
**VOLUME 3 HIGHWAY STRUCTURES
INSPECTION AND
MAINTENANCE**
SECTION 4 ASSESSMENT

PART 22

BD 101/11

**STRUCTURAL REVIEW AND
ASSESSMENT OF HIGHWAY
STRUCTURES**

SUMMARY

This standard gives the requirements and guidance for Structural Review and Assessment of highway structures.

INSTRUCTIONS FOR USE

1. Insert BD 101/11 into Volume 3, Section 4.
2. Please archive this sheet as appropriate.

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THE HIGHWAYS AGENCY



TRANSPORT SCOTLAND

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Welsh Government



THE DEPARTMENT FOR REGIONAL DEVELOPMENT
NORTHERN IRELAND

Structural Review and Assessment of Highway Structures

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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

Background

1.1 This standard gives requirements and guidance for Structural Review and Assessment of highway structures. Structural Review will be used to support decisions on whether highway structures are required to undergo Assessment. BD 34/90, BA 34/90, BD 46/92 and BD 50/92 are hereby withdrawn.

1.2 Road vehicles in the United Kingdom are categorised for regulatory purposes into three broad groups as given below:

- 1.2.1 Vehicles complying with The Road Vehicles Construction and Use (C&U) Regulations and Authorised Weight (AW) Regulations. This group includes cars, light goods vehicles, and rigid and articulated heavy goods vehicles up to a gross weight of 44 tonnes. These vehicles are covered by the C&U and AW Regulations and are not subject to permit and notification requirements. For convenience, the term AW referred to hereinafter will be taken to include C&U. The effects of these AW vehicles are assessed in accordance with BD 21 (DMRB 3.4.3).
- 1.2.2 Vehicles complying with The Road Vehicles (Authorisation of Special Types) General Order (STGO Regulations). This group includes vehicles that do not comply with the AW Regulations such as those used for carrying or drawing abnormal indivisible loads. Vehicle operators are required to provide notification of vehicle movements in accordance with STGO Regulations. The effects of STGO vehicles are assessed in accordance with BD 86 (DMRB 3.4.19).
- 1.2.3 Special Order (SO) Vehicles. This group includes vehicles that do not comply with the AW or STGO Regulations and is covered by Section 44 of the 1988 Road Traffic Act. Vehicle operators are required to submit to the Overseeing Organisation an application for an individual Special Order authorising the movement of an SO vehicle. In Northern Ireland the equivalent vehicles are covered by Article 60 of the Road Traffic (Northern Ireland) Order 1995. The effects of SO vehicles are assessed in accordance with BD 86 (DMRB 3.4.19).

1.3 Overseeing Organisations have undertaken comprehensive programmes of bridge Assessment and strengthening. The aim of these programmes was to ensure the bridge stock could safely carry AW vehicles. However, for those bridges that could safely carry AW Vehicles, the assessed HB capacity (for STGO vehicles) was occasionally less than required. Also studies have shown that the HB loading model does not represent accurately the effects of real STGO and SO vehicles, and is particularly onerous for structures with loaded lengths of less than 10m. Thus the concept of assessing for STGO and SO vehicles was introduced by BD 86 – The Assessment of Highway Bridges and Structures for the Effects of Special Types General Order (STGO) and Special Order (SO) Vehicles (DMRB 3.4.19). This offers the benefit of attainment of higher load capacity ratings, particularly for structures with loaded lengths of less than 10m. This may assist in avoiding the need for costly and disruptive strengthening work. Although HB capacity is still used in some cases as a comparator for determining some Abnormal Load routes, the intention is that use of HB ratings will be phased out (see BD 86 (DMRB 3.4.19)).

Objectives

1.4 This standard introduces a system for Structural Review and Assessment of structures as recommended by ‘Management of Highway Structures – A Code of Practice’ (reference 3.3).

1.5 The objective of Structural Review and Assessment of highway structures is to meet and maintain the operational requirements of the route and network.

1.6 Structural Review and, where necessary, Assessment and strengthening are ongoing activities in the management of highway structures, ensuring that the operational capacity available reflects the needs of the network, including STGO and SO vehicle movements. This will ensure that the capacities of structures are kept up-to-date and reduce the risk of structural inadequacy due to ongoing deterioration, accidental or other damage, changes in vehicle loading, and changes in design and Assessment standards.

1.7 Structural Review and Assessment contributes to route strategies, for example enabling identification of the points of lowest capacity on a route and supporting decisions on route upgrades.

1.8 Structural Review and Assessment also contributes to maintenance strategies. For example, by capturing the Reserve Factors of the bridge stock, and recording them in the Overseeing Organisations' records management system, data on the change in Reserve Factor over time can be used to support decisions on maintenance interventions.

Scope

1.9 Requirements and guidance are provided on:

- a) Structural Review – the method of establishing whether structures need to undergo Assessment.
- b) Assessment procedures and reporting.

1.10. This standard is applicable to the following highway structures:

- a) Bridge, buried structure, subway, underpass, culvert and any other structure supporting the highway and subject to applied vehicular traffic loading with clear span or internal diameter of 1.8m or greater (2.0m in Scotland) except that corrugated steel buried structures are included if they have spans of 0.9m or more.
- b) Earth retaining structures (as defined in BD 62) with an effective retained height of 1.5m or greater, and subject to applied vehicular traffic loading.
- c) Reinforced/strengthened soil/fill structure with hard facings (as defined in BD 62) with an effective retained height of 1.5m or greater, and subject to applied vehicular traffic loading.

1.11 This standard may be applied to highway structures which are outside the descriptions in paragraph 1.10 (such as footbridges), provided this is agreed or specified by the Overseeing Organisation.

Mandatory Sections

1.12 Sections of this document containing mandatory requirements are identified by being contained in boxes. These requirements must be complied with or a prior agreement to a Departure from Standard must be obtained from the Overseeing Organisation. The text

outside boxes contains advice and explanation, which is commended to users for consideration.

Implementation

1.13 This Standard must be used forthwith on all projects for the Assessment, design, construction, operation, management and maintenance of motorway and all-purpose trunk roads (and all roads in Northern Ireland) except where procurement of works has reached a stage at which, in the opinion of the Overseeing Organisation, its use would result in significant additional expense or delay progress (in which case the decision must be recorded in accordance with the procedure required by the Overseeing Organisation).

Definitions and Abbreviations

1.14 For the purpose of this standard the following definitions apply:

- i) Structural Review: A Review of an individual structure or group of structures, within the highway structures stock, to establish or confirm the validity of the latest Assessment (or original design, if there has been no subsequent Assessment) and identify any need for further assessment.
- ii) Assessment: Inspections and determination of load carrying capacity of a structure or part of a structure in terms of either full AW loading or specified gross vehicle weights, or other applied vehicle loading (including impact).
- iii) Condition Factor: As defined in BD 21 (DMRB 3.4.3).
- iv) Reserve Factor: As defined in BD 86 (DMRB 3.4.19).
- v) SO Vehicles, STGO Vehicles and SV Load Models: As defined in BD 86 (DMRB 3.4.19).
- vi) Type HB Loading: As defined in BD 37 (DMRB 1.3.14).
- vii) Vehicle Rating: As defined in BD 86 (DMRB 3.4.19).
- viii) Technical Approval Authority: As defined in BD 2 (DMRB 1.1).

1.15 The following abbreviations are used in this standard:

AIP	Approval in Principle
ALL	Assessment Live Loading
AW	Authorised Weight
BS	British Standard
BSALL	Bridge Specific Assessment Live Loading
DMRB	Design Manual for Roads and Bridges
SO	Special Order
STGO	Special Type General Order
SV	Special Vehicle
TAA	Technical Approval Authority
VR	Vehicle Rating

2. THE STRUCTURAL REVIEW AND ASSESSMENT PROCESS

General

2.1 The process comprises two stages. The first stage is the Structural Review. The second stage is Assessment (or part Assessment) in accordance with the appropriate DMRB Assessment standard. The Structural Review is used to determine whether the second stage is required.

Structural Review

2.2 Structural Reviews should only be carried out if the need arises. Events that might trigger a Structural Review include changes in:

- condition (detected by the inspection programme);
- operational load carrying requirements;
- Assessment standards.

2.3 Structures with known load management problems should be Reviewed at the earliest opportunity.

2.4 The Structural Review must identify the validity of existing Assessment records, changes in Assessment and design standards, changes in condition of the structure from inspection reports and changes to the required operational capacity of the network, including STGO and SO vehicles. Changes in condition of the structure might result from deterioration, accidental damage or vandalism. STGO and SO load capacity requirements for a particular structure must be agreed with the TAA.

2.5 The Structural Review should be carried out in the light of DMRB Assessment standards current at the time of the Review. It will be for the Reviewer to consider any differences between the current Assessment standards and the standards used for previous Assessment or design, and to make a recommendation as to whether those differences are significant.

2.6 Unless otherwise specified, the Structural Review is not expected to verify the accuracy of existing Assessment calculations. Notwithstanding this, any obvious inaccuracies noted may be considered in the Structural Review.

2.7 Structures with a Structural Review confirming they have previously been assessed and their capacity recorded as 40 tonne ALL and 45 units of HB with no significant change in condition may, if necessary and with the agreement of the TAA, have their corresponding Reserve Factors for SV load models ascertained using the conversion charts given in BD 86 (subject to the stated limitations). It is intended that over time Vehicle Ratings will replace HB ratings as an indication of the STGO and SO load capacity of a bridge.

2.8 The Structural Review process is illustrated in the flowchart in Annex A.

2.9 The Structural Review must be documented in a Record of Structural Review Form in accordance with the format shown in Annex B, summarising the evidence considered together with a recommendation as to whether an Assessment is required.

2.10 The Record of Structural Review Form must be submitted to the TAA for acceptance and the completed form must be recorded in the Overseeing Organisation's records management system in accordance with BD 62.

Assessment

2.11 An Assessment must not be carried out unless the Structural Review recommends that it is necessary, and that recommendation is accepted by the TAA.

2.12 Assessments must be carried out in accordance with BD 21 (DMRB 3.4.3), BA 16 (DMRB 3.4.4) and BD 86 (DMRB 3.4.19) as appropriate, as well as any other DMRB standards relevant to the specific Assessment task.

2.13 The Assessor should recommend the level of Assessment in the AIP, drawing on the advice in BD 79, taking into account the complexity of the structure and the operational requirements (AW, STGO and SO) of the route/network and in consultation with the relevant parts of the Overseeing Organisation.

2.14 New Assessments for HB ratings may be permitted in addition to Assessment for SV load models (see BD 86), subject to the agreement of the Overseeing Organisation, where they are needed for the continued operation of load management systems in use at the date of publication of this standard.

2.15 For consistency in reporting, all Assessments must be reported in accordance with the standard report format shown in Annex C.

2.16 Assessment results must be recorded in the Overseeing Organisation's records management system in accordance with BD 62.

2.17 Any structures found by Assessment to be unable to carry the required operational load must be managed in accordance with BD 79 (DMRB 3.4.18).

3. REFERENCES

3.1 Design Manual for Roads and Bridges

- BD 2 Technical Approval of Highway Structures (DMRB 1.1.1).
- BA 16 The Assessment of Highway Bridges and Structures [incorporating Amendment No 1 Nov 1997, Amendment No 2 Nov 2001] (DMRB 3.4.4).
- BD 21 The Assessment of Highway Bridges and Structures (DMRB 3.4.3).
- BD 37 Loads for Highway Bridges (DMRB 1.3.14).
- BD 62 As Built, Operational and Maintenance Records for Highway Structures (DMRB 3.2.1).
- BD 79 The Management of Substandard Highway Structures (DMRB 3.4.18).
- BD 86 The Assessment of Highway Bridges and Structures for the Effects of Special Types General Order (STGO) and Special Order (SO) Vehicles (DMRB 3.4.19).

3.2 Statutory Instruments

The Road Vehicles (Construction and Use) (Amendment) (No.7) Regulations 1998 (SI 1998 No.3112).

The Road Vehicles (Authorised Weight) Regulations 1998 (SI 1998 No.3111).

The Road Vehicle (Authorisation of Special Types) General Order 2003 (SI 2003 No.1998).

The Motor Vehicles (Construction and Use) Regulations (Northern Ireland) 1999.

The Motor Vehicles (Authorisation of Special Types) Order (Northern Ireland) 1997 (SR 1997/109) as amended.

The Motor Vehicles (Authorised Weight) Regulations (Northern Ireland) 1999 as amended.

3.3 Other publications

Management of Highway Structures – A Code of Practice – TSO – September 2005.

4. ENQUIRIES

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

Chief Highway Engineer
The Highways Agency
123 Buckingham Palace Road
London
SW1W 9HA

G CLARKE
Chief Highway Engineer

Director, Major Transport Infrastructure Projects
Transport Scotland
Buchanan House
58 Port Dundas Road
Glasgow
G4 0HF

A C McLAUGHLIN
Director, Major Transport Infrastructure Projects

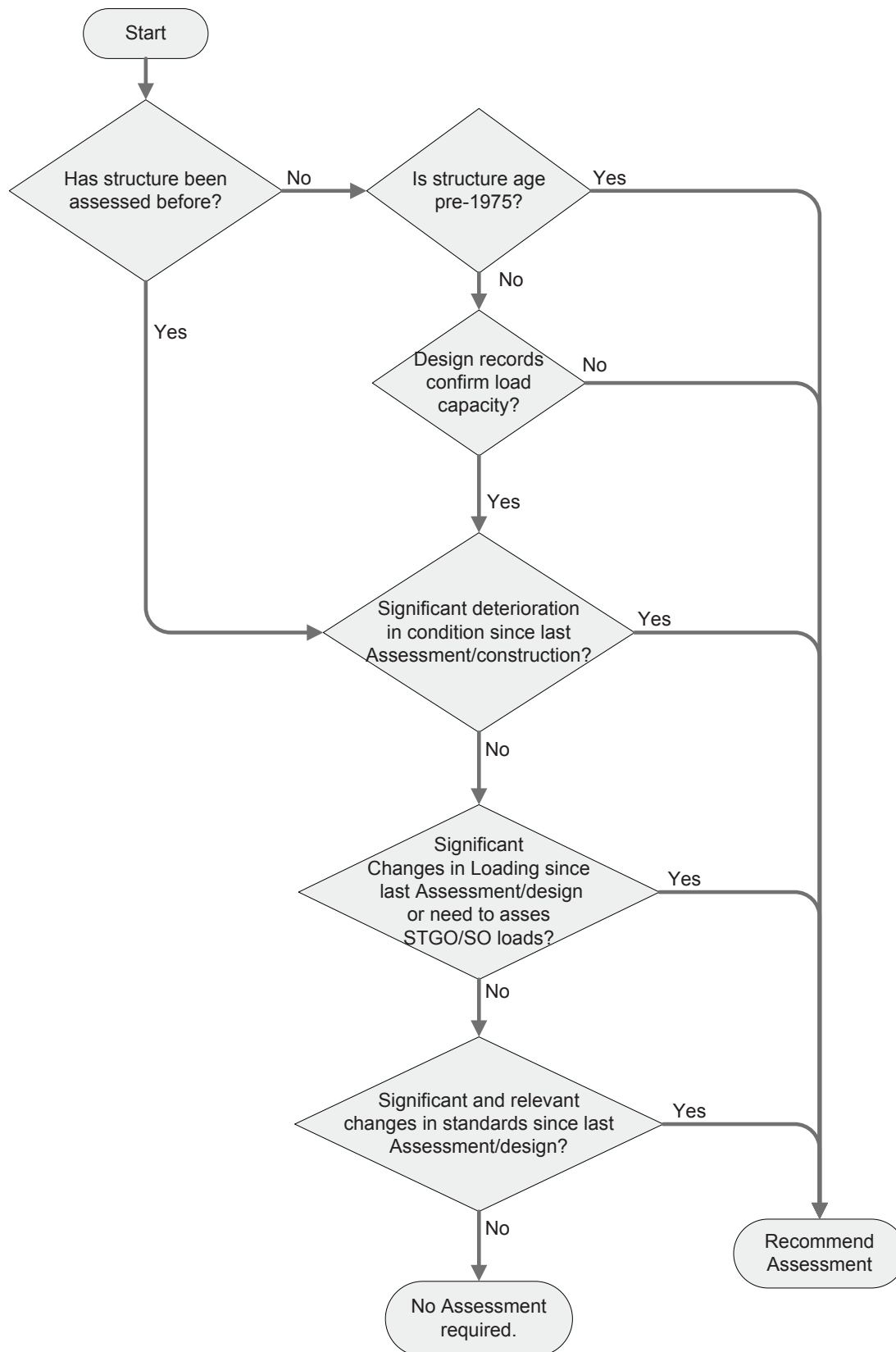
Chief Highways Engineer
Director Roads and Projects Division
Welsh Government
Crown Buildings
Cathays Park
Cardiff
CF10 3NQ

J COLLINS
Chief Highways Engineer

Director of Engineering
The Department for Regional Development
Roads Service
Clarence Court
10-18 Adelaide Street
Belfast
BT2 8GB

R J M CAIRNS
Director of Engineering

ANNEX A STRUCTURAL REVIEW FLOWCHART



ANNEX B RECORD OF STRUCTURAL REVIEW FORM

1	Structure Details			
	Structure Name	<Structure Name>		
	Structure Number	<Structure Number>		
	Structure Key (not Scotland)	<Structure Key Number>		
	Date Commissioned	<Date that the structure came into service>		
	Obstacles Crossed	<Name of road, railway, river etc.>		
	Bridge Carries	<Name of road, etc>		
	Brief Description of Structure			
	<Give a brief description of the structure including structural type (deck, substructure and foundations) and span. Identify any unusual features or modifications since first constructed, and any interim measures in place.>			
	Elements to be Reviewed (where not the whole structure)			
<List elements to be Reviewed>				
Reason for Structural Review	<May be routine or special circumstances>			
2	Existing Assessment Details or Design Records			
	Inspection for Assessment Date	<Date>	Recorded Condition	<Condition Factor>
	AIP for Assessment	<Date>	Status	<eg Agreed>
	Assessment Date	<Date>	Report Number	<Report Number>
	Current Assessed/Design Capacity (include Reserve Factors)			
	HA/ALL	<eg 40te ALL/30 HB>	SV/STGO/SO	<eg SV150>
	Critical Elements	<List the elements whose failure would result in significant local collapse or global collapse of the structure>		
	Parapet	<State parapet type and Assessment result>		
	Pier Impact	<State Assessment result and/or risk of impact>		
	Certification	<Record if certificates exist and storage location>		
	Calculations	<Record if calculations exist and storage location>		
	As built drawings	<Record if as built drawings exist and storage location>		
	Comments on Assessment or Design			
	<A brief summary of the Assessment/design method and findings. Describe any strengthening works done as a result of existing Assessment, stating revised capacity.>			
3	Evaluation			
	Inspection Date	<Date of Principal (or other) Inspection being used to assess current condition.>		
	Change In Condition	<Identify any significant deterioration, damage or changes in condition since last Assessment/construction.>		
	Change In Standards	<Identify any significant changes to standards since last Assessment/design>		
	Change In Loading	<Identify any changes in loading since last Assessment/design, and any need to assess for abnormal loads.>		

	Conclusion	<Having considered the records available and any changes in condition, standards or loading, give your conclusion on the validity of the existing Assessment or design.>
4	Recommendation (delete and complete as applicable)	
	<Insert a recommendation as to the validity of the existing Assessment/design and whether a new Assessment is needed. The validity might be considered conditional on further inspection or investigation, which should be identified. The existing Assessment/design might be considered valid but unduly conservative, in which case a new Assessment might be appropriate. Where a new Assessment is recommended, an outline of the scope of the Assessment should be given.>	

5. THE ABOVE IS SUBMITTED FOR ACCEPTANCE

Signed _____
 Name _____

 Reviewer
 Engineering Qualifications _____²
 Name of Organisation _____
 Date _____

6. THE ABOVE IS REJECTED/AGREED¹ SUBJECT TO THE AMENDMENTS AND CONDITIONS SHOWN BELOW³

Signed _____
 Name _____

 Engineering Qualifications _____²
 TAA _____
 Date _____

1. *Delete as appropriate*
2. *CEng, MICE, MStructE or equivalent*
3. *Agreement is valid for three years after the date of agreement by the TAA. If the recommendation has not been implemented within this period, the Record of Structural Review Form must be re-submitted to the TAA for review*

ANNEX C TYPICAL ASSESSMENT REPORT FORMAT

Prescriptive details for an Assessment report are difficult to define because of the unique nature of the Assessment process. However all reports should be prepared against a similar framework and should include the following:

Contents

1. Introduction
2. Structure Description
3. Previous Assessment summary with dates (include details of any strengthening works undertaken as a result of the previous Assessment and the revised capacity)
4. Interim measures summary with dates
5. Monitoring summary with dates (in accordance with BD 79)
6. Assessment inspection summary (include text to identify and justify the condition factor used in the Assessment calculations)
7. Assessment method
8. Assessment Commentary
9. Assessment Result (note. in addition to giving the overall assessed capacity of the structure data should be presented about those elements that were critical to the Assessment failure including)
 - a. Critical element identity
 - b. Value of appropriate Assessment load effects; S_A^* , S_D^* , S_{HA}^* and S^*
 - c. Value of Assessment Resistance R_A^*
 - d. Mode of failure
 - e. Structural Adequacy Factor R_A^*/S_A^* , or Reserve Factors Ψ_{SV} and Ψ_{SV}^*
 - f. Vehicle Rating VR
10. Recommendations
11. Assessment synopsis

Appendices

Reduced copy of General Arrangement drawing

Copy of data report form as required by the Overseeing Organisation

Graphs of the critical loading combinations/capacities

ANNEX D LIST OF TPB CONTRIBUTING ORGANISATIONS

Association of Directors of Environment, Economy, Planning and Transport (ADEPT)

Department for Regional Development – Northern Ireland

Highways Agency

Transport Scotland

Welsh Government