

Network Rail

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**King's Cross Station  
Redevelopment  
Programme Package 6  
GRIP 5**

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Civil Specification  
Volume 11: Anchorages  
to Concrete and Masonry

**Job Number 123345**

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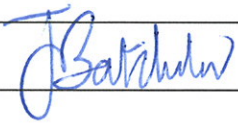
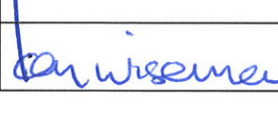

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It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

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## Contents

	Page
1 Civil Specification Volume 11: Anchorages to Concrete and Masonry	1
1.1 Scope of Specification	1
1.2 Specification References	1
2 Design	1
2.1 Contractor's Design Responsibility	1
2.2 Design Procedure	2
3 Products and Materials	3
3.1 General	3
3.2 Fixing and Anchorage Materials	3
3.3 Limits on Use	4
3.4 Control of Deflections	5
4 Execution	5
4.1 Post-Drilled Anchors in Existing Concrete Sections	5
4.2 Installation of Cast In Anchors	6
4.3 Prevention of Bimetallic Corrosion at Anchors	6
4.4 Heritage	6
5 Testing of Anchors	6
5.1 Testing of Post-Drilled Anchors	6

# 1 Civil Specification Volume 11: Anchorages to Concrete and Masonry

## 1.1 Scope of Specification

This Specification provides particular requirements for Contractor to design, coordinate, install and test anchorages into concrete and masonry for all load-carrying applications, including but not limited to non-structural elements such as finishes, MEP systems, equipment and signage, arising from installations in accordance with Contractors' working drawings.

Anchorages into concrete and masonry indicated on the Design Drawings shall be provided and installed as shown, and tested in accordance with this Specification.

Structural requirements for fixings and anchorages to structural timber are covered separately in the Structural Timber Specification.

Requirements for fixings and anchorages to structural steel are covered separately in the Structural Steelwork Specification, and the WCR Roof Steelwork Specification.

## 1.2 Specification References

Read this Specification together with all the following documents:

- Sections A and other related sections of the Architectural Specification,
- Structural Concrete Specification
- Master Building Services Specification (all sections related to fixings and anchorages of the elements covered in the Master Building Services Specification, including but not limited to equipment, pipework, cabling, ductwork, and systems).
- Preliminaries and Contract Conditions
- The Architectural drawings (which indicate the arrangement of Architectural elements to be fixed and anchored, and the design intent).
- The Mechanical Electrical and Plumbing and Fire Suppression Systems drawings (which indicate the arrangement of systems and their elements to be fixed and anchored, and the design intent).

# 2 Design

## 2.1 Contractor's Design Responsibility

Take responsibility for the design of fixings and anchorages to concrete and masonry, including (but not limited to) the following tasks, as described in the Technical Preliminaries:

### 2.1.1 Anchorage Design

Unless the final details of an anchorage is provided on the design drawings, undertake residual coordination, detailing, product selection and justification of all anchorage systems required to complete the works.

### 2.1.2 Anchorage Co-ordination

- Include bracket, fixing, cast-in anchor, post-drilled anchor and insert details on the working drawings as required by the Architectural Specifications and Building Services Master Specifications.

- Coordinate the bracket and fixing design with structure, other services, and finishes including Grade I Listed Building fabric to be protected and refurbished in accordance with the Architectural Specifications.

#### 2.1.3 Submittals

- Submit details of proposed anchors and fixings including manufacturer's rated loads, design recommendations, recommendations for installation and test data for acceptance by the Employer's Representative.
- Submit any details of fixing proposals required by English Heritage and secure their approval for carrying out the work.
- Where the Contract Drawings specifically require calculations to be provided for elements including their anchors, submit the anchorage calculations to the Employer's Representative.

### 2.2 Design Procedure

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#### 2.2.1 Anchorage Loads

- Unless explicitly defined on the Design Drawings, calculate the loads on the fixings based on the operating weights of items to be supported and any imposed dead, live, wind or other loads defined in the relevant performance specifications.
- Determine whether any of the loads have oscillating components (for example, from vibrating machinery) in order to inform the choice and design of anchorage.
- Determine the additional loads in the anchors due to any prying, eccentricity, torsion, etc, effects due to the arrangements of end-plates and brackets.

#### 2.2.2 Base Material Conditions

- Verify the strength of the concrete or masonry into which the anchorages will be installed from design drawings or records of existing structure.
- Identify whether the anchorages will be in "cracked" or "uncracked" zones of concrete.
- Confirm the likely temperature range of the substrate.
- Determine the required fire resistance for the area from the fire compartmentation drawings.

#### 2.2.3 Justification Methods

- Justify the selection of anchorages using the detailed design method outlined by the manufacturer in their handbook or manual.
- Apply load and material safety factors in accordance with the manufacturer's specification.
- Take account of anchor spacing and edge effects, embedment depth, base material strength/cracking/temperature/thickness and all other aspects affecting the anchor capacity in accordance with the manufacturer's design method.
- Take account of co-existent tensions and shears in accordance with the manufacturer's specification.
- Justify the anchorage for any oscillating loads identified.
- Justify the anchorage for the required fire resistance.
- The use of design software supplied and assured by the manufacturer is acceptable but must be used by a technically competent person who can ensure that input data is entered correctly and verify and interpret the results.

## 3 Products and Materials

### 3.1 General

King's Cross Station is a Grade I listed, publicly accessible part of the national railway infrastructure and is to be designed and executed to ensure that all primary elements of the fabric have a life expectancy of 120 years. Carry this requirement through to the selection, design and provision of anchorage systems.

Fit-out elements such as ceilings and services are likely to be stripped out and replaced numerous times during the design life of the building. In all locations, consider provision of anchorage systems that can be re-used in future refurbishments so that repeated drilling and fixing into structural elements is avoided:

- Unless physically impossible, make use of fixing systems provided on the design drawings, for example the dovetail slots on the soffit of composite slabs on profiled metal decking and the "Halfen" or similar channels cast into the soffits of various new-build slabs. Provide a sub-grid of framing elements attached to these fixing systems to create a facility for hangers for ceilings, services, etc, or to reach head-restraint systems for block walls, etc.
- Where no soffit fixing system exists (for example, in works previously constructed), provide an extent (agreed with the Employer's Representative) of face-fixed array of stainless steel "Halfen" or similar channels fixed with stainless steel undercut anchors (or other system suited for installation and use overhead in long-term tension in the cracked zone of the concrete). Design this system to carry loads of 0.5kN/m<sup>2</sup> for services and 0.2kN/m<sup>2</sup> for ceilings, unless the contractor proposes using heavier items or noted otherwise on the loading plans.
- Coordinate the fixings required for façades, shop-fronts and other cladding, balustrades, wind-posts, building services etc as described in section 2.1.1 above to ensure that wherever possible anchorages are cast or built in to concrete, masonry, structural steelwork and timber rather than post-fixed.

### 3.2 Fixing and Anchorage Materials

Use stainless steel (SS) grade 1.4401 (A316) products, or products hot dip galvanised or sherardized to at least 5µm by the manufacturer (Galv) in the locations tabulated below. Cold galvanizing or other similar products will not be accepted as equivalent to sherardizing or hot-dip galvanizing:

Location		Notes on Scope and Constraints
Ceilings, cladding and miscellaneous metalwork anchors	Galv.	Internal environment inside rooms or WCR public spaces.
	SS	External or Station environment (Main Train Shed or Suburban Train Shed).
Ad panels and signage anchors to concrete	SS	For anchors to vertical surfaces, or any external surfaces.
	Galv.	Internally, anchors to horizontal surfaces and anchors buried in floor finishes.
Hand rails and balustrade anchors to concrete. Fall arrest system anchors. Perforated metal screen anchors and post anchors	SS	Front of house or station environment, internal or external. Back of house, external.
	Galv.	Back of house internal.
Drilled anchors to structural concrete or masonry for supports, brackets and internal MEP equipment in WRB, STS, NRPR and WCR.	SS.	Internal rooms.
Holding down bolts for external MEP equipment on roof and in station areas subject to power hosing, including all mechanical and fire services plant rooms.	SS	External or station environment.
Anchors for equipment, including but not limited to CCTV, loudspeakers,	Galv.	Internal rooms or WCR public spaces.
	SS	External or station environment.

Elsewhere, use stainless steel grade 1.4401 (A316) products for all built-in or post-fixed anchorages.

### 3.3 Limits on Use

#### 3.3.1 Stone Corridor Floor Slabs in West Range Building

No drilled or chased fixings may be made into the York Stone slabs forming the West Range Building corridor.

#### 3.3.2 Post-Fixed "Drilled-In" Anchors into Masonry

- Use only chemical adhesive systems for heavy-duty anchors into masonry in accordance with the limitations in section 3.3.3 below.
- Comply with the manufacturer's requirements on minimum edge distance and spacing in masonry
- Install expanding anchors into brick/block units, not into bed-joints in accordance with guidance in the Construction Fixing Association Guidance Note *Fixings for Brickwork and Blockwork*. Injection-type chemical anchors for façade retention should be installed in the mortar bed-joint of the masonry at a junction with a vertical joint as in accordance



with guidance in the Construction Fixing Association Guidance Note *Fixings for the retention of masonry façades*.

- Avoid drilling into cracked or otherwise damaged units.

"Through-drilled" systems whereby bolts pass completely through the wall with a bearing plate at each end are acceptable alternatives subject to observing an acceptable edge distance from the end of a wall.

### 3.3.3 Chemical Anchors

Do not use chemical anchors in overhead situations.

Elsewhere, demonstrate as part of the design that:

- The proposed anchors are suitable to resist any long-term loads without creep rupture, based on assurances and test data from the manufacturer.
- The proposed anchors are safe in fire situations based on assurances and test data from the manufacturer.

### 3.3.4 Shot-Fired/Percussive Staple Anchors

Shot fired or percussive staple type anchors shall not be used without the prior approval of the Employer's Representative.

Field tests shall be carried out to demonstrate the load capacity and stiffness of such fixings to the approval of the Employer's Representative. All material used in shot fired or percussive staple type anchors shall be stainless steel grade 304.

## 3.4 Control of Deflections

Unless stated otherwise on the Contract Documents, the working loads shall be achieved without slip or deformation of the anchors or substrate.

# 4 Execution

Install all anchors in accordance with this section irrespective of whether they are shown on the design drawings or are Contractor designed.

## 4.1 Post-Drilled Anchors in Existing Concrete Sections

### 4.1.1 Edge Distances

Install post-drilled anchors into existing concrete with a minimum of 100mm side cover to the nearest edge, and design the anchor with the edge-distance reduction factors stipulated by the manufacturer. If drilling anchors into existing concrete members with less than 100mm side cover is unavoidable, conduct field trials to determine the most practical way to achieve the required load carrying capacity without damage to existing concrete members.

### 4.1.2 Existing Reinforcement

- No existing reinforcement in slabs is to be cut when post-drilling. Use a non-destructive rebar detection device to scan for positions of bars and drill to avoid these. "Trial and error" drilling is not acceptable. It is recommended that bracketry is designed with alternative hole positions to allow for a drilling to be relocated to avoid existing reinforcement.
- Only where permitted by the ER or shown on the design drawings the cover zone of existing concrete may be scabbled back to expose existing reinforcement to allow holes to be located away from these. Make good the scabbled surface with a repair mortar to a detail accepted by the ER after installing anchors, unless new fresh concrete is to be cast against the scabbled face as part of new works.

#### 4.2 Installation of Cast In Anchors

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Install cast-in anchors with a minimum embedment of 100mm and side cover of 125mm, unless designed reinforcement is provided to prevent splitting of the concrete to the approval of the Employer's Representative. Install cast-in elements with anchoring studs/tails placed so that they are inside a layer of reinforcement lying orthogonal to the anchor and the anchors are never positioned in the cover zone of the concrete.

#### 4.3 Prevention of Bimetallic Corrosion at Anchors

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Where the potential for bimetallic corrosion exists between the anchors and the element fixed to them, provide bimetallic separation details to the approval of the Employer's Representative.

#### 4.4 Heritage

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Include proposals for installation methods, testing, and prevention of damage to existing historic fabric from drilled anchors in the Works Package Plans covering these activities for acceptance by the Employer's Representative.

Where anchors to existing historic structures are required (including but not limited to the Western Range Building and the Suburban Train Shed), carry out all work in accordance with the requirements of the Architectural Specification Section X: Protection of Historic Resources

Perform the work with special care to prevent damage to existing work. Reinstate any existing work (including but not limited to finishes, equipment and structures) damaged by the installation of anchors to the approval of the Employer's Representative.

## 5 Testing of Anchors

Test all anchors in accordance with this section irrespective of whether they are shown on the design drawings or are Contractor designed.

#### 5.1 Testing of Post-Drilled Anchors

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Carry out site testing of drilled anchors in accordance with the manufacturer's instructions, and the following requirements:

##### 5.1.1 Ultimate Load Tests to Establish Suitability of Fixings

Prior to installation of the anchors required for the works, undertake Ultimate Load testing of three samples of each size, application, and type of anchor to establish suitability of the proposed anchor and installation method:

- Engage an independent testing agency with at least 3 years experience in similar work, approved by the Employer's Representative, to carry out preliminary pullout tests
- Secure the approval of the Employer's Representative for test locations.
- Propose remedial works to the concrete or masonry after testing to the approval of the Employer's Representative. Carry out repairs in accordance with the proposals after tests are completed.
- Carry out tests in accordance with BS 5080-1 and the guidance of the Construction Fixings Association Guidance Note *Procedure for Site Testing Construction Fixings*.
- The tests indicate that the product and installation method are acceptable if the lowest tensile failure load of any of a group of three tests exceeds the manufacturer's nominal rated tensile capacity of the anchors.

- If the test results are not acceptable, carry out further testing until a product and installation method has been found which gives acceptable results.

#### 5.1.2 Proof Load Testing to Validate Installation

- Carry out non-destructive proof load testing of drilled anchors designed to carry working loads in excess of 5kN at a frequency as approved by the Employer's Representative. The Proof Load Testing shall consist of a tensile load equal to 1.25 times the Design Capacity of the fixing, applied to at least 1% of all anchors.
- Carry out the tests in accordance with BS 5080-1 and the guidance of the Construction Fixings Association Guidance Note *Procedure for Site Testing Construction Fixings*.
- The anchors shall be deemed to pass the test if no damage or measurable deflection occurs after a static load application with duration of at least 2 minutes.
- If any failures occur during Proof Load Testing of the anchors increase the rate of testing to 5% of all anchors including anchors already installed. Get the approval of the Employer's Representative for extra testing and any corrective action required to replace inadequate anchors.

#### 5.1.3 Testing of Fall Arrest Restraint Anchors

In addition to the manufacturers' requirements for testing of restraint anchors, where anchors are required for safe access restraints and wires, or for lifting points, test 10% of the fixing points by proof loading to 1.25 times their rated resistance as shown on the design drawings or specifications. Submit the proposed method of testing and calibration of the applied load for the approval of the Employer's Representative before commencing testing. If any fixing points fail the test, test the rest of the fixing points to the approval of the Employer's Representative.

All testing and installation of fall arrest restraint anchors shall also be in accordance with the Architectural Specifications.