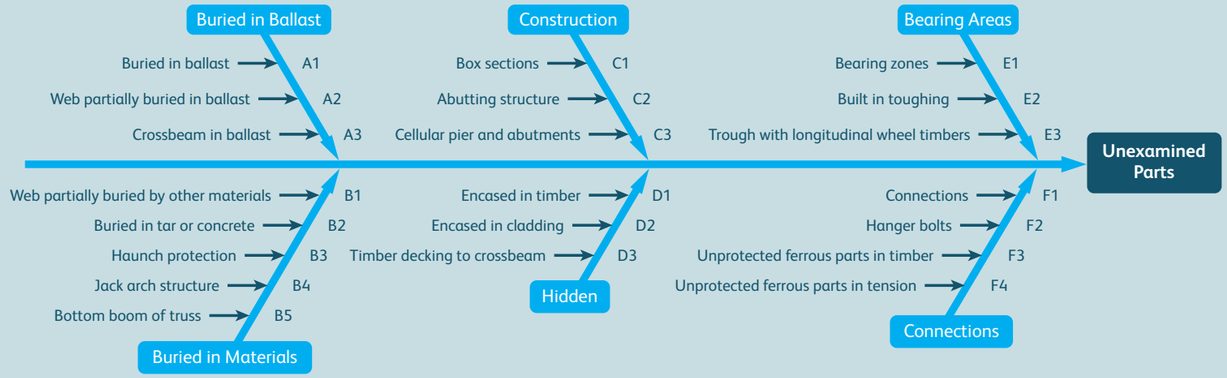
The relevance of the unknown condition of hidden parts within structures was brought into focus following the collapse of Stewarton Bridge in 2009. The collapse was linked to the condition of the hidden parts not being sufficiently understood or acted upon. Network Rail has subsequently reviewed its examination processes to specify in more detail the requirements to expose hidden parts of bridges.

63,857 Recorded HCEs,

which equates to approximately 10,500 examinations per year.

Destructive methods are used to expose HCEs - for example, the excavation of ballast to expose buried centre main girders. These destructive methods are expensive, time-consuming, can cause disruption to the network and can disturb protective coatings that were otherwise intact. Deciding the part of the member to expose can raise doubts when ascertaining the 'worse' defected condition.

Analysis of causes



Priority problems

Specific priority problems

- Detection of deterioration. Protection of hidden elements.
- Protection of hidden elements.
- Quicker inspections (reduced possession time).

Benefits

- Examine HCEs without needing enabling works.
- Non-intrusive examination methods.
- Live remote condition monitoring.
- Hidden elements are protected to prevent changes in condition.
- Cheaper, more effective, more durable protective solutions.
- Improved modelling of deterioration of details to enable improved examination and intervention.
- Details and tools to enable quicker exposure of hidden elements.
- Examine HCEs without needing enabling works.

Scope

To address these challenges it is expected that R&D actions will need to address the following aspects:

- Development of technology to enable non-intrusive inspection of metallic structures buried in ballast, concrete or other materials. To confirm the condition of hidden parts, thus omitting the requirement for intrusive investigation, or identifying hidden parts where condition should be confirmed by a limited sample of exposure. This technology would provide the condition of all hidden parts, rather than a small sample.
- Ensure portability of the equipment, and the limited requirement for site calibration, with the technology solution versatile enough to be applied to a diverse structures asset portfolio, including metallic elements with protective (paint) coatings to visible and hidden parts.
- The potential need for software to process the data gathered providing a display/output that can be interpreted by an examiner.
- Development of existing technologies from other industries to enable the inspection of hidden structural elements while providing greater data and information for assessments. Equipment such as magnetic particle testing, ultrasonic testing, electromagnetic testing, and vibration analysis to improve accuracy, operability and miniaturisation of equipment.
- Testing on a representative sample of Network Rail assets under different conditions.
- Research and modelling to help us understand the whole life cost of protective material degradation treatments that aren't being inspected regularly in the railway environment. I.e. the increased access costs with less time to install/maintain but the longer life of assets due to the absence of de-icing salts.
- New design and materials for structures to eliminate the issue of hidden critical elements including research into ballast free bridges.

Expected impact & benefits

The benefits are expected to be:

- A Significant reduction (£m's/annum) in the cost of examination of hidden bridge components, due to intrusive examination not being required.
- Enhanced condition information on which to plan future work banks for maintenance and renewal activities.
- Lower reliance on reactive maintenance to manage safety and performance risk.
- Reduced workforce safety risk associated with undertaking physical works to expose bridge elements.

The costs to Network Rail associated with undertaking intrusive HCE examination can help support the business case for research and development in this area.