

PARTICULAR SPECIFICATION

APPENDIX D

ANCHOR BOLTS

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1.1 General

- 1.1.1 Cast-in-anchors shall be used wherever possible. Post-installed anchors shall only be used with the acceptance of the Engineer. Anchors used shall comprise the complete anchorage system including anchors bolts, washers, locknut etc. and mixing of different components from different system or suppliers shall be prohibited. Adhesive anchors that have not been tested and/or have failed creep test shall be prohibited from use.
- 1.1.2 Prior to the installation of any anchor bolts, the Contractor shall appoint a Professional Engineer (PE) to design and submit calculations to the Engineer and QP(S) for acceptance. The Contractor shall comply with the guidelines set by the anchor bolt manufacturer to justify the proposals made by him on the use of anchor bolts.
- 1.1.3 The complete anchorage system shall be Grade 316 stainless steel or equivalent.
- 1.1.4 Proposed anchorage system shall be a proven proprietary system with a track record of at least 5 rail transit system projects.

1.2 Code of Practice

- 1.2.1 Contractor's attention is drawn to the BCA Circular (Ref: BCA BC 15.0.3) dated 1 Oct 2014 requiring compliance to **BS 8539**: "Code of Practice for Selection and Installation of Post-Installed Anchors in Concrete and Masonry" for post-Installed anchors for structures requiring plan approval.
- 1.2.2 BS 8539 gives recommendations for the safe selection and installation of post-installed anchors for use in concrete and masonry by providing measures to be taken to ensure that the anchors meet the overall design requirements including minimising risk of anchor corrosion.
- 1.2.3 For fixings to cladding, the Building Regulations require the anchors to be of stainless steel material. The required embedment depth for the anchors should be measured from the base material. Any plaster layer should be removed prior to installing the anchors and this requirement should be clearly indicated in the structural plans.

1.3 Test Reports and Design

- 1.3.1 When adhesive anchors are proposed, manufacturer's information on the formulation of adhesive, creep characteristics, creep and other test reports shall be submitted for the Engineer's acceptance prior to use. The ultimate capacity of adhesive anchors shall be determined based on their long term load carrying capacity appropriate to the design life span of the main structure taking into consideration creep characteristics and temperature effects under the sustained tensile loads.
- 1.3.2 A test report shall be prepared in accordance to Annex B.4 of **BS 8539**. The report shall record at least the information listed. The test report shall be submitted to the Engineer for acceptance.
- 1.3.3 Testing frequency/sample size shall be included in submitted manufacturer test reports.

1.4 Installation

- 1.4.1 Detection devices shall be used to locate the steel reinforcements before carrying out any drilling of holes for anchor installation. Holes shall be drilled and cleaned in accordance with manufacturer's instructions. Anchors shall be installed in accordance with manufacturer's instruction and at not less than the minimum edge distance, spacing and embedment depth specified by the manufacturer. The anchors shall be installed using the specified tools by the same manufacturer such as drilling systems, drill bits, accessories, setting tools, plug, dispensers, mixing nozzle etc. Mixing of installation tools of different make by different manufacturer is prohibited. Where the manufacturer recommends the use of special tools for installation of anchors, such tools shall be used. The installation of anchors shall be carried out only by trained and certified applicators. Certificates of applicators shall be submitted to the Engineer for acceptance prior to any installation work.
- 1.4.2 All bolts installed must be properly tightened and torque readings are to be submitted to the Engineer for acceptance.

1.5 On Site Testing Standards

- 1.5.1 For anchor bolts that are installed above the trackway at the station and all tunnels, pull-out test shall be carried out for all (100%) of the bolts installed above the trackway.
- 1.5.2 For anchor bolts that are installed at other locations, pull-out test shall be carried out for a minimum sample size of 1 in every 40 anchors or 2.5% of the same type for each batch, with a minimum of three (3) tests. For every anchor that fails the test, an additional five (5) anchors or additional 2.5% will be tested (whichever is higher). If any of the additional anchors selected for testing do not meet the test criteria, test shall be carried on all the remaining anchors in the test batch.
- 1.5.3 A batch is defined as a particular group of anchor bolts which is secured to the same structural element, carrying the same type of load, at the same location. If these conditions are not fully met, it shall be deemed as a different batch subject to testing.
- 1.5.4 The procedure for site test shall be in accordance to Annex B.3 of **BS 8539**.