INTERIM ADVICE NOTE 171/12

Risk Based Principal Inspection Intervals

Summary
This Interim Advice Note sets out the requirements and guidance for service providers using risk based inspection intervals.

Instructions for Use
This document is supplementary to BD63 and must be implemented in accordance with Clause 1.4 of the document.

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1. Introduction

1.1 General

1.1.1 BD 63/ 07 (DMRB 3.1.4) sets out the requirements for the inspection of highway structures. The required interval between Principal Inspections is six years, but allowance is made in the Standard for changing this inspection frequency subject to a risk assessment (clause 3.37)

1.2 Purpose

1.2.1 This document has been developed to support the BD 63 provision for risk based Principal Inspection intervals, enabling it to be used in a consistent manner. It sets out the requirements and guidance for carrying out a risk assessment to identify an appropriate inspection interval that allows a more efficient use of resources whilst minimising risk exposure.

1.3 Relationship

1.3.1 This IAN is supplementary to BD63. It is intended that the requirements and guidance in this IAN will be incorporated in BD63, with alterations as required following a review period.

1.4 Implementation

1.4.1 This IAN must only be used where risk based inspection intervals are permitted by contract requirements or where otherwise instructed by the Overseeing Organisation.

1.5 Scope

1.5.1 This IAN is applicable to highway structures subject to Principal Inspections in accordance with BD 63.

1.5.2 Chapter 2 of this IAN outlines the requirements for risk based Principal Inspection intervals as well as detailing the roles and responsibilities of the various parties. Chapter 3 details the risk assessment process and how it is to be used to determine the appropriate interval between Principal Inspections.

1.5.3 Only Principal Inspection intervals may be varied. General Inspection must be undertaken every two years.

1.5.4 Strategic structures, including long span structures (suspension and cable stayed bridges) and tunnels, and relatively high risk structures (including half-joint, hinge deck, segmental post-tensioned, and scour susceptible structures) must not depart from the six year Principal Inspection interval defined in BD63.

1.5.5 Structures subject to management under BD 79 ‘The Management of Sub-standard Highway Structures’ are not eligible for increased Principal Inspection intervals.

1.6 Definitions

1.6.1 The definitions for Agent and Supervising Engineer are as given in BD63.

2. General Requirements

2.1 Risk Based Inspection Intervals

2.1.1 The assessment method has been developed using the basic principles of risk analysis to support decisions as to whether increased inspection intervals may be used. It is not intended to replace engineering judgement.

2.1.2 Risk assessment considers the likelihood and consequences of failure as essentially:

Risk = f (Likelihood of Event, Consequence of Event)

2.1.3 A risk rating should be calculated for each structure under consideration based on certain parameters, representing the likelihood of an event (defect occurring, structural failure) and its potential consequences. These parameters are defined in paragraph 3.4. It is intended that by using a qualitative scoring system, structures can be ranked or grouped in terms of relative risk.

2.2 Roles and Responsibilities

2.2.1 The Agent is responsible for determining whether it is appropriate to use a risk based approach to Principal Inspection intervals for any given structure.

2.2.2 All risk assessments must be undertaken by appropriately qualified and competent staff, whose responsibility it is to make an informed decision based on the risk assessment as well as other known factors and information. The completed risk assessments must be authorised by the Supervising Engineer (see 3.7).

2.2.3 Where a structure has already been through the risk assessment process resulting in an increased interval between Principal Inspections, a review of the risk assessment must be carried out following each subsequent General Inspection. This is necessary to re-assess the inspection needs of the structure, by monitoring for signs of deterioration.

2.2.4 Where an increased Principal Inspection interval is proposed the Service Provider must send a copy of the risk assessment form to the Overseeing Organisation's Technical Approval Authority (TAA) for agreement in accordance with BD 63/07 Para 3.37. Principal Inspection intervals must not be increased without the TAA's prior written agreement.

2.3 Scheduling Inspections

2.3.1 Inspections should be scheduled to make the most efficient use of resources and to minimise disruption. It may not be beneficial to have different Principal Inspection intervals for structures on the same route.

2.3.2 Where the interval between successive Principal Inspections has been increased beyond six years, a General Inspection must be carried out in their place. When a General Inspection coincides with a due Principal Inspection only the latter needs to be undertaken. Tolerance for timeliness of inspections remains in accordance with paragraphs 3.51 and 3.52 of BD 63.

2.3.3 General Inspections must be carried out in accordance with para 3.21 of BD 63.

2.3.4 Where a risk assessment has not been carried out to increase the Principal Inspection interval beyond 6 years, intervals must remain at 6 years. Subject to the risk assessment, Principal Inspections may be held at intervals of 6, 8, 10 or 12 years. A maximum period of 12 years is permitted for cases where there is very low risk exposure.

2.3.5 Under no circumstance may a longer Principal Inspection interval be used than that determined by the risk assessment.

2.4 Records Management

2.4.1 The time to the next Principal Inspection must be recorded in the Overseeing Organisation's record management system, as defined in the Provider contract and the Asset Data Manual Provider Requirements. Inspection Schedules should then be updated to reflect any changes made to the frequency.

2.4.2 Signed and authorised risk assessments must be uploaded to the appropriate document storage module of the Overseeing Organisation's record management system, as defined in the Provider contract and the Asset Data Manual Provider Requirements.

3. Application of Risk Assessment Method

3.1 Risk Assessment Process

3.1.1 The procedure for determining risk based inspection intervals is shown in Figure 1.

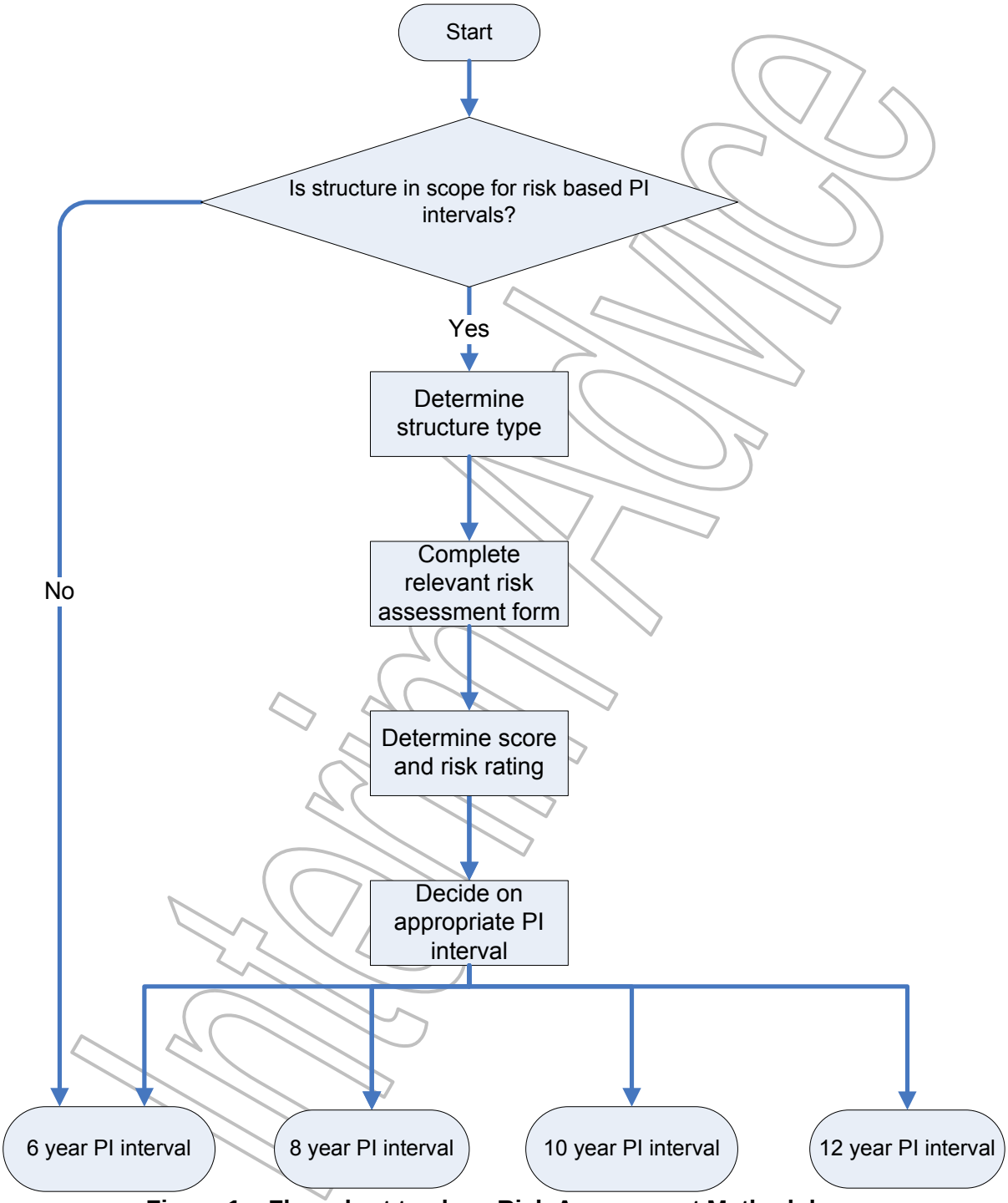

Figure 1 – Flow chart to show Risk Assessment Methodology

3.2 Risk Assessment Forms

3.2.1 Structures must be assessed using the supplied risk assessment spreadsheet forms for the structure type. The spreadsheet contains different forms for various structure types. Each form contains a set of categories and criteria that are used to assess risk. Optional attributes for the various criteria have an associated score. Scores for all criteria are then combined to give an overall risk score for a structure. This score is then used to determine the overall risk rating and recommended Principal Inspection interval (see Table 2).

3.2.2 The risk assessment's role is to assist and inform, not replace, engineering judgement on structures. Upon completion, the record management procedures described in 2.4 must be followed.

3.2.3 The risk assessment spreadsheet forms are available at the same web page as this IAN.

3.2.4 Separate risk assessment forms have been developed for each of the following structure types.

- Bridges and Large Culverts
- Small Span Structures
- Retaining Walls
- Masts and Mast Schemes
- Sign/Signal Gantries
- Service Crossings and Other Structures

3.2.5 For multi-span bridges a single risk assessment may be carried out using a combination of the worst criteria across all spans. This, however, is likely to result in a conservative score. Alternatively, each individual span may be assessed separately, with the lowest scoring span (most conservative) being used to determine the most appropriate Principal Inspection interval for the structure.

3.3 Assessment Criteria

3.3.1 The risk assessment uses five categories to cover the attributes used to ascertain the risk score. These categories are:

- Structure Type
- Environment
- Inspection/Assessment
- Condition
- Consequences

3.3.2 Within each category are the specific assessment criteria. Table 1 describes these criteria and gives the assumptions and the principles behind their selection and how they affect the scoring. Whilst it is accepted that these assumptions may not fit every situation, they should nevertheless produce a good indication of the overall level of risk exposure. Engineering judgement should then be used to determine an acceptable interval between Principal Inspections. The criteria vary slightly depending on the structure type as discussed in paragraph 3.3.1.

3.4 Source of information

3.4.1 The risk assessment has been designed such that all the input data to complete the risk assessment is readily available and accessible within the Overseeing Organisation's records management system. Table 1 suggests sources of information. The key sources are:

- Structure File records (including historical Roads 277 Form)
- Inspection reports (General and Principal Inspection Reports)
- Assessment reports
- Condition Performance Indicator reports
- Practical knowledge and experience of the structure

Table 1 – Risk Assessment Criteria

ASSESSMENT CRITERIA	COMMENTARY	SOURCE OF INFORMATION
Structure Type		
Form	Different structural forms can be expected to experience varying degrees of deterioration and have each been rated accordingly to consider this.	(a) Inventory (b) Structure File
Material	The primary constituent material will have an impact on the likelihood of deterioration. Historical performance has been evaluated for different construction materials and is reflected in the scoring.	(a) Inventory (b) Structure File
Age	The age of a structure will usually affect the likelihood and rate of deterioration. In general, it would be expected that an older structure approaching the end of its design life will encounter more maintenance issues and hence be more prone to deterioration. Newer structures may encounter initial teething problems before they are considered to be performing optimally.	(a) Inventory (b) Structure File
Span / Height / Headroom / Length	Although every structure has different design requirements, probabilistic analysis shows that bridges with longer spans and retaining walls with greater retained heights, tend to be at a higher risk of failure. Not only is the likelihood increased but also the associated consequence of failure.	(a) Inventory (b) Structure File
Environment		
Scour	Scour susceptible structures are not suitable for reduced inspection intervals.	(a) Inventory (b) Structure File (c) Scour Assessment in accordance with BA 74/06 or BD 97/12
Flooding	Structures in areas susceptible to flooding should be assessed as having increased risk.	(a) Qualitative assessment of the available information that would inform the likelihood of flooding (b) Environment Agency records
Inspection / Assessment		
Visual Access	Limited visual accessibility to critical elements will reduce the reliability of the General Inspections undertaken between Principal Inspections.	(a) Qualitative assessment of the available information on visual accessibility.
Latent defects	Some structure types are more susceptible to containing defects that are not evident during a Principal Inspection for example, post-tensioned concrete bridges with internal grouted tendons.	(a) Inventory (b) Structure File

ASSESSMENT CRITERIA	COMMENTARY	SOURCE OF INFORMATION
Assessments	Where an assessment has been carried out on a structure, a greater degree of confidence can be achieved with regard to the structure's ability to carry load. The findings of the assessment report should give a clear indication of any current load restrictions and any recommended condition factors. Any current load restrictions in place indicate that the current condition of the bridge is below design standard, resulting in a higher potential risk of deterioration.	(a) Load Management Records (b) Assessment reports (c) Interim Measures Records
Condition		
Inspector's Condition Rating	Condition is to be assessed using two criteria. The first is the Inspector's subjective condition rating of the structure (ie. Good, Fair or Poor), which should give a good overview of the condition of the structure.	(a) inspection records
Condition Performance Indicators	Secondly, Condition Performance Indicators, where available, are to be taken into account. These are an objective measure of the physical condition of the highway structures stock, calculated using the Highways Agency's Severity/Extent condition rating system[5]. They are reported for each structure on a scale of 0 to 100, where 0 represents the worst possible condition and 100 represents the best possible condition. There are two scores to consider: 1. Average Condition PI Score, PI_{Av} (based on all elements) 2. Critical Condition PI Score, PI_{Crit} (based on the most critical elements only)	(a) Condition Performance Indicator Reports
Concrete Deterioration	Any deterioration of concrete including that due to Thaumasite Sulphate Attack, Alkali Aggregate Reaction, Alkali Silica Reaction and Alkali Carbonate Reaction should be scored	(a) Inventory (b) Structure File (c) inspection records
Consequences		
Load Type	Load type may not have an impact on the likelihood of deterioration or failure. However, it will have a bearing on the overall consequence of any potential collapse.	(a) Load Management Records (b) Assessment reports (c) Interim Measures Records
Route supported and obstacle crossed	These attributes are intended to reflect the importance of the structure within the overall road network in the event of a structural collapse.	Inventory
Failure Mode	Brittle failure modes can result in collapse without warning and high consequences whereas ductile modes typically give warning of structural distress.	(a) Inventory (b) Assessment reports

3.5 Scoring System

3.5.1 The scoring system is used to determine an indicator of relative risk to support decisions on appropriate intervals between Principal Inspections.

3.5.2 The risk assessment calculations have been automated in a spreadsheet. with the five categories (3.4.1) each containing a number of criteria for which there are several attribute options with an associated score based on the level of risk. The categories are weighted according to the relative importance.

3.5.3 The spreadsheet sums the score for each category, then applies the weightings to calculate an overall score of between 0 and 100. A lower score indicates higher risk, whilst a higher score indicates lower risk.

3.5.4 In all cases where data are unknown or unobtainable, a conservative approach should be taken by applying the lowest score available. Hence, for a structure with many unknown variables, it is likely that the recommended Principal Inspection interval will remain at 6 years.

3.6 Risk Rating

3.6.1 Once the risk score has been derived, it can be used to determine the Risk Rating for the structure (High, Medium, Low or Very Low).

3.6.2 The Risk Rating is then used to determine a recommended Principal Inspection Interval (see the tables in Annex A).

3.7 Final assessment and decision

3.7.1 The recommended Principal Inspection interval is then used to assist the informed decision on the most appropriate inspection interval, based on all the information available. It does not replace engineering judgement.

3.7.2 The final decision on the most appropriate Principal Inspection interval must be recorded on the spreadsheet which should be signed by the person responsible for preparing the risk assessment, and the supervising engineer (see 2.4.1 to 2.4.2).

4. Advice and Feedback

Any feedback or requests for advice should be directed to the contact given in section 5.

5. Contacts

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6. Normative References

BD 63/07 Inspection of Highway Structures, DMRB 3.1.4, TSO.

BD 79/06 The Management of Sub-standard Highway Structures, DMRB 3.4.18, TSO.

BD 53/95 Inspection & Records for Road Tunnels, DMRB 3.1.6, TSO.

IAN 148/12 Risk assessment sheets – Department for Transport, Highways Agency Standards Webpages.- http://www.dft.gov.uk/ha/standards/index.htm

7. Informative references

Inspection Manual for Highway Structures, TSO, 2007.

Annex A: Breakdown of Risk Ratings

Total Risk Score	Risk Rating	Recommended Principal Inspection Time Interval
0 ≤ x < 65	High	6 years
65 ≤ x < 75	Medium	8 years
75 ≤ x < 85	Low	10 years
85 ≤ x ≤ 100	Very Low	12 years

Table 2 – Risk Ratings and Recommended Principal Inspection Intervals for Bridges and Large Culverts

Total Risk Score	Risk Rating	Recommended Principal Inspection Time Interval
0 ≤ x < 50	High	6 years
50 ≤ x < 60	Medium	8 years
60 ≤ x < 70	Low	10 years
70 ≤ x ≤ 100	Very Low	12 years

Table 3 – Risk Ratings and Recommended Principal Inspection Intervals for Small Span Structures

Total Risk Score	Risk Rating	Recommended Principal Inspection Time Interval
0 ≤ x < 55	High	6 years
55 ≤ x < 65	Medium	8 years
65 ≤ x < 75	Low	10 years
75 ≤ x ≤ 100	Very Low	12 years

Table 4 – Risk Ratings and Recommended Principal Inspection Intervals for Retaining Walls

Total Risk Score	Risk Rating	Recommended Principal Inspection Time Interval
0 ≤ x < 50	High	6 years
50 ≤ x < 60	Medium	8 years
60 ≤ x < 70	Low	10 years
70 ≤ x ≤ 100	Very Low	12 years

Table 5 – Risk Ratings and Recommended Principal Inspection Intervals for Masts and Mast Schemes

Total Risk Score	Risk Rating	Recommended Principal Inspection Time Interval
0 ≤ x < 50	High	6 years
50 ≤ x < 60	Medium	8 years
60 ≤ x < 70	Low	10 years
70 ≤ x ≤ 100	Very Low	12 years

Table 6 – Risk Ratings and Recommended Principal Inspection Intervals for Sign/Signal Gantries

Total Risk Score	Risk Rating	Recommended Principal Inspection Time Interval
0 ≤ x < 50	High	6 years
50 ≤ x < 60	Medium	8 years
60 ≤ x < 70	Low	10 years
70 ≤ x ≤ 100	Very Low	12 years

Table 7 – Risk Ratings and Recommended Principal Inspection Intervals for Service Crossings and Other Structures