VOLUME 3 HIGHWAY STRUCTURES INSPECTION AND MAINTENANCE

SECTION 4 ASSESSMENT

PART 1

BD 46/92

TECHNICAL REQUIREMENTS FOR THE ASSESSMENT AND STRENGTHENING PROGRAMME FOR HIGHWAY STRUCTURES - STAGE 2 - MODERN SHORT SPAN BRIDGES

INTRODUCTION

This Standard identifies the structures to be included in Stage 2 of the programme, highlights aspects of structural adequacy which should be assessed, and sets out the procedures for assessment, strengthening and 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.
2. Insert new contents pages for Volume 3, dated August 1992.
3. Insert BD 46/92 into Volume 3, Section 4.
4. Archive this sheet as appropriate.

THE HIGHWAYS AGENCY **BD 46/92**

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 2 - Modern Short Span Bridges

Summary: This Standard descibes the procedures for the assessment and strengthening of highway structures included within Stage 2.

Printed and Published by the
above Overseeing Departments

Price: £1.00

REGISTRATION OF AMENDMENTS

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

REGISTRATION OF AMENDMENTS

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

VOLUME 3	HIGHWAY STRUCTURES INSPECTION AND MAINTENANCE
SECTION 4	ASSESSMENT

PART 1

BD 46/92

TECHNICAL REQUIREMENTS FOR THE ASSESSMENT AND STRENGTHENING PROGRAMME FOR HIGHWAY STRUCTURES - STAGE 2 - MODERN SHORT SPAN BRIDGES

Contents

Chapter

1. Introduction

2. Assessment

3. References

4. Enquiries

1. INTRODUCTION

1.1 The Overseeing Department is currently undertaking a comprehensive programme of assessment and strengthening (the term hereinafter covers both strengthening and 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. Stage 1 of the programme primarily covered older structures not designed to any modern loading requirement. The technical requirements for that stage are given in BD 34 (DMRB 3.4) and the accompanying BA 34 (DMRB 3.4). This Standard is intended to deal with Stage 2 of the programme covering mainly more modern short span bridges which may be inadequate as a result of significant changes in design criteria since they were constructed.

1.2 The structures shall be assessed in accordance with BD 21 (DMRB 3.4) together with BA 16 (DMRB 3.4), which 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 and therefore, where applicable, the requirements of BD 44 (DMRB 3.4) with associated BA 44 (DMRB 3.4) shall prevail for the assessment of concrete bridges. For the time being BD 13 (DMRB 1.3) and BD 16 (DMRB 1.3) shall be used as guidance for steel and composite bridges. The Overseeing Department intends to issue assessment versions of BD 13 (DMRB 1.3) and BD 16 (DMRB 1.3) in the future. The loading requirements of BD 21 (DMRB 3.4) still remain applicable and any structure which is found to be inadequate when assessed for the 40 tonnes Assessment Live Loading shall be strengthened.

1.3 In addition, structures which can carry the 40 tonnes Assessment Live Loading shall be assessed to determine an HB rating and, if applicable, assessed for specific abnormal vehicle loads but only if such capacities are not known from any recent assessment.

1.4 The programme of assessment and strengthening of trunk road bridges forms a part of the Bridge Rehabilitation Programme being undertaken by the Overseeing Department.

Purpose

1.5 The purpose of this Standard is to identify the structures to be included in Stage 2 of the programme, to highlight the aspects of structural adequacy which should be assessed and to set out the procedures to be adopted for assessment, strengthening and the subsequent recording of the results of these activities.

Scope

1.6 The following types of structures owned by the Overseeing Department shall be assessed in Stage 2, subject to the exceptions given in 1.7:

i. Concrete and composite bridges

ii. Reinforced concrete retaining walls

iii. Reinforced concrete buried structures

iv. Structures which are at present subject to weight and/or traffic restrictions for loading reasons

v. Structures which are thought to have a reduced load carrying capacity as a result of deterioration.

vi. Steel or composite bridges which are suspected to be grossly inadequate in some aspects of current design practice, for example those without bearing stiffeners or those with deformation in excess of the shape limitation criteria.

vii. Steel bridges of spans up to 15 metres with non-compact sections (unless designed to 45 units of HB loading current at the time of construction).

[Note: The last item has been included because bridges designed for 30 units of HB loading were exempted from Stage 1 as it was generally believed that those structures would be adequate for the current assessment loading; however, a recent study has shown that this may not be true for the type of bridge concerned and hence it is being included in Stage 2.]

1.7 The following structures shall not be assessed in Stage 2:

i. Structures included in Stage 1 of the assessment programme or structures constructed after 1975.

ii. Long span bridges, ie bridges which have one or more loaded lengths (the term loaded length is defined in BD 37 (DMRB 1.3)) in excess of 50 metres. Such bridges are generally identified by the following criteria:-

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

(b) For multi-span bridges, whose individual spans are simply supported, the sum of any two adjacent spans exceeds 50 metres.

(c) For continuous construction, the sum of any two adjacent spans exceeds 50 metres.

(d) 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 either side with its adjacent span exceeds 50 metres. For the rest of the adjacent structure criterion (c) applies.

The overall length of a bridge or a viaduct is not a criterion for its classification as a long span bridge.

iii. Structures known to have been designed to concrete shear criteria given in BE 1/73 (DMRB 2.3).

iv. Bridges, culverts, buried structures used as under-passes, pedestrian subways and cattle creeps of less than 1.8 metres span, multi-cell culverts where the cumulative span is 5 metres or less and retaining walls of height 1.5 metres or less from the finished ground level in front of the wall to the top of the wall.

v. Culverts and buried structures of 3 metres span or less with a cover from the top of the structure to the finished road level of 1 metre or more.

vi. Culverts and structures which are buried to an extent that highway loading is only of marginal significance when compared with the magnitude of earth pressure acting on the structure.

vii. Structures carrying accommodation roads and other non-public roads.

viii. Dry stone retaining walls.

ix. Corrugated steel buried structures.

1.8 Piled foundations are not required to be assessed where there are no apparent signs of distress.

1.9 Assessments of short-span bridges and other structures not covered by Stages 1 or 2 of the present programme of assessment and strengthening may be needed under normal bridge management procedures.

Additional Assessment Items

1.10 Serviceability. For Stage 1, there was no requirement for checking the adequacy of a structure at the serviceability limit state (SLS). The reason for this is that older bridges would by now show clear signs of deterioration if they were inadequate in this respect. However, this argument is not valid with respect to the more recently constructed bridges. Therefore in Stage 2, SLS checks, using the partial safety factors for loads and load combinations given in BD 37 (DMRB 1.3), are to be carried out for the 40 tonnes Assessment Live Loading and the following actions taken as appropriate.

i. Once a bridge is assessed to be inadequate at the Serviceability Limit State, in general, no immediate strengthening measures need to be taken. The type, location and severity of the failure are to be recorded and should be borne in mind during subsequent bridge management activities such as inspections and resurfacing etc. It should be noted that SLS failures do not imply any immediate or short-term risk to the structure, although they may indicate a possible threat to its long-term durability.

ii. If the SLS failure is of a significant magnitude, increased frequency of inspection may be advisable. If the failure is of a type that could cause cracking of unexposed concrete surfaces, calculations to determine crack widths must be carried out. It should be noted that the crack width formula for reinforced concrete is not appropriate for prestressed concrete, which should be treated as partially prestressed concrete for this purpose. If the calculated crack widths are in excess of, say, 0.3 mm, the need for further action should be considered, especially if there is a possibility of the ingress of deleterious substances such as road salt solutions, for example at concrete surfaces just below the road surfacing layer. In considering the need for remedial action, the age of the bridge and the

type and effectiveness of the waterproofing system etc should be taken into account. It may be necessary to expose a part of the deck surface, say 1m2 (under the footway if possible), in order to examine the type of waterproofing membrane present. It may also be worthwhile at the same time to determine the chloride content of the deck material and check for the appearance of any cracks under live load conditions. Alternatively, such investigations and possible renewal of the waterproofing system and other repairs may be postponed until the next resurfacing round.

Implementation

1.11 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, Section 4.2.3.

1.12 In Scotland this Standard is to be implemented by the Maintenance Agents as soon as the Stage 2 Assessment Programme has been agreed with the Roads Directorate of the Scottish Office Industry Department.

1.13 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. ASSESSMENT

Inspections for Assessment

2.1 Inspections for assessment shall be carried out in accordance with Section 4 of 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, 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 structure records. In England, such records include Form ROADS 277 and Form BE 13/86.

Assessments

2.3 The loading criteria and the overall principles of assessment shall be in accordance with BD 21 (DMRB 3.4) and BA 16 (DMRB 3.4).

2.4 With respect to material strength and procedures the assessment of concrete elements shall be carried out, where applicable, in accordance with BD 44 (DMRB 3.4) and BA 44 (DMRB 3.4). Assessment versions of BD 13 (DMRB 1.3) and BD 16 (DMRB 1.3) are under preparation.

2.5 Whenever possible, quick and simple cost-effective assessment methods shall be used in the first instance. However, as these methods are generally conservative, they are likely to underestimate the carrying capacity of structures. Therefore, where such methods indicate that a structure may be sub-standard, more refined methods of assessment shall then be applied.

2.6 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 is considerably higher than that assumed in the original design.

2.7 During the assessment stage, 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 also determine which interim measures 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

2.8 Structures which are assessed as being unable to carry the 40 tonnes Assessment Live Loading shall be strengthened. However, as it will not usually be possible to commence strengthening immediately, it will generally be considered necessary, except on structures which can carry the 38 tonnes Assessment Live Loading (ie all vehicles within the current Construction and Use Regulations), 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) which also specifies levels of restricted loading for substandard structures which are related to the maximum gross weights of certain vehicle types.

2.9 The restriction signs shall comply with the requirements of BD 21 (DMRB 3.4).

2.10 Interim measures shall not be applied until the necessary technical approval procedures, for restriction signs referred to in 2.9 above, have been carried out.

Strengthening

2.11 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

2.12 Technical approval procedures shall be carried out in accordance with BD 2 Part 1 (DMRB 1.1) and BA 32 (DMRB 1.1). In N Ireland, the DoE(NI) Roads Service, Technical Approval Scheme should be used.

Documentation

2.13 In England and Wales, structural assessment reports are to be completed and submitted on Forms AHS/2iii and AHS/2iv. 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), Clause 9. 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

3.1 Design Manual for Roads and Bridges

Volume 1: Section 1 Approval Procedures

BD 2 (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 (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 13 (DMRB 1.3) - Design of Steel Bridges: Use of BS 5400: Part 3: 1982

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

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

Volume 2: Section 3 Materials and Components

BE 1/73 (DMRB 2.3) - Reinforced Concrete for Highway Structures (including 1st Revision (9 August 1973) but not including Amendment No. 1 (31 December 1979)).

Volume 3: Section 1 Inspection

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

Volume 3: Section 4 Assessment

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

BD 34 (DMRB 3.4) and BA 34 (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 (DMRB 3.4) and BA 44 (DMRB 3.4) - The Assessment of Concrete Highway Bridges and Structures.

3.2 Trunk Road Maintenance Manual: Volume 1 - Highways Maintenance Code: (April 1992).

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

4. ENQUIRIES

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

Chief Highway Engineer
The Department of Transport
St Christopher House
Southwark Street
London SE1 OTE

T A ROCHESTER
Chief Highway Engineer

The Deputy Chief Engineer, Roads Directorate
The Scottish Office Industry Department
New St. Andrew's House
Edinburgh
EH1 3TG

J INNES
Deputy Chief Engineer

The Director of Highways
Welsh Office
Y Swyddfa Gymreig
Government Buildings
Ty Glas Road
Llanishen
Cardiff CF4 5PL

K J THOMAS
Director of Highways

Chief Engineer - Roads Service
Dept. of the Environment for
Northern Ireland
Commonwealth House
Castle Street
Belfast BT1 1GU

W J McCOUBREY
Chief Engineer - Roads Service

Orders for further copies should be addressed to:-

DOE/DOT Publications Sales Unit
Government Building
Block 3, Spur 2
Lime Grove
EASTCOTE HA4 8SE

Telephone No: 081 - 429 5170