International Bridge Forum
September 2009

Inspection, Testing and Monitoring

Condition Evaluation

Graham Cole
UK Bridges Board

Roads Liaison Group

- Roads Board
- Lighting Board

Bridges Board
- Chaired by Chair of CSSBG
- Reps from CSS, DfT, HA, Scottish Executive, DRD (NI), LOBEG, SCOTS, Welsh Assembly, Network Rail, Transport for London, LUL, DLR, British Waterways

Traffic Management Board
CSS Bridges Group

CSS Management Committee

- Finance
- Waste

CSS Engineering Committee

- Transport and Environment

CSS Bridges Group

Area Bridge Conferences (8), SCOTS, WATO, DRD (NI), LOBEG/LOTAG
Structure of Session

- Chairman’s Introduction
- Presentations
- Contributions and Discussion
  - Inspections
  - Testing
  - Monitoring
- Summary
Chairman’s Introduction
CONDITION EVALUATION

SAFE FOR USE

FIT FOR PURPOSE

WELL MANAGED

INSPECTIONS

TESTING

MONITORING
The Purpose of Inspection is to:

- Provide data on current condition and performance
- Inform management planning by noting change of condition, deterioration etc.
- Compile, verify and maintain inventory data

SAFE FOR USE
FIT FOR PURPOSE
WELL MANAGED
This photo from June 12, 2003, shows a bent gusset plate on the I-35W bridge that is visible to the eye. (Photo courtesy of NTSB)
Incident on 30 September 2006 killed 5 people and injured 6 others.

Commission of Inquiry reported on 12 October 2007

Negligence during Construction

Lapses in the management of the structure during its life
To the Victims of their Incompetence
Woking Inspection Trial
August 2005
Spot chips and cracks of finishing coat

or - All coats failed?

3E: Moderate defects covering more than 50% of the area

5D: Failed element covering 20 to 50% of the area
### Four different dominant defect types

Severities vary from 2 to 5 and Extent from B to E

**Scotland Bridge Primary Deck Element**

<table>
<thead>
<tr>
<th>Severity</th>
<th>Extent</th>
<th>Defect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>D</td>
<td>3.7</td>
<td>Moderate bulging, leaning or displacement</td>
</tr>
<tr>
<td>5</td>
<td>E</td>
<td>3.1</td>
<td>Major deformation</td>
</tr>
<tr>
<td>3</td>
<td>D</td>
<td>3.1</td>
<td>Minor deformation</td>
</tr>
<tr>
<td>3</td>
<td>B</td>
<td>3.2</td>
<td>Moderate pointing loss</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>3.1</td>
<td>Minor deformation</td>
</tr>
<tr>
<td>2</td>
<td>E</td>
<td>3.2</td>
<td>Minor depth of pointing deteriorated</td>
</tr>
<tr>
<td>3</td>
<td>D</td>
<td>3.4</td>
<td>Diagonal cracks, longitudinal cracks &gt; 3mm</td>
</tr>
<tr>
<td>2</td>
<td>E</td>
<td>3.7</td>
<td>Minor bulging, leaning or displacement</td>
</tr>
</tbody>
</table>
BCI for Scotland Bridge
BCI Critical Range

Scotland
Victoria Way
Subway
Goldsworth Relief
Goldsworth Park Canal
Kiln Bridge
Variations in BCI can create problems for safety, valuation and maintenance planning.

The trial shows that this is reality!
What have we done about this?

‘The Simplicity of the Solution belies the Complexity of the Problem.’

Advice and Training
Task No: YY86731

Guidance Document for Performance Measurement of Highway Structures

Part B1: Condition Performance Indicator

Report prepared by:

ATKINS

Report prepared on behalf of:

Highways Agency
CSS Bridges Group

2007
Management of Highway Structures
A Code of Practice
September 2005
This Code is supported, endorsed and recommended by

Department for Transport

County Surveyors’ Society

Network Rail

British Waterways

SCOTS

Cymdeithas Syyddigion Technegol Cymru

BRIDGES

UK BRIDGES BOARD

Transport for London

Street Management

UNDERGROUND

SCOTTISH EXECUTIVE

Local Government Association

ROADS Service

Welsh Local Government Association

THE INSTITUTION OF HIGHWAYS & TRANSPORTATION
WHAT HAVE WE GOT?

CSS generic asset management framework

1. Starting Point
- Goals, objectives & policies
- inventory

2. Level of Service
- Condition Assessment
- Demand Aspirations

Long term asset management planning process for highway structures

1. Strategic goals and objectives and Levels of Service
2. Asset inventory, condition and performance data
3. Determine current performance
4. Predict future demand
5. Determine performance targets

WHAT CONDITION IS IT IN?
<table>
<thead>
<tr>
<th>Milestone</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ONE</strong></td>
<td>• Implement a regime of Routine, Safety, Special and Acceptance Inspections covering all highway structures and any necessary testing and monitoring (Section 6.4).&lt;br&gt;• Implement a regime of General Inspections at an interval of not more than two years covering all highway structures (Section 6.4).&lt;br&gt;• Implement a process whereby the inspector has a clearly defined duty to inform the bridge manager, at the earliest possible opportunity, of any defects that may represent an immediate risk to public safety (Section 6.5).&lt;br&gt;• Implement a monitoring regime for all sub-standard structures (Section 6.7).</td>
</tr>
<tr>
<td><strong>TWO</strong></td>
<td>• Implement a regime of Principal Inspections at an interval of not more than six years covering all highway structures except those where a Principal Inspection would not add significantly to the defects picked up by a General Inspection (Section 6.4).&lt;br&gt;• Record the severity and extent of defects during General and Principal Inspections. It is recommended that the CSS Inspection Guidance, or a similar approach, is used (Section 6.5).&lt;br&gt;• Produce a full report for each Principal Inspection (Section 6.5).&lt;br&gt;• Carry out regular in-house inspection meetings to assess the consistency and competence of inspectors OR check that external contractors have suitably qualified/experienced inspectors who are also reviewed on a regular basis (Section 6.5).</td>
</tr>
<tr>
<td><strong>THREE</strong></td>
<td>• Implement a regime of Principal Inspections covering all highway structures. Where appropriate, use risk assessment to determine the inspection interval (Section 6.4).&lt;br&gt;• Produce an inspection, testing and monitoring manual that clearly defines the inspection requirements for the authority with H&amp;S, Environmental and Conservation information recorded for each structure (Sections 2 and 6).</td>
</tr>
</tbody>
</table>
Bridge Inspection Manual

Volume One – A4

Volume Two – A5
2.1 PURPOSE OF THE MANUAL

2.1.1 The purpose of this Inspection Manual is to provide guidance on the inspection process for all staff involved in the management of highway structures. It is also considered that this Manual provides a sound basis for the development of formal inspector training courses.

2.1.2 This Manual aims to ensure that inspections are carried out efficiently, uniformly and to a high standard. The Manual is intended for use as guidance, outlining typical procedures and defining the normal requirements for the various categories of inspection. It is not intended to provide the definitive solution in all situations, as the party best able to decide on the appropriate course of action is the inspector or engineer undertaking the work.

2.1.3 This Manual supersedes the *Bridge Inspection Guide* [5] and is endorsed by the Highways Agency, Transport Wales, Transport Scotland, Department for Regional Development Northern Ireland (DRDNI) Roads Service, CSS Bridges Group and the London Bridges Engineering Group (LoBEG). To be agreed.
The most important part of any inspection regime is the inspector, who is relied upon to perform their duties accurately, consistently, thoroughly and safely. At least one experienced inspector, who should give due consideration to the inspection requirements set down by the authority, should always be present on site during an inspection. The qualities of this experienced inspector should include, but should not be limited to the following:

- knowledge of the safe working practices and methods of access required for inspection;
- ability to recognise and evaluate defects on highway structures;
- an understanding of the behaviour of highway structures;
- knowledge of the construction methods and materials used in the construction of highway structures;
- knowledge of the causes of defects and suitable testing methods to identify, confirm or investigate these; and
- ability to record defects accurately, clearly and consistently.
Figure A.1 – Process for the implementation of the Inspection Manual

1. Examine the Manual
2. Disseminate Key Advice
3. Identify/develop formal training programme
4. Knowledge gap analysis
5. Produce Development Action Plan
6. Attend training activities
7. Record and assess training activities
8. Review Development Action Plan

Activities Key:
- All Inspection Personnel
- Inspectors
- Supervising Engineers
Inspections are a critical bridge management activity.

Significant variations in bridge condition reporting have been recorded during trials.

Adverse impact on effective management of the bridge stock.


Provide training – leading to qualifications.

Inspectors to be able to demonstrate competence.
Trained, competent inspectors with sufficient resources appropriately procured
Risk Based Inspections of Highway Structures – (Study)

Project Report

June 2009
Bridge Inspector Competency Trials
‘Guide to testing and monitoring the durability of concrete structures’
Condition Monitoring Phase

- Inspections
- Periodic condition testing
- Routine automated monitoring
Diagnosis Phase

• Diagnosis testing

Solution Development Phase

• Solution development testing

• Special automated monitoring
Conclusions
Montreal
‘The fact that the physical causes were not detailed raises two questions: could the collapse, or at the very least, the existence of a major structural defect, have been foreseen, and was it avoidable?’

‘At play were both organisational and human causes that include failure to fulfill obligations and to comply with procedures, incomplete files, lack of team work, missed evaluation opportunities, and an approach that did not take into account the special character of this overpass’

‘Quebec did not rigorously and effectively deploy all the means at its disposal to properly evaluate the condition of the overpass despite numerous signs of deterioration; it also failed to maintain adequate records that could have better guided its inspection and maintenance work’
‘To the Victims of their Incompetence’
If we do CONDITION EVALUATION effectively through competent inspection, testing and monitoring then ……

SAFE FOR USE

FIT FOR PURPOSE

WELL MANAGED
The end & thank you!