

Mechanical anchors

BTN 008

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1. Scope and Application

BTN 008 Mechanical anchors states Department of Transport's (DoT) requirements for the design of post-installed mechanical anchors used to make structural connections to reinforced concrete substrates.

The requirements in this document are intended to reduce the risk of failure of connections made with mechanical anchors.

Bridge Technical Notes are a Code of Practice. Compliance with Bridge Technical Notes is mandatory.

Other than as stated in this document and relevant Department of Transport standard specifications, the provisions of AS5100:2017 shall apply. Where this document differs from AS5100:2017, its requirements override those of AS5100:2017.

2. Design requirements

2.1. General

The design, selection and specification of mechanical anchors must be conducted by an engineering consultancy that is, as a minimum, prequalified in accordance with DoT's Prequalification for Structures in either the Simple Structures or Complex Structures category

Mechanical anchors must have the load-carrying capacity required by the design and sufficient durability to achieve the required design life of the structure.

2.2. Design considerations

The design of mechanical anchors shall be in accordance with concrete capacity (CC) method as described in AS 5216 or ACI 318-14.

For tensile loading, the mechanical anchors must be prequalified and designed in accordance with AS 5216.

The spacing of mechanical anchors and minimum edge distance must be in accordance with the product

prequalification or specific supplier's recommendations.

Mechanical anchors shall be designed for the combined effects of shear, bending and/or tension loads calculated by the designer and as appropriate to the intended use.

Connections shall be designed with sufficient redundancy such that the failure of one anchor does not lead to progressive short or long term failure of the connection.

2.3. Design life

Mechanical anchors must have the minimum specified design life of all the following items:

1. The remaining design life of the structure to which the mechanical anchors are going to be attached to;
2. The minimum design life of the components that the mechanical anchors will support;
3. In the case of the components that have an unequal design life the greatest design life shall be adopted.

Waterproofing protection must be provided to eliminate the ingress of water into the mechanical anchor system to prevent corrosion and loss of capacity of the load carrying elements over the required design life thereby compromising its structural performance over its design life.

In the case of retrofitting applications, the chosen anchor must have a minimum design life equivalent to the components being attached to the existing structure.

The design life of mechanical anchors must be demonstrated by testing in accordance with European Organisation for Technical Approvals (EOTA) requirements specifically EAD 330232 – Mechanical fasteners for use in concrete.

Only Grade 316 stainless steel anchors shall be used for applications in bridges and road-related structures to meet the specified design life requirements.

2.4. Restrictions

2.4.1. Permitted anchor types

Subject to selection of the appropriate anchor for the required loading and application from manufacturers' data, the following anchor types are permitted:

Torque Controlled Expansion Anchors

- thick sleeve anchors
- wedge anchors
- undercut anchors

Undercut anchors have superior performance under tensile loading.

2.4.2. Anchor types not permitted

Deformation controlled anchors are not permitted for structural applications.

Non-stainless steel anchors.

2.4.3. Permitted applications

Subject to appropriate design considerations and the restrictions on use stated in this document, mechanical anchors are permitted for use in applications where they are subjected primarily to axial compressive forces and shear forces transverse to the anchor – for example:

- to attach small ancillary items such as plastic pipes (<150mm) and electric cables to a structure if the mechanical anchor is primarily in shear.
- to attach retro-fitted bridge bearings to bridge substructures.

2.4.4. Applications not permitted

Mechanical anchors **shall not** be used in the following applications:

- in new structures if cast-in anchors can be used.
- in existing structures if the connection can be achieved by the use of positive connections*.
- if the remaining design life of the structural components being connected exceeds the tested/certified design life of the available mechanical anchor.
- in applications where mechanical anchor will be subjected to fatigue loadings i.e. stresses that vary with time.
- to support tensile loads in any orientation if the failure of one anchor in the anchor group, for an individual connection, could result in collapse, instability or failure of the connection.
- as holding-down connections for use with cantilever or portal sign structures and high mast light structures.

- as holding-down connections for steel and concrete bridge barriers and bridge barrier posts
- if the thickness of the concrete substrate into which the anchor is being placed is less than 1.25 x required length of the anchor.
- if the concrete substrate into which the anchor is being installed is friable, shows signs of delamination or any other defect other than the permitted use in cracked concrete in accordance with the product prequalification.
- in concrete with characteristic strength less than 20 MPa or greater than 50 MPa - with the exception of undercut anchors which are permitted at strengths in excess of 50MPa if used in accordance with the product prequalification.

* Positive connections are defined as structural connections that are achieved by cast-in fitments such as rag-bolt assemblies or threaded ferrules, or by clamping either through or around the full depth of the elements being connected. For example, a threaded rod (or bolt) in a full-depth hole together with a backing plate.

3. Construction requirements

3.1. Certification of installers

The installation of the fastener shall be carried out by a person certified by the Australian Engineering Fasteners and Anchor Council and evidence shall be provided of competency acceptable to DoT.

Contact Details

For further information please contact:

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Bridge Technical Notes are subject to periodic review and may be superseded.