Risk based inspections

Some railway industry initiatives

Brian Bell, Network Rail
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Industry workstreams

- There have been 4 separate workstreams recently looking at RBI, 3 closely related and 1 totally separate.
  - 2 workstreams run by the RSSB
    - Mott MacDonald
    - TRL
  - 2 workstreams run by Network Rail
    - Surrey University
    - TRL
- This presentation will primarily discuss the RSSB work and touch on the associated TRL work for Network Rail.
  - The PhD study at Surrey University will be the subject of a separate presentation

RSSB (1)

RSSB was established in April 2003.

- The Company's primary objective is to facilitate the railway industry's work to achieve continuous improvement in the health and safety performance of the railways in Great Britain, and thus to facilitate the reduction of risk to passengers, employees and the affected public.
- RSSB is a not-for-profit company owned by major industry stakeholders. The company is limited by guarantee and is governed by its members, a board and an advisory committee. It is independent of any single railway company and of their commercial interests.
- RSSB is funded by levies on its members and grants for research from the Department for Transport.

RSSB (2)

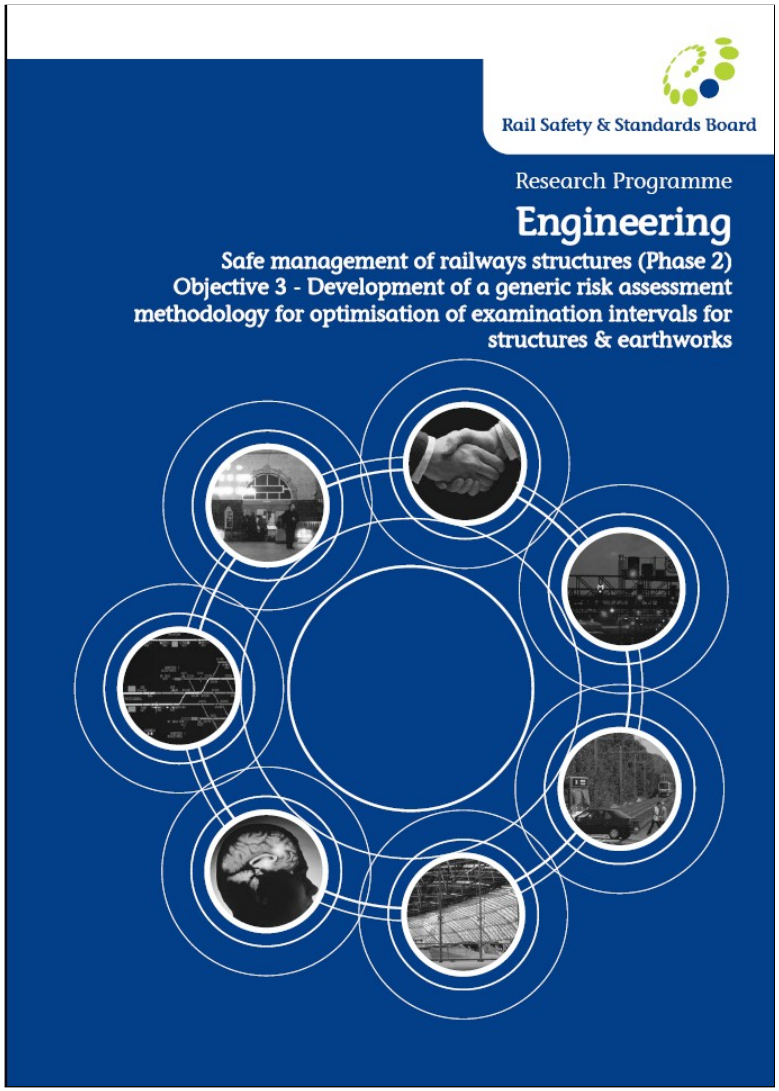
Key elements of the company's remit are to:

- *Manage Railway Group Standards on behalf of the industry*
- *Lead the development of long-term safety strategy for the industry, including the publication of annual Railway Strategic Safety Plans*
- **Propose change through facilitation of the research and development programme, education and awareness**
- *Measure, report and inform on health and safety performance, safety intelligence, trends, data and risk*
- *Support cross-industry groups in national programmes which address major areas of safety concern*
- *Facilitate the effective representation of the UK rail industry in the development of European legislation and standards that impact on the rail system*

Safe management of railway structures research project – Phase 2 Objective 3

- **Identify any risk assessment methods that are currently or have previously been used to increase/decrease examination frequencies.**
- Identify current national and international practice, past & current research, and gaps in knowledge/research.
- *Obtain breakdown of examination related costs.*
- *Obtain statistical data on fatalities, injuries, other incidents, train hours lost etc, arising from the examination process itself and due to the deterioration of structures and earthworks.*
- *Identify gaps in cost and incident data, and make recommendations relating to the viability and methodology for Phase 3 to fill the gaps in this information.*
- *Determine how hidden parts are currently being managed (in terms of examinations or investigations) across the Territories and across asset types.*

Phase 2 Objective 3 output Report by Mott MacDonald (RSSB ref T360)



Safe management of railway structures (Phase 2)

Objective 3 - Development of a generic risk assessment methodology for optimisation of examination intervals for structures & earthworks

Desk Study Report

September 2005

Mott MacDonald
St Anne House
20-26 Wellesley Road
Croydon
Surrey
CR9 2UL
UK
Tel : 44 (0)20 8774 2000
Fax : 44 (0)20 8681 5706

Report T360 – Conclusions (1)

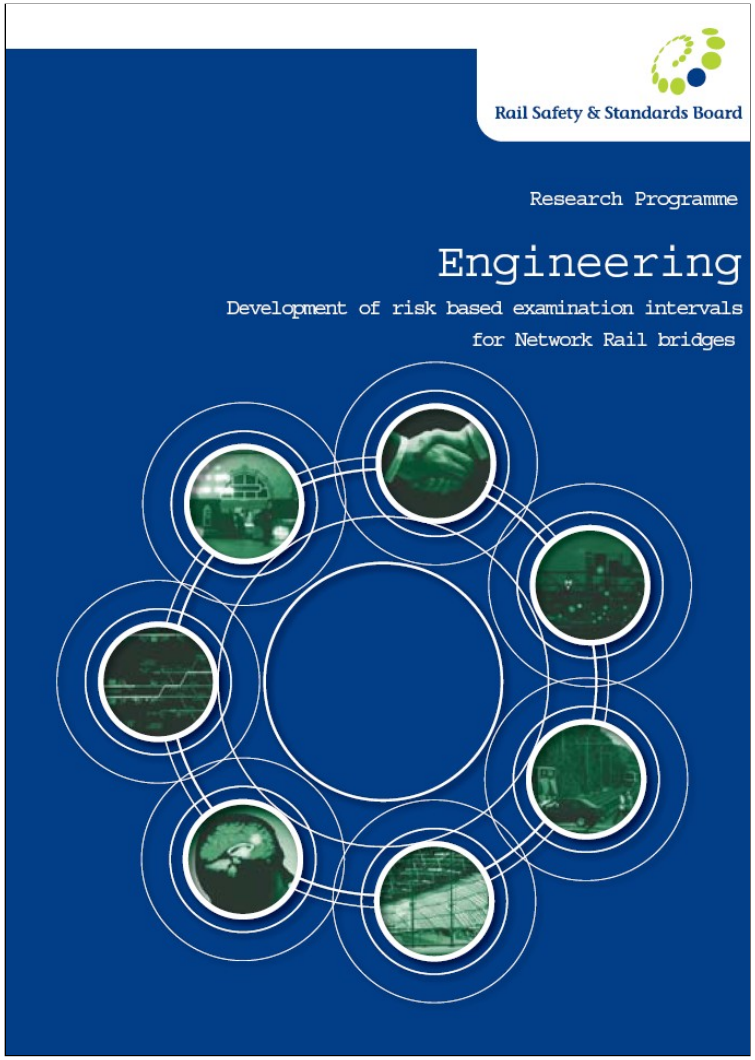
- Variables that are currently considered to be pertinent to a risk-ranking approach are:
  - Age and condition of the structure; Deterioration rates; Exposure to various environmental influences (e.g. water, chemicals); Loading type (e.g. mainly dead load, predominantly live load, fatigue loading); Previously assessed capacity (and therefore any known reserves of strength); Presence of hidden defects, Examination interval; Material type; Form of construction - particular forms may be known or anticipated to be vulnerable to deterioration; Anticipated failure mode; Consequence of failure; Visibility of deterioration/damage/defects (i.e. would a visual examination identify them); Changes in use (e.g. increased frequency or weight of rail traffic).

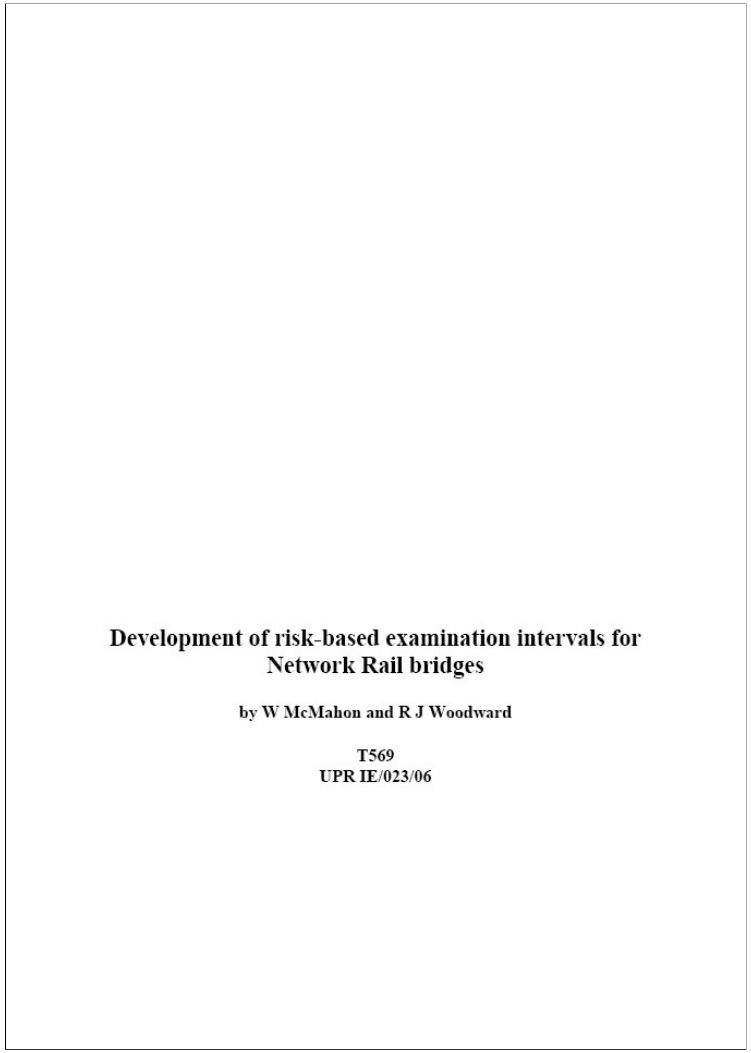
Report T360 – Conclusions (2)

A more detailed approach for determining examination intervals using risk and reliability methods would require information on structures and materials that is not available in sufficient quality or quantity. This information includes:

- Material properties (e.g. the properties of cast iron as used on particular railway structures).
- Deterioration rates for historic materials (e.g. masonry, cast iron, wrought iron, riveted steel).
- Reliability of visual examinations (typically quite subjective).
- Presence of hidden parts/defects (initially reliant on historic records).
- Records of structural failure (either of an element, or the full structure).

Follow on report by TRL Ltd (RSSB ref T569)





Report T569 Background and objectives

- At present, Network Rail's bridges are subject to an annual visual examination and a detailed examination at six-yearly intervals. Because the structures are subject to the same examination regime, it could be inferred that their risk of failure through deterioration is more or less the same. However, this is not the case: the likelihood of a defect occurring, the form it takes, the rate at which it develops, and the consequences of allowing it to progress unchecked, will vary from one structure to another.

- The aim of this project was to assess how the examination regime for particular types of bridge could be varied according to the risk of failure through deterioration. If such an approach could be developed and implemented, there would be benefits to Network Rail in terms of getting better value for the money expended on examinations, by matching resources to where they are most needed. To put this project in context, the annual expenditure on the examination and assessment of Network Rail's civil engineering infrastructure is, in round figures, about £40 Million; about half of this is spent on the examination of the bridge stock.

Earlier work by TRL

In 1997 Vassie & Ricketts produced a report for Railtrack which:

- assumed that visual examinations would be undertaken annually, but the interval between detailed examinations could be varied - with the length of the interval being determined by the likelihood that a structure would deteriorate to a significant* state between consecutive detailed examinations. The interval between such examinations would be longer than the norm for structures that posed a relatively low risk, whereas it would be shorter for those that posed a higher than average risk.

- created a structure specific method for assessing the risk of a defect reaching a significant state between consecutive detailed examinations.

* A structure was deemed to have reached a 'significant state' of deterioration at the point where remedial measures could still be carried out effectively and before safety and serviceability could be affected.

Report T569 – Conclusions (1)

The report establishes the principles upon which risk-based examination intervals may be determined for any particular type* of bridge, and goes on to describe a method of selecting the interval for detailed examinations based on:

- The rate at which a structure deteriorates to an unacceptable condition
- The level of detection provided by the examination regime (i.e. the ability to identify critical defects in good time to deal with them before the structure reaches an unacceptable condition).

* Unlike the earlier work by Vassie and Ricketts, this method is intended to be used on groups of bridges having similar characteristics, hence reducing the work load in determining changed intervals.

Report T569 – Conclusions (2)

The method uses two parameters to determine the interval for detailed examinations:

x – which is the length of time that elapses between a defect becoming detectable during a detailed examination and subsequently becoming detectable during a visual examination.

y – which is the length of time that elapses between a defect becoming detectable during a detailed examination and subsequently developing to a notifiable state

In the risk-based method developed in this project, the interval between detailed examinations varies according to the value of ratio *x/y*

Examination regime proposed

D3	Annual visual examinations with a detailed examination every 3 years
D6	Annual visual examinations with a detailed examination every 6 years
D9	Annual visual examinations with a detailed examination every 9 years
D12	Annual visual examinations with a detailed examination every 12 years
D15	Annual visual examinations with a detailed examination every 15 years
D18	Annual visual examinations with a detailed examination every 18 years

Reasoning employed

It has been assumed that an 18-year interval represents a reasonable upper limit between detailed examinations. This is based on the following considerations:

- A detailed examination should be carried out from time to time to check that the condition of an asset has not (unexpectedly) degraded substantially by one or more of :
  - (a) previously unrecorded defects,
  - (b) the effect of external factors,
  - (c) a change in use (or abuse),
  - (d) site-specific conditions.
- The longer the interval, the more likely that there will be some change in the way that the examination regime is procured and undertaken, and also in the team undertaking examinations. (An 18-year interval is probably close to the 'collective memory' of an examination team.) Any such changes could introduce a risk; for example, that examination records are not passed from one team to another.

Determination of theoretical detailed examination interval

Value of ratio (x/y)	Detailed examination interval (I_{DE})
≤ 0.2	y
$0.2 - 0.4$	$0.8y$
$0.4 - 0.6$	$0.7y$
$0.6 - 0.8$	$0.6y$
≥ 0.8	$0.5y$

Determination of examination regime to be employed

Calculated detailed examination interval (I_{DE} years)	Examination Regime
< 3	Other measures
3 – 6	D3
6 – 9	D6
9 – 12	D9
12 – 15	D12
15 – 18	D15
> 18	D18