VOLUME 3 HIGHWAY STRUCTURES INSPECTION AND MAINTENANCE

SECTION 4 ASSESSMENT

PART 2

BD 50/92

TECHNICAL REQUIREMENTS FOR THE ASSESSMENT AND STRENGTHENING PROGRAMME FOR HIGHWAY STRUCTURES

STAGE 3 - LONG SPAN BRIDGES

INTRODUCTION

This Standard identifies the structures to be included in Stage 3 of the bridge assessment programme and sets out the procedures to be adopted for assessment, strengthening and subsequent recording of the results of these activities.

INSTRUCTIONS FOR USE

This is a new document to be incorporated into the Manual.

1. Remove existing contents pages for Volume 3 and insert new contents pages for Volume 3, dated December 1992.

2. Insert BD 50/92 into Volume 3, Section 4.

3. Archive this sheet as appropriate.

THE HIGHWAYS AGENCY BD 50/92

THE SCOTTISH OFFICE DEVELOPMENT DEPARTMENT

THE WELSH OFFICE
Y SWYDDFA GYMREIG

THE DEPARTMENT OF THE ENVIRONMENT FOR
NORTHERN IRELAND

Technical Requirements for the Assessment and Strengthening Programme for Highway Structures

Stage 3 - Long Span Bridges

Summary: This Standard sets out the technical requirements for a programme of assessment and strengthening of long span bridges on motorways and other trunk roads.

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Volume 3 home page

REGISTRATION OF AMENDMENTS

Amend No	Page No	Signature & Date of incorporation of amendments	Amend No	Page No	Signature & Date of incorporation of amendments

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1. INTRODUCTION

General

1.1 The Overseeing Department is currently undertaking a comprehensive programme of assessment and strengthening (the term hereinafter also covers reconstruction) of its highway structures on motorways and other trunk roads to ensure that they are adequate for present day and foreseeable future traffic needs. This Standard is intended to provide the technical requirements for Stage 3 of the programme which will cover long span bridges as defined in 1.2.

Stage 1 of the programme primarily covered older structures not known to have been designed to any modern loading requirement. The technical requirements for Stage 1 are given in Standard BD 34 (DMRB 3.4) and the accompanying Advice Note BA 34 (DMRB 3.4).

Stage 2 of the programme mainly covered relatively modern short span bridges where there might be certain design deficiencies. The technical requirements for Stage 2 are given in BD 46 (DMRB 3.4.1).

1.2 Long span bridges are defined as those bridges which have one or more loaded lengths (the term is defined in BD 37 (DMRB 1.3)) in excess of 50 metres. Such bridges can generally be identified by the following criteria:-

i) For single span bridges, the effective span exceeds 50 metres.

ii) For multi-span bridges, whose individual spans are simply supported, the sum of any two adjacent spans exceeds 50 metres.
[Note: An influence line covering two adjacent simply-supported spans is relevant for the gross reaction at the intermediate pier ie for the assessment of the pier and its foundation. For steel bridges, unless some other spans come under criteria (i), (iii) or (iv), only the intermediate piers are to be assessed in Stage 3. However, all parts of concrete bridges coming under this criterion shall be assessed in Stage 3 as such bridges may be deficient with respect to certain recent design requirements and were excluded from Stage 2].

iii) For continuous construction the sum of any two adjacent spans exceeds 50 metres.

iv) For cantilever/suspended - span construction, any suspended portion of the deck exceeds 50 metres or the sum of any suspended portion and the cantilever on any one side with its adjacent span exceeds 50 metres. For the rest of the adjacent structure criterion (iii) applies.

The overall length of a bridge structure is not a necessary criterion for classification into the long span bridge category.

1.3 With the exception of the loading criteria, which are dealt with in 2.3 to 2.6.4, the structures shall be assessed in accordance with Standard BD 21 (DMRB 3.4) together with Advice Note BA 16 (DMRB 3.4) these remain the primary documents for assessment. However, it should be noted that various provisions in these documents relating to material strength and analysis methods may only be appropriate for older structures. Therefore, where applicable, the requirements of BD 44 (DMRB 3.4) (with associated Advice Note BA 44 (DMRB 3.4)) shall prevail for the assessment of concrete bridges and elements. For the time being BD 13 (DMRB 1.3) shall be used as guidance for steel bridges and BD 16 (DMRB 1.3) for composite bridges. The Overseeing Department intends to issue assessment versions of these two Standards in the future.

1.4 Any structure which is found to be sub-standard when assessed for a 40 tonnes Assessment Live Loading shall be strengthened.

1.5 Structures which can carry the 40 tonnes Assessment Live Loading shall also be assessed for Type HB loading and, if applicable, for any abnormal vehicle loadings specified by the Overseeing Department, which were not used either in the original design or in any recent assessment.

Purpose

1.6 The purpose of this Standard is to identify the structures to be included in Stage 3 of the bridge assessment programme, and to set out the procedures to be adopted for assessment, strengthening and the subsequent recording of the results of these activities.

Scope

1.7 The following types of structures owned by the Overseeing Department and not included in Stages 1 and 2 shall be assessed in Stage 3:

(i) Long span concrete, steel and composite bridges constructed by the end of 1985 not known to have been designed to the Interim Revised Loading Specification (IRLS, September 1983) rules now incorporated into BD 37 (DMRB 1.3).

(ii) Long span bridges which are at present subject to weight and/or traffic restrictions for loading reasons.

(iii) Long span bridges which are thought to have a reduced load carrying capacity as a result of deterioration.

[See 1.2 for definition of long span bridges. All others are to be considered as short span.]

1.8 Substructures and foundations shall be assessed in accordance with BD 21 (DMRB 3.4) and BD 34 (DMRB 3.4) as applicable.

Implementation

1.9 In England and Wales this Standard is to be implemented forthwith in accordance with the procedures for Maintenance Agents set out in the Trunk Road Maintenance Manual.

1.10 In Scotland this Standard is to be implemented by Maintenance Agents as soon as the Stage 3 Assessment Programme has been agreed with the Roads Directorate of The Scottish Office Industry Department.

1.11 In Northern Ireland this Standard is to be implemented forthwith and, since the Department of the Environment for Northern Ireland does not operate an agency system, supplementary implementation procedures are unnecessary.

2. ASSESSMENTS

Inspections for Assessment

2.1 Inspections for assessment shall be carried out in accordance with BD 21 (DMRB 3.4). Where a General or Principal Inspection is due, the opportunity may be taken to combine that inspection with the inspection needed for assessment. In England and Wales, see Trunk Road Management and Maintenance Notice TRMM 2/88. In Scotland see Technical Memorandum SB 1/78.

2.2 Whilst carrying out such inspections the opportunity shall be taken to update the structure records. In England and Wales, such records include Form ROADS 277 and Form BE 13/86.

Loading

2.3 The loading criteria (with the following modifications) and the overall principles of assessment shall be in accordance with Standard BD 21 (DMRB 3.4) and Advice Note BA 16 (DMRB 3.4) and Amendments to both documents. Long span bridges shall be assessed using the nominal HA uniformly distributed load (UDL) and knife edge load (KEL) specified in BD 37 (DMRB 1.3), reduced by the application of reduction factors, to two levels of Assessment Live Loading, 40 tonnes and 7.5 tonnes. The corresponding reduction factors for loaded lengths greater than 50 metres shall be 0.91 and 0.4 respectively. For loaded lengths less than or equal to 50 metres, the reduction factors for these two levels given in BD 21 (DMRB 3.4) shall apply.

2.4 When a long span bridge is found to be inadequate with respect to the 40 tonnes Assessment Live Loading, an alternative 40 tonnes Bridge Specific Assessment Live Loading (BSALL) may be derived individually for that bridge, with the agreement of the Overseeing Department. As traffic surveys and computer analyses necessary for such load derivation are likely to be costly and time consuming, the Overseeing Department should agree to such a procedure only when there is a reasonable possibility of improving the assessed load capacity. Such cases may arise where the 40 tonnes assessment fails by a small margin and the bridge is located on a lightly trafficked road.

2.5 Where the Overseeing Department agrees to the derivation of a BSALL, based on traffic surveys at a particular long span bridge site, provision shall be made to take account of any future changes of traffic patterns, by regular comparison surveys, at intervals not exceeding 2 years (or as stipulated by the Assessing Engineer) from the date of the original traffic survey. Due allowance shall also be made for any changes in traffic patterns caused by re-routing or disruptions due to major bridge or highway maintenance works in the locality.

2.6 Collection of traffic loading data and the derivation of the BSALL shall be the responsibility of the Assessing Engineer. However, the following criteria may be used as the minimum required for the purpose:

i. Traffic surveys should take place over 7 continuous days, from 4am until 10pm, preferably in the months of April or October. The survey should establish:

a) The frequency distribution of each vehicle type (including light goods vehicles and cars), for each traffic lane and for each hour.

b) The traffic flow rates within each lane for each hour of the day.

c) The gross vehicle axle weights and the vehicle overall length.

d) Queue formation and lane selection details in traffic jam situations.

ii. Automatic data collection using WIM (weigh in motion) equipment may be used to determine vehicle lengths and axle weights. Alternatively, manual counts may be used in conjunction with a weighbridge static survey and/or a related database of vehicle dimensions and axle weights.

iii. Probability methods, for example those referred to in TRRL Contractor Report 16, shall be applied to the traffic survey data to determine the characteristic 40 tonnes BSALL, in excess of 50 metres length, for the particular bridge site, which will have a 5% probability of occurrence in a period of 120 years. The nominal 40 tonnes BSALL shall be derived from the characteristic loading by dividing it by a

factor of 1.2.

iv. For loaded lengths in excess of 50 metres the effects of crowding vehicles into a lane (lateral bunching factor) or dynamic impact (impact factor) need not normally be considered. The effects for any overloaded vehicles (overload factor) will normally be contained within the survey statistics.

Materials

2.7 With respect to material strength and procedures, the assessment of concrete elements shall be carried out in accordance with BD 44 (DMRB 3.4) and BA 44 (DMRB 3.4). Pending the publication of their assessment versions, BD 13 (DMRB 1.3) and BD 16 (DMRB 1.3) (with respect to steel and composite elements) shall be used for assessment. Assessment for fatigue of steel structures shall be carried out using BD 9 (DMRB 1.3) and BA 9 (DMRB 1.3) as appropriate.

Initial Assessment

2.8 An initial assessment may be carried out using conservative estimates of strength parameters. However, if a bridge fails the initial assessment, a more refined analysis may be considered appropriate. When carrying out a more refined analysis, particularly for a structure which appears to be only marginally sub-standard, the assumptions about material properties and the dimensions of structural elements etc used in the analysis shall be thoroughly verified. In the case of metal structures the positions of those elements which are in the poorest condition may not necessarily correspond with the positions of maximum load effect. In the case of concrete structures tests may indicate that the strength of concrete or reinforcement is higher than that assumed in the original design.

2.9 If a bridge is considered to be seriously inadequate at any stage during assessment, it will be for the Overseeing Department to determine what initial action, if any, is appropriate to safeguard public safety and the integrity of the structure. In England, the TAA will advise the Overseeing Department. If, on completion of the assessment, strengthening measures are shown to be necessary, the Overseeing Department will determine which interim measures, if any, shall be appropriate until such time as the strengthening can be carried out. Advice on this subject is given in BA 34 (DMRB 3.4).

Interim Measures

2.10 Structures which are assessed as being unable to carry the 40 tonnes Assessment Live Loading (or the BSALL) shall be strengthened (See 2.13). However, as it will not usually be possible to commence strengthening immediately, it will be necessary to undertake some interim measures such as the imposition of a temporary weight/lane restriction, or actions such as propping. The appropriate courses of action are described in BD 21 (DMRB 3.4). BD 21 (DMRB 3.4) specifies levels of restricted loading for substandard structures which are related to the maximum gross weights of certain vehicle types. (See also 2.3). Of these only the 7.5 tonnes weight restriction level shall be used for long span bridges. Emergency and Public Service Vehicles may be exempted, with the agreement of the Overseeing Department, where there is no likelihood of queue formation.

2.11 Any restriction signs shall comply with the requirements of BD 21 (DMRB 3.4).

2.12 Interim measures shall not be applied until the necessary approval procedures, for restriction signs referred to in 2.11 above, have been carried out.

Strengthening

2.13 Strengthening works shall be designed as for new structures in accordance with the standards given in the Technical Approval Schedule (TAS) current at the time.

Technical Approval Procedures

2.14 Technical approval procedures shall be carried out in accordance with BD 2 Part 1 (DMRB 1.1). The Advice Note associated with this Standard is BA 32 (DMRB 1.1). In N Ireland the DOE(NI) Roads Service, Technical Approval Scheme shall be used.

Documentation

2.15 In England and Wales only, structural assessment reports are to be completed and submitted on Forms AHS/2v and AHS/2vi. The forms are identical, except for minor changes, to Forms AHS/2i and AHS/2ii used in the Stage 1 assessments and shall be completed in accordance with BD 34 (DMRB 3.4). In Scotland, forms similar to those used in the Stage 1 Assessment shall be completed in accordance with the Scottish Addendum to BD 34 (DMRB 3.4).

3. REFERENCES

The following documents should be referred to in conjunction with this Standard:

1. Design Manual for Roads and Bridges

Volume 1: Section 1 Approval Procedures

BD 2/89 (DMRB 1.1) - Technical Approval of Highway Structures on Motorways and Other Trunk Roads Part 1: General Procedures. [In N Ireland refer to DOE(NI) Roads Service, Technical Approval Scheme.]

BA 32/89 (DMRB 1.1) - Technical Approval of Highway Structures on Motorways and Other Trunk Roads Part 1: General Procedures. [This Advice Note does not apply in N.Ireland.]

Volume 1: Section 3 General Design

BD 9/81 (DMRB 1.3) - Implementation of BS 5400: Part 10: 1980 Code of Practice for Fatigue.

BA 9/81 (DMRB 1.3) - The Use of BS 5400: Part 10: 1980

BD 13/90 (DMRB 1.3) - Design of Steel Bridges: Use of BS 5400: Part 3: 1982

BD 16/82 (DMRB 1.3) - Design of Composite Bridges: Use of BS 5400: Part 5: 1979

BD 37/88 (DMRB 1.3) - Loads For Highway Bridges.

Interim Revised Loading Specification (now embodied in BD 37), 1983.

Volume 3: Section 1 Inspection

Technical Memorandum SB 1/78 (DMRB 3.1) - The Inspection of Highway Structures. [For use in Scotland only]

Volume 3: Section 4 Assessment

BD 21/84 (DMRB 3.4) and BA 16 (DMRB 3.4) - The Assessment of Highway Bridges and Structures.

BD 34/90 (DMRB 3.4) and BA 34/90 (DMRB 3.4) - Technical Requirements for the Assessment and Strengthening Programme for Highway Structures, Stage 1 - Older Short Span Bridges and Retaining Structures.

BD 44/90 (DMRB 3.4) and BA 44/90 (DMRB 3.4) - The Assessment of Concrete Highway Bridges and Structures.

BD 46/92 (DMRB 3.4.1) - Technical Requirements for the Assessment and Strengthening Programme for Highway Structures, Stage 2 - Modern Short Span Bridges.

2. TRMM 2/88: Trunk Road Management and Maintenance Notice: Trunk Road and Motorway Structures - Records and Inspection: March 1988.

3. TRRL Contractor Report 16 - Interim Design Standard: Long Span Bridge Loading - Flint & Neill Partnership, 1986.

4. Trunk Road Maintenance Manual: Volume 1 - Highways Maintenance Code: April 1992.

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All technical enquiries or comments on this Standard should be sent in writing as appropriate to:-

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