Design Manual for Roads and Bridges

Highway Structures & Bridges
Inspection & Assessment

CS 451
Structural review and assessment of highway structures

(formerly BD 101/11)

Revision 0

Summary
This document contains the requirements for structural review and assessment of highway structures.

Application by Overseeing Organisations
Any specific requirements for Overseeing Organisations alternative or supplementary to those given in this document are given in National Application Annexes to this document.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

This is a controlled document.

Contents

Release notes **2**

Foreword **3**
Publishing information . . . 3
Contractual and legal considerations . . . 3

Introduction **4**
Background . . . 4
Objectives . . . 4
Assumptions made in the preparation of this document . . . 5
Mutual Recognition . . . 5

Abbreviations and symbols **6**

Terms and definitions **7**

1. Scope **8**
Aspects covered . . . 8
Implementation . . . 8
Use of GG 101 . . . 8

2. The structural review and assessment process **9**
General . . . 9
Structural review . . . 9
Assessment . . . 10

3. Normative references **11**

Appendix A. Risk appraisal **12**

Appendix B. Record of structural review form **16**

Appendix C. Typical assessment report format **19**

Release notes

Version	Date	Details of amendments
0	Mar 2020	CS 451 replaces BD 101/11. The full document has been rewritten to make it compliant with the new Highways England drafting rules.

Foreword

Publishing information

This document is published by Highways England.

This document supersedes BD 101/11, which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

This document gives requirements and advice on the structural review and assessment of highway structures. Structural review is to be used to support decisions on whether highway structures are required to undergo assessment. With the issue of BD 101/11, the following standards were withdrawn: BD 34/90, BA 34/90, BD 46/92 and BD 50/92.

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

1) Vehicles complying with The Road Vehicles Construction and Use (C&U) Regulations SI 1986/1078 [Ref 12.N] and Authorised Weight (AW) Regulations SI 1998/3111 [Ref 11.N]. 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 not subject to permit and notification requirements. For convenience, the term AW referred to hereinafter is to be taken to include C&U. The effects of these AW vehicles are assessed in accordance with CS 454 [Ref 2.N].
2) Vehicles complying with The Road Vehicles (Authorisation of Special Types) General Order (STGO Regulations) SI 2003/1998 [Ref 10.N] . 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 CS 458 [Ref 8.N].
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 Road Traffic Act 1988 [Ref 6.N] . Vehicle operators are required to submit to the Overseeing Organisation an application for an individual SO authorising the movement of an SO vehicle. In Northern Ireland the equivalent vehicles are covered by Article 60 of the SI 1995 No. 2994 (NI 18) [Ref 9.N] Road Traffic (Northern Ireland) Order 1995. The effects of SO vehicles are assessed in accordance with CS 458 [Ref 8.N].

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. 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 is to be phased out (see CS 458 [Ref 8.N]).

Objectives

This document presents a system for structural review and assessment of structures as recommended by "Management of Highway Structures – A Code of Practice" MHS CoP [Ref 4.N].

Structural review and, where necessary, assessment and strengthening, are on-going 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 ensures 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.

Structural review and assessment contribute to route strategies, for example enabling identification of the points of lowest capacity on a route and supporting decisions on route upgrades.

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.

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 3.N] apply to this document.

Mutual Recognition

Where there is a requirement in this document for compliance with any part of a "British Standard" or other technical specification, that requirement may be met by compliance with the Mutual Recognition clause in GG 101 [Ref 3.N].

Abbreviations and symbols

Abbreviations

Abbreviation	Definition
AIP	Approval in Principle
ALL	Assessment live loading
AW	Authorised weight
C&U	Construction & use
DMRB	Design Manual for Roads and Bridges
DTp	Department of Transport
EqIA	Equality impact assessment
MOT	Ministry of Transport
PI	Principal inspection
RSRF	Record of structural review form
SO	Special order
STGO	Special type general order
SV	Special vehicle
TAA	Technical Approval Authority
VR	Vehicle rating

Symbols

Symbol	Definition
m	metres
Ψ_{SV}	Reserve factor against a SV load model with the associated type HA loading (or AW vehicle loading)
Ψ^*_{SV}	Reserve factor against a SV load model without the associated type HA loading (or AW vehicle loading)
S^*	Load effect due to a SV or SOV, STGO or SO vehicle
S^*_A	Assessment load effect
S^*_D	Assessment load effects due to dead and superimposed dead loads
S^*_{HA}	Assessment load effect due to the associated type HA (or AW vehicle loading)
R^*_A	Assessment resistance

Terms and definitions

Terms and definitions

Term	Definition
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).
Condition factor	As defined in CS 454 [Ref 2.N]
Reserve factor	As defined in CS 458 [Ref 8.N]
SO vehicles, STGO vehicles and SV load models	As defined in CS 458 [Ref 8.N]
Structural review	A review of an individual structure or group of structures, to establish or confirm the validity of its latest assessment (or its original design, if there has been no subsequent assessment) and identify any need and priority for further assessment.
Technical Approval Authority	As defined in CG 300 [Ref 7.N]
Type HB loading	As defined in CS 454 [Ref 2.N]
Vehicle rating	As defined in CS 458 [Ref 8.N]

1. Scope

Aspects covered

1.1 This document shall be used for requirements and guidance on:

1) structural review – the method of establishing whether structures need to undergo assessment, and setting priorities for assessment; and,
2) assessment procedures and reporting.

1.2 This document shall be applied to the following highway structures:

1) 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 except that corrugated steel buried structures are included if they have spans of 0.9m or more;
2) earth retaining structures (as defined in CG 302 [Ref 1.N]) with an effective retained height of 1.5m or greater, and subject to applied vehicular traffic loading; and,
3) reinforced/strengthened soil/fill structure with hard facings (as defined in CG 302 [Ref 1.N]) with an effective retained height of 1.5m or greater, and subject to applied vehicular traffic loading.

1.3 Structures that have not been previously assessed, because they have either been designed to standards which allow for current vehicle loading or they pose a low risk of failure due to current vehicle loading, shall not be brought into the scope of structural review unless agreed by the Overseeing Organisation.

NOTE *Details of the structures which were not included in assessment programmes and do not fall within the scope of this document are:*

1) bridges, culverts, buried structures used as under-passes, pedestrian subways and cattle creeps, where these are of less than 1.8m span; multi-cell culverts where the cumulative span is 5m or less; retaining walls of 1.5 metres height or less from finished ground level in front of the wall to the top of the wall;
2) culverts and buried structures of 3m span or less with cover of 1 metre or more;
3) structures carrying accommodation roads and other non-public roads; and,
4) structures that have been certified as designed to carry at least 30 units of HB, or in the case of walls, type HA surcharge or equivalent, unless suffering from a reduction in capacity as described in the Terms and Definitions under 'SO vehicles, STGO vehicles and SV load models'.

1.3.1 This document may be applied to other highway structures, such as footbridges, as agreed by the Overseeing Organisation.

Implementation

1.4 This document shall be implemented forthwith on all schemes involving the assessment, design, construction, operation, management and maintenance of the Overseeing Organisations' motorway and all-purpose trunk roads according to the implementation requirements of GG 101 [Ref 3.N].

Use of GG 101

1.5 The requirements contained in GG 101 shall be followed in respect of activities covered by this document.

2. The structural review and assessment process

General

2.1 The structural review and assessment process shall comprise two stages:

1) the structural review, which determines the requirement for, and priority of, the second stage; and,
2) an assessment (or part assessment) in accordance with the relevant assessment document.

Structural review

2.2 Structures shall undergo a structural review on a 12 year cycle, to align with alternate principal inspections (PIs).

2.2.1 Where there are reasons for not undertaking a structural review of a structure which is within the scope of this document, or for varying the 12 yearly intervals, these should be recorded and presented to the Overseeing Organisation for agreement.

NOTE *All eligible structures are to undergo their first structural review within 12 years of the date of publication of this document, and receive a further structural review every 12 years thereafter.*

2.2.2 Where the period between PIs has been increased by a risk assessment, and agreed with the Technical Approval Authority (TAA), the structural review should match this cycle, e.g if the period between PIs has been increased to 8 years then subsequent structural reviews can be undertaken at 16 year intervals.

NOTE *As an increased period between PIs reflects the risks posed by a structure then the period between structural reviews can be similarly extended.*

2.3 An annual programme of structural reviews shall be identified to smooth the workload associated with this activity.

2.3.1 The programme for structural reviews should be guided by operational needs and the PI programme.

NOTE *Structures which have defects that are likely to affect their design or assessed capacity; and structures which have, or are going to have, changes to their imposed loading can be identified as high priorities for structural review and would appear early in the programme.*

2.3.2 The structural review should include the following criteria in a risk appraisal which provides an evaluation of the consequences of a failure to identify a shortcoming in the carrying capacity of the structure:

1) load capacity – this can can be from an assessment, original design loading, or assumption on design loading based on year of construction;
2) the presence, or otherwise of interim (CS 470 [Ref 5.N]) measures;
3) the current condition of the structure, from a recent PI;
4) the accessibility of critical elements of the structure to inspection;
5) the presence, or otherwise of a monitoring regime for the structure;
6) any changes in condition that have occurred since the assessment (if assessed) or design, that are likely to detrimentally affect the load capacity;
7) any increase in loading that has occurred since the assessment (if assessed) or design;
8) any proposed increase in loading; and,
9) the route carried and obstacle crossed.

2.4 The structural review shall be carried out with reference to the assessment documents current at the time of the review.

NOTE *The reviewer can evaluate any differences between the current assessment standards and the standards used for previous assessment or design, and make a recommendation as to whether those differences are significant to the current loading regime on the structure.*

2.4.1 Any obvious inaccuracies noted in the existing assessment calculations may be identified in the structural review.

NOTE *Unless otherwise specified, the structural review is not expected to verify the accuracy of existing assessment calculations.*

2.4.2 Structures with a structural review confirming they have been designed or have previously been assessed and their capacity recorded as 40 tonne assessment live loading (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 special vehicle (SV) load models ascertained using the conversion charts given in CS 458 [Ref 8.N] (subject to the stated limitations).

NOTE *It is intended that over time vehicle ratings are to replace HB ratings as an indication of the STGO and SO load capacity of a bridge.*

2.5 The structural review process shall be undertaken as follows, using Appendix A of this document:

1) establish that the structure is within scope for a structural review;
2) determine the structure's year of construction;
3) determine the load carrying capacity of the structure from design or assessment documentation;
4) where design/assessment documentation is insufficient to determine load carrying capacity, review other sources of information to determine capacity, e.g general arrangement drawings;
5) using engineering judgement decide which of three scenarios best fits the structure and the information available and complete the appraisal using the tables and equations provided;
6) from the numerical appraisal, engineering judgement and local knowledge determine if an assessment is justified and the priority for undertaking any assessment.

2.6 The structural review shall be documented in a record of structural review form in accordance with the format shown in Appendix B, summarising the evidence with recommendations as to whether an assessment is required and the priority for any assessment.

2.7 The record of structural review form shall be submitted to the TAA for acceptance.

2.8 The completed form(s) and the criteria used shall be recorded in the Overseeing Organisation's records management system.

Assessment

2.9 An assessment shall not be carried out unless the structural review recommends that it is necessary, and that recommendation is accepted by the TAA.

2.10 Assessments shall be carried out in accordance with CS 454 [Ref 2.N] and CS 458 [Ref 8.N] as relevant, as well as any other published documents relevant to the specific assessment task at the time of the assessment.

2.10.1 The level of assessment (1, 2 or 3) should be recommended in the Approval in Principle (AIP), drawing on the advice in CS 470 [Ref 5.N] and CS 454 [Ref 2.N], taking into account the complexity of the structure and the operational requirements of the route/network.

NOTE *Consultation with the relevant parts of the Overseeing Organisation can be beneficial if in doubt of the level of assessment to be recommended. .*

2.10.2 New assessments for HB ratings may be permitted in addition to assessment for SV load models (see CS 458 [Ref 8.N]), subject to the agreement of the Overseeing Organisation.

NOTE *For the continued operation of load management systems HB ratings are sometimes required.*

2.11 For consistency in reporting, all assessments shall be reported in accordance with the standard report format shown in Appendix C.

2.12 Assessment results shall be recorded in the Overseeing Organisation's records management system.

2.13 Any structures found by assessment, and agreed with the TAA, to be unable to carry the required operational load shall be managed in accordance with CS 470 [Ref 5.N]).

3. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. CG 302, 'As-built, operational and maintenance records for highway structures'
Ref 2.N	Highways England. CS 454, 'Assessment of highway bridges and structures'
Ref 3.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 4.N	Department for Transport. UK Roads Liaison Group. MHS CoP, 'Management of Highway Structures - Code of Practice'
Ref 5.N	Highways England. CS 470, 'Management of sub-standard highway structures'
Ref 6.N	The National Archives. legislation.gov.uk. Road Traffic Act 1988, 'Road Traffic Act 1988'
Ref 7.N	Highways England. CG 300, 'Technical approval of highway structures'
Ref 8.N	Highways England. CS 458, 'The assessment of highway bridges and structures for the effects of special type general order (STGO) and special order (SO) vehicles '
Ref 9.N	The National Archives. legislation.gov.uk. SI 1995 No. 2994 (NI 18), 'The Road Traffic (Northern Ireland) Order 1995'
Ref 10.N	The National Archives. legislation.gov.uk. SI 2003/1998, 'The Road Vehicles (Authorisation of Special Types) (General) Order 2003'
Ref 11.N	The National Archives. legislation.gov.uk. SI 1998/3111, 'The Road Vehicles (Authorised Weight) Regulations 1998'
Ref 12.N	The National Archives. legislation.gov.uk. SI 1986/1078, 'The Road Vehicles (Construction and Use) Regulations 1986'

Appendix A. Risk appraisal

In order to fully address the risks associated with an existing structure not having had a load assessment a number of scenarios have been developed which covers most circumstances. Where an exact circumstance is not addressed then the closest scenario available should be used and the reasoning for using this scenario provided. The procedure is as follows:

1) select closest applicable scenario, B1, B2 or B3;
2) select from Table A.1, Table A.2 or Table A.3 the value of variable D (B1), variable D (B2) or variable D (B3);
3) select from Table A.4 to Table A.11 values of variables E, F, G, H, F, J, K, R1, R2, R3, interpolation of values is not required, the value which most closely reflects the structure should be selected;
4) determine from the structure details values of structure width (W), length (L) and maximum span (S), all measurements in metres;
5) apply these values into the following Equation A.1 to Equation A.6;
6) from the risk and reliability scores from Equation A.5 and Equation A.6 use the decision matrix, Table A.12, to prioritise an assessment;

Equation A.1 Consequences 1

$$\text{Consequences}(C1) = 18000((\mathsf{S} + 70) \times \mathsf{R}1 + (\mathsf{W} + 70) \times \mathsf{R}2)$$

Equation A.2 Consequences 2

$$\text{Consequences}(C2) = (((9.6 \times \mathsf{S}) + 242) \times \mathsf{L} + \mathsf{W}) + (5124 \times \mathsf{W}) + (1742 \times \mathsf{L}) + 50000$$

Equation A.3 Consequences 3

$$\text{Consequences}(C3) = 337500 \times (\mathsf{R}1 + \mathsf{R}2)$$

Equation A.4 Consequences 4

$$\text{Consequences}(C4) = 0.4 \times (\mathsf{R}3 + C1 + C2 + C3)$$

Equation A.5 Reliability

$$\text{Reliability} = C4 \times (\mathsf{D} \times \mathsf{E} \times \mathsf{F} \times \mathsf{G} \times \mathsf{H} \times \mathsf{J} \times \mathsf{K})$$

Equation A.6 Risk

$$\text{Risk} = \frac{1}{1000 \times (\mathsf{D} \times \mathsf{E} \times \mathsf{F} \times \mathsf{G} \times \mathsf{H} \times \mathsf{J} \times \mathsf{K})}$$

Scenario B1

The bridge has had an assessment and the documentation indicates an assessed load capacity for the structure. Where different capacities have been assessed for different parts of the structure the capacity for that part which supports the running lanes should be used.

For this scenario the variable D (B1) should be obtained from the following table:

Table A.1 Variable 'D' (B1)

Capacity / Year	Pre-1950 or unknown	1950-1975	1976-1990	Post-1990
38T+	1.00E-08	1.00E-08	1.00E-08	1.00E-08
26T	4.0E-07	2.0E-07	1.0E-07	5.0E-08
18T	5.0E-06	1.0E-06	8.0E-07	5.0E-07
7.5T	1.0E-05	5.0E-06	1.0E-06	5.0E-07
3T	1.0E-04	5.0E-05	1.0E-05	5.0E-06

Scenario B2

The bridge may have had an assessment however the documentation to confirm this is not complete or is non-existent. The age of the bridge can determine if it was likely that it was included as part of an assessment programme. It should be noted that not all bridges constructed have been required to be assessed.

For this scenario the variable D (B2) should be obtained from the following table:

Table A.2 Variable 'D' (B2)

Confidence Level / Year	Pre-1950 or unknown	1950-1975	1976-1990	Post- 1990
Some records show load capacity is satisfactory	5.00E-08	2.00 E-08	1.00 E-08	1.00 E-08
High confidence that assessment completed for current applied loading	6.00E-08	3.00 E-08	2.00 E-08	1.00 E-08
Medium confidence that assessment has been undertaken where it was a requirement	1.00E-07	6.00 E-08	3.00 E-08	1.00 E-08
Low confidence that assessment has been undertaken where it was a requirement	1.00E-05	1.00 E-06	1.00 E-07	1.00 E-08

Scenario B3

The bridge has not had an assessment however there was no requirement for it to be assessed. Due to changes that have occurred since construction it may now be considered prudent that the need for an assessment should be appraised.

For this scenario the variable D (B3) should be obtained from the following table:

Table A.3 Variable 'D' (B3)

Year	Pre-1950 or unknown	1950-1975	1976-1990	Post-1990
No assessment requirement for the structure	6.00E-08	3.00E-08	2.00E-08	1.00E-08

The following tables apply to all scenarios and address the criteria interim measures, current condition, inspectability, monitoring, change in condition and change in loading.

Table A.4 Interim measures

Measure	Variable 'E'
3T limit signage	0.05
7.5T limit signage	0.1
18T limit signage	0.5
26T limit signage	0.75
Physical restraints for vehicles	0.001
Not applicable	1

Table A.5 Current condition

Condition	Variable 'F'
Good	30
Fair	20
Poor	1000

Table A.6 Inspectability of critical elements

	Variable 'G'
Critical element(s) not hidden and can be adequately inspected during a PI	1
Critical element(s) hidden and/or cannot be adequately inspected during a PI	10

Table A.7 Monitoring

	Variable 'H'
Appropriate monitoring in place	0.1
No monitoring in place or not required	1.0

Table A.8 Change in condition

	Variable 'J'
Significant deterioration in condition since design/assessment	500
Slight deterioration in condition since design/assessment	2
No significant deterioration in condition since design/assessment	1

Table A.9 Change in loading

	Variable 'K'
Significant increase in operational load carrying requirements since design/assessment	50
Moderate (10-30%) increase in operational load carrying requirements since design/assessment	5
Slight increase in loading since design/assessment	1.1
No increase in loading since design/assessment	1
Need to assess for STGO/SO loads	500

Table A.10 Route supported

	Variable 'R1'	Variable 'R3'
Motorway/railway	7	1.00E+7
A road	3.5	1.00E+6
B road	0.8	1.00E+5
Other road/footpath/canal	0.2	1.00E+4

Table A.11 Route crossed

	Variable 'R2'
Motorway/railway	7
A road	3.5
B road	0.8
Other road	0.15
Other - bridleway, canal, disused land, etc.	0.1

Table A.12 Decision matrix

	Reliability			
Risk score	0 to 13.2	13.3 to 25.0	25.1 to 83.0	83+
0 to 1.00	Assessment recommended (low priority)	Assessment recommended (medium priority)	Assessment recommended (high priority)	Assessment recommended (very high priority)
1.01 to 10.00	Review need for assessment at next structural review	Assessment recommended (low priority)	Assessment recommended (medium priority)	Assessment recommended (high priority)
10+	Review need for assessment at next structural review	Review need for assessment at next structural reviews	Review need for assessment at next structural review	Assessment recommended (low priority)

Appendix B. Record of structural review form

Table B.1 Record of structural review form

1.	Structure Details				
	Structure Name	<Structure Name>			
	Structure Number	<Structure Number>			
	Structure Key (if used)	<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, railway 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	<e.g. Agreed>	
	Assessment Date	<Date>	Report Number	<Report Number>	
	Current Assessed/Design Capacity (include Reserve Factors)				
	HA/ALL	<e.g. 40te ALL/ 30 HB>	SV/STGO/SO	<e.g. 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.>			

Table B.1 Record of structural review form (continued)

	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.>
	Required capacity	<Operational capacity of the route supported, with reasons>
	Vulnerable details	<Presence of any details such as half-joints should be noted.>
	Hidden critical elements	<Presence of any hidden critical elements should be noted.>
	Interim measures	<Any interim measures or monitoring if present should be noted.>
	Condition	<Condition of critical elements from last PI.>
	Conclusion	<Having considered the result of the numeric appraisal, 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 an 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. Other appraisals, such as those for half-joints should be referenced if applicable. Where a new assessment is recommended, an outline of the scope of the assessment should be given, further details would be required in an AIP if the assessment is to be progressed.>	

5. THE ABOVE IS SUBMITTED FOR ACCEPTANCE

Signed .....

Name .....

Engineering Qualifications .....[2]

Name of Organisation .....

Date .....

6. THE ABOVE IS REJECTED/ACCEPTED[1] SUBJECT TO THE AMENDMENTS AND CONDITIONS SHOWN BELOW[3]

Signed .....

Name .....

Engineering Qualifications .....[2]

TAA .....

Date .....

1. Delete as appropriate

2. CEng, MICE, MIStructE 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, t he record of structural review form should be re-submitted to the TAA for Review with any updated information that has become available in the int ervening period.

Appendix 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 CS 470 [Ref 5.N]);
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;
10) recommendations;
11) assessment synopsis.

Appendices:

1) copy of accepted AIP;
2) copy of accepted assessment and check certificate/s;
3) reduced copy of general arrangement drawing;
4) copy of data report form as required by the Overseeing Organisation;
5) graphs of the critical loading combinations/capacities.

Highway Structures & Bridges
Inspection & Assessment

CS 451
England National Application Annex to CS 451 Structural review and assessment of highway structures

(formerly BD 101/11)

Revision 0

Summary
There is no specific requirements for Highways England supplementary or alternative to those given in CS 451.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

This is a controlled document.

Contents

Release notes **2**

Release notes

Version	Date	Details of amendments
0	Mar 2020	Highways England National Application Annex to CS 451.

Department for Infrastructure
An Roinn Bonneagair

Highway Structures & Bridges
Inspection & Assessment

CS 451
Northern Ireland National Application Annex to CS 451 Structural review and assessment of highway structures

(formerly BD 101/11)

Revision 0

Summary
This National Application Annex sets out the Department for Infrastructure, Northern Ireland-specific legislation as background to the operation of CS 451 in Northern Ireland.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated team in the Department for Infrastructure, Northern Ireland. The email address for all enquiries and feedback is: dcu@infrastructure-ni.gov.uk

This is a controlled document.

Contents

Release notes **2**

Foreword **3**
Publishing information 3
Contractual and legal considerations 3

Introduction **4**
Background 4
Assumptions made in the preparation of this document 4

Abbreviations and symbols **5**

Terms and definitions **6**

NI/1. Special order (SO) vehicles **7**

NI/2. Normative references **8**

Release notes

Version	Date	Details of amendments
0	Mar 2020	Northern Ireland National Application Annex to CS 451.

Foreword

Publishing information

This document is published by Highways England on behalf of the Department for Infrastructure, Northern Ireland.

This document supersedes BD 101/11, which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

Road vehicles in the United Kingdom are categorised for regulatory purposes into three broad groups, one of which is 'special order vehicles'. This group includes vehicles that do not comply with the AW or STGO Regulations.

In Northern Ireland the equivalent vehicles are covered by Article 60 of the Road Traffic (Northern Ireland) Order 1995 as amended - SI 1995 No. 2994 (NI 18) [Ref 3.N]. The effects of SO vehicles are assessed in accordance with CS 458 [Ref 2.N].

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 1.N] and its NI NAA apply to this document.

Abbreviations and symbols

Abbreviations

Abbreviation	Definition
AW	Authorised weight
SO	Special order
STGO	Special type general order

Terms and definitions

Terms

Term	Definition
SO vehicles, STGO vehicles and SV load models	As defined in CS 458 [Ref 2.N].

NI/1. Special order (SO) vehicles

NI/1.1 The Road Traffic (Northern Ireland) Order SI 1995 No. 2994 (NI 18) [Ref 3.N] must be applied for special order (SO) vehicles in Northern Ireland.

NI/1.2 Where a clause in CS 451 refers to section 44 of the Road Traffic Act 1988, the reference shall be replaced by The Road Traffic (Northern Ireland) Order SI 1995 No. 2994 (NI 18) [Ref 3.N].

NI/2. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 2.N	Highways England. CS 458, 'The assessment of highway bridges and structures for the effects of special type general order (STGO) and special order (SO) vehicles '
Ref 3.N	The National Archives. legislation.gov.uk. SI 1995 No. 2994 (NI 18), 'The Road Traffic (Northern Ireland) Order 1995'

Highway Structures & Bridges
Inspection & Assessment

CS 451
Scotland National Application Annex to CS 451 Structural review and assessment of highway structures

(formerly BD 101/11)

Revision 0

Summary
This National Application Annex gives the Transport Scotland requirements for structural review and assessment of highway structures.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Transport Scotland team. The email address for all enquiries and feedback is: TSStandardsBranch@transport.gov.scot

This is a controlled document.

Contents

Release notes **2**

Foreword **3**
Publishing information 3
Contractual and legal considerations 3

Introduction **4**
Background 4
Assumptions made in the preparation of this document 4

S/1. Applicability of CS 451, clause 1.2 **5**

S/2. Normative references **6**

Release notes

Version	Date	Details of amendments
0	Mar 2020	Transport Scotland National Application Annex to CS 451.

Foreword

Publishing information

This document is published by Highways England on behalf of Transport Scotland.

This document supersedes BD 101/11, which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

This National Application Annex gives the Transport Scotland related requirements for structural review and assessment of highway structures.

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 2.N] apply to this document.

S/1. Applicability of CS 451, clause 1.2

S/1.1 CS 451, clause 1.2 shall not apply in Scotland.

S/1.2 This document shall be applied to the following highway structures:

1) 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 2.0m, except that corrugated steel buried structures are included if they have spans of 0.9m or more;
2) earth retaining structures (as defined in CG 302 [Ref 1.N]) with an effective retained height of 1.5m or greater, and subject to applied vehicular traffic loading;
3) reinforced/strengthened soil/fill structure with hard facings (as defined in CG 302 [Ref 1.N]) with an effective retained height of 1.5m or greater, and subject to applied vehicular traffic loading.

S/2. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. CG 302, 'As-built, operational and maintenance records for highway structures'
Ref 2.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'

Llywodraeth Cymru
Welsh Government

Highway Structures & Bridges
Inspection & Assessment

CS 451
Wales National Application Annex to CS 451 Structural review and assessment of highway structures

(formerly BD 101/11)

Revision 0

Summary
There are no specific requirements for the Welsh Government supplementary or alternative to those given in CS 451.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Welsh Government team. The email address for all enquiries and feedback is: Standards_Feedback_and_Enquiries@gov.wales

This is a controlled document.

Contents

Release notes **2**

Release notes

Version	Date	Details of amendments
0	Mar 2020	Welsh Government National Application Annex to CS 451.