



Highway Structures & Bridges
Design

CD 373

Impregnation of reinforced and prestressed concrete highway structures using hydrophobic pore-lining impregnants

(formerly BD 43/03)

Revision 0

Summary

This document contains the requirements for the application of hydrophobic impregnation providing protection to concrete 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

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Release notes

Version	Date	Details of amendments
0	Mar 2020	CD 373 replaces BD 43/03. This full document has been re-written 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This document supersedes BD 43/03, which is withdrawn.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 provides the requirements and advice for the the impregnation of reinforced and prestressed concrete highway structures using hydrophobic pore-lining impregnants.

This document also incorporates technical updates due to progress in modern concrete construction since the publication of BD 43/03 and has also been developed for compliance with BS EN 1504-2 [Ref 2.I] and EC product harmonisation.

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 4.N] apply to this document.

Terms and definitions

Terms

Term	Definition
Historic structures	Structures requiring special permission for works to be undertaken on them.
Hydrophobic impregnation	Treatment of concrete to produce a water-repellent surface resistant to diffusion of chloride ions in accordance with BS EN 1504-2 [Ref 2.I].
Leachate	Where water has passed through concrete and left some of the constituent material on the surface.
Sensitive area	Sensitive areas as defined by Section 105A of the Highways Act 1980 (as amended) Highways Act 1980 [Ref 2.N].

1. Scope

Aspects covered

- 1.1 This document shall apply for the application of hydrophobic impregnation providing protection to concrete highway structures.

Implementation

- 1.2 This document shall be implemented forthwith on all schemes involving the application of hydrophobic impregnation to concrete structures on the Overseeing Organisations' motorway and all-purpose trunk roads according to the implementation requirements of GG 101 [Ref 4.N].

Use of GG 101

- 1.3 The requirements contained in GG 101 [Ref 4.N] shall be followed in respect of activities covered by this document.

2. Application of impregnation systems

General requirements

- 2.1 Impregnation systems used in combination with other surface protection systems shall be compatible with each other and specified in complementary combinations.

NOTE 1 An example of impregnation systems being used in complementary combination with other surface protection systems is a compatible anti-graffiti coating that permits vapour transmittability applied on top of an impregnation system.

NOTE 2 An example of a poor choice is an impregnation system on top of a sacrificial anti-graffiti product.

- 2.2 Where hydrophobic impregnation is proposed for structures within or near water bodies, consent for the application of impregnation system shall be obtained from the relevant water authority.

- 2.3 Where hydrophobic impregnation is proposed for structures within or near sensitive areas, as defined by Section 105A of the Highways Act 1980 [Ref 2.N] (as amended), consent for the application of impregnation systems shall be obtained from the relevant environmental regulator.

- 2.4 Where hydrophobic impregnation is proposed for historic structures, consent for the application of impregnation systems shall be obtained from the relevant planning and heritage authorities.

NOTE Historic structures can include listed or scheduled structures.

- 2.5 Where hydrophobic impregnation is proposed for structures on or near transport infrastructure, consent for the application of impregnation systems shall be obtained from the relevant authorities.

NOTE Transport infrastructure include railway and highway assets.

- 2.6 The design drawings shall clearly state any constraints for the application of impregnation systems on concrete highway structures.

NOTE The constraints for the application of hydrophobic impregnation can include:

- 1) encapsulating the structure receiving impregnation systems;*
- 2) masking of elements or components of the structure that could be adversely affected by the impregnation systems such as elastomeric bearings or joint sealants;*
- 3) covering carriageway surfacing to prevent contamination; and,*
- 4) protection measures to prevent contamination of the local environment.*

- 2.7 A risk assessment shall be undertaken to inform the constraints for the application of surface protection systems on concrete highway structures.

- 2.8 Hydrophobic impregnation systems shall be colourless following application to the concrete substrate.

NOTE A coloured impregnation system can obscure defects and hinder inspections.

- 2.9 Where the application of hydrophobic impregnation on the refurbishment of existing concrete structures has been agreed by the Overseeing Organisation, the existing concrete substrate shall be free from defects.

NOTE Defects can include rust stains, cracks, delamination and spalls.

- 2.10 Where defects are present on the existing concrete substrate, repairs shall be designed and executed prior to the application of hydrophobic impregnation.

Hydrophobic impregnation

- 2.11 The application of hydrophobic impregnation on new concrete structures or refurbishment of existing concrete structures to protect against diffusion of chloride ions shall be agreed with the Overseeing Organisation.

- 2.11.1 Hydrophobic impregnation should be applied to concrete highway structures subject to the following chloride exposure conditions:

- 1) where one surface is immersed in water containing chlorides from sources other than seawater and another is exposed to air; and,
- 2) exposure class XS3 in accordance with BS 8500-1 [Ref 1.].

NOTE 1 *Diffusion of chloride ions is not expected where the concrete capillary absorption to water is < 0.01kg/m².h0.5 in accordance with BS EN 1504-2 [Ref 2.].*

NOTE 2 *Where application of hydrophobic impregnation is agreed, the early application of hydrophobic impregnation can limit the contamination of structure from chloride ions.*

2.12 Hydrophobic impregnation on new concrete structures shall not be used as a substitute for repairs to poor quality new construction.

2.13 Reapplication of hydrophobic impregnation on concrete highway structures shall be agreed with the Overseeing Organisation.

2.13.1 Hydrophobic impregnation should be reapplied in the following situations:

- 1) after expiry of the system's expected life in accordance with the manufacturer's recommendations;
- 2) half-cell potential is more negative than -350mV;
- 3) chloride ion concentrations are greater than 0.3% by weight of cement; and,
- 4) concrete substrate has been subjected to physical abrasion and degradation.

2.14 Where defects are present on the existing concrete substrate, repairs shall be designed and executed prior to the reapplication of hydrophobic impregnation.

3. Materials

- 3.1 Hydrophobic impregnation systems shall protect the concrete highway structure against diffusion of chloride ions.
- 3.2 The performance requirements for hydrophobic impregnation systems that protect a structure from diffusion of chloride ions shall be in accordance with Clause 1709 of MCHW Series 1700 [Ref 5.N].

4. Records and inspection

Records

- 4.1 A record of the application of the impregnation system shall be prepared in accordance with CG 302 [Ref 1.N] incorporating the following information:
- 1) as-built records showing extents of the impregnation system application;
 - 2) all relevant technical literature including health and safety data sheets relating to the products used;
 - 3) application method;
 - 4) test findings;
 - 5) amount of materials used;
 - 6) number of applications;
 - 7) coverage rate;
 - 8) weather conditions;
 - 9) maintenance requirements; and,
 - 10) removal requirements.

Inspection

- 4.2 Structural elements where impregnation systems have been applied shall be inspected for signs of deterioration of the impregnation system, as part of the structural inspection regime in accordance with CS 450 [Ref 3.N].

NOTE *Signs of deterioration of the impregnation system can include the following:*

- 1) *dirt build up;*
- 2) *graffiti;*
- 3) *peeling;*
- 4) *cracking;*
- 5) *leachates;*
- 6) *non-uniform patches within treated areas.*

5. 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	The National Archives. legislation.gov.uk . Highways Act 1980, 'Highways Act 1980'
Ref 3.N	Highways England. CS 450, 'Inspection of highway structures'
Ref 4.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 5.N	Highways England. MCHW Series 1700, 'Manual of Contract Documents for Highway Works, Volume 1 Specification for Highway Works - Series 1700 Structural Concrete.'

6. Informative references

The following documents are informative references for this document and provide supporting information.

Ref 1.I	BSI. BS 8500-1, 'Concrete. Complementary British Standard to BS EN 206. Method of specifying and guidance for the specifier.'
Ref 2.I	BSI. BS EN 1504-2, 'Products and systems for the protection and repair of concrete structures. Definitions, requirements, quality control and evaluation of conformity. Surface protection systems for concrete'

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Highway Structures & Bridges
Design

CD 373

England National Application Annex to CD 373 Impregnation of reinforced and prestressed concrete highway structures using hydrophobic pore-lining impregnants

(formerly BD 43/03)

Revision 0

Summary

There are no specific requirements for Highways England supplementary or alternative to those given in CD 373.

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

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Version	Date	Details of amendments
0	Mar 2020	Highways England National Application Annex to CD 373.

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Highway Structures & Bridges
Design

CD 373

Northern Ireland National Application Annex to CD 373 Impregnation of reinforced and prestressed concrete highway structures using hydrophobic pore-lining impregnants

(formerly BD 43/03)

Revision 0

Summary

This National Application Annex contains the Department for Infrastructure Northern Ireland requirements related to impregnation of reinforced and prestressed concrete highway structures using hydrophobic pore-lining impregnants.

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

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Release notes

Version	Date	Details of amendments
0	Mar 2020	Department for Infrastructure Northern Ireland National Application Annex to CD 373.

Foreword

Publishing information

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

This document supersedes BD 43/03, 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 Department for Infrastructure Northern Ireland requirements related to the impregnation of reinforced and prestressed concrete highway structures using hydrophobic pore-lining impregnants.

Assumptions made in the preparation of this document

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

Terms and definitions

Terms

Term	Definition
Sensitive area	Sensitive Area is defined in Northern Ireland in the Roads (NI) Order 1993 Part V as amended by the Roads (EIA) Regulations, Reg 3(3) R(EIA)Regs (NI) 2017 [Ref 2.N].

NI/1. Application of impregnation systems

General requirements (CD 373, clause 2.3)

NI/1.1 CD 373, clause 2.3 shall not apply.

NI/1.2 Where hydrophobic impregnation is proposed for structures within or near sensitive areas, as defined by the Northern Ireland in the Roads (NI) Order 1993 Part V as amended by the Roads (EIA) Regulations, Reg 3(3) R(EIA)Regs (NI) 2017 [Ref 2.N], consent for the application of impregnation systems shall be obtained from the relevant environmental regulator.

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	legislation.gov.uk. R(EIA)Regs (NI) 2017, 'The Roads (Environmental Impact Assessment) Regulations (Northern Ireland) 2017'

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Highway Structures & Bridges
Design

CD 373

Scotland National Application Annex to CD 373 Impregnation of reinforced and prestressed concrete highway structures using hydrophobic pore-lining impregnants

(formerly BD 43/03)

Revision 0

Summary

This National Application Annex contains the Transport Scotland specific requirements for CD 373.

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: TSSStandardsBranch@transport.gov.scot

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Release notes

Version	Date	Details of amendments
0	Mar 2020	Transport Scotland National Application Annex to CD 373.

Foreword

Publishing information

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

This document supersedes BD 43/03, 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 specific requirements related to the impregnation of reinforced and prestressed concrete highway structures using hydrophobic pore-lining impregnants.

Assumptions made in the preparation of this document

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

Terms and definitions

Terms

Term	Definition
Sensitive area	Sensitive area as defined by The Environmental Impact Assessment (Scotland) Regulation 1999 EIA(S) 1999 [Ref 2.N].

S/1. Application of impregnation systems

General requirements (CD 373, 2.3)

S/1.1 CD 373, clause 2.3 shall not apply.

S/1.2 Where hydrophobic impregnation is proposed for structures within or near sensitive areas, as defined by The Environmental Impact Assessment (Scotland) Regulations 1999 EIA(S) 1999 [Ref 2.N], consent for the application of impregnation systems shall be obtained from the relevant environmental regulator.

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. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 2.N	EIA(S) 1999, 'The Environmental Impact Assessment (Scotland) Regulations 1999'

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Highway Structures & Bridges
Design

CD 373

Wales National Application Annex to CD 373 Impregnation of reinforced and prestressed concrete highway structures using hydrophobic pore-lining impregnants

(formerly BD 43/03)

Revision 0

Summary

There are no specific requirements for Welsh Government supplementary or alternative to those given in CD 373.

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

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