

AEFAC – TN03

SELECTION OF ANCHOR CHANNEL FOR SAFETY-CRITICAL APPLICATIONS

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1. Scope

This guidance note will provide an introduction to the criteria that needs to be considered during the selection of cast-in anchor channels for safety critical applications.

2. Terminology

The following terminology and definitions are adopted in this document. Additional terminology and definitions may be found in AS 5216 – Design of post-installed and cast-in fastenings in concrete [1] and the AEFAC Anchor Dictionary [2].

Anchor: Element made of steel cast into concrete that is used to transmit applied loads. In the case of anchor channels, a steel anchor is rigidly connected to the back of the channel and embedded in concrete.

Anchor channel: A fastener made of profiled steel element with two or more rigidly connected anchors that are installed into position prior to the casting for concrete.

Attachment: Metal assembly that transmits loads to the anchor.

Channel bolt: Proprietary bolt (such as a T-head bolt) which connects the element to be fixed to the anchor channel.

Cast-in channel: See Anchor channel.

Fixture: See attachment.

Safety critical: The class of safety of an anchor whereby the failure of which would cause risk to human life and/or considerable economic consequences.

3. Components of a cast-in channel system

The provision of an adequate structural connection requires the correct selection of the anchor channel and channel bolt as illustrated in Figure 1. An example of an anchor channel used in a curtain wall application is provided in Figure 2.

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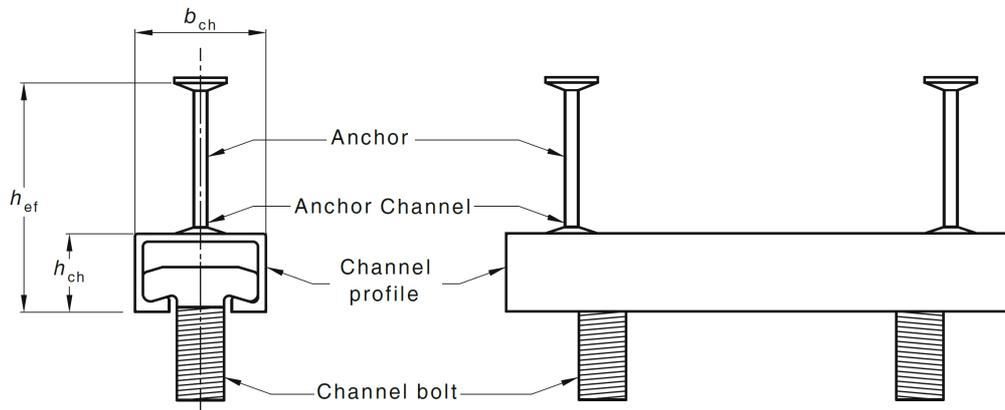


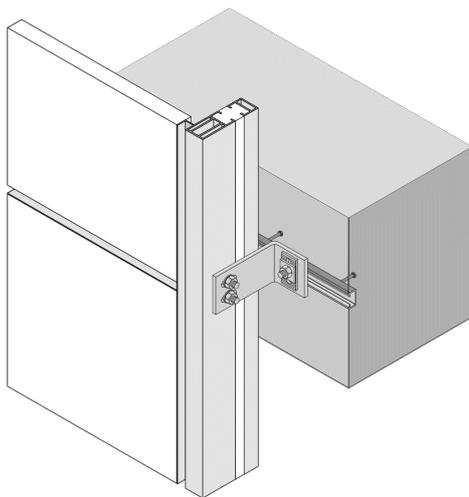
Figure 1: Components of a cast-in channel system [1].

4. Design Considerations

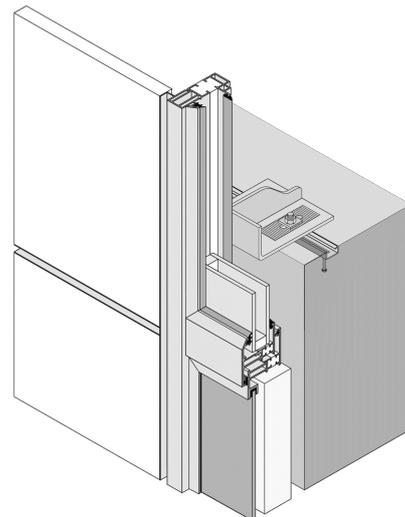
Due to the typical applications of anchor channels in the construction industry, such as the connection of precast elements and attachments of curtain wall panels, they tend to be of a safety critical nature.

The implications of incorrect selection can range from site delays whilst an alternative post-installed solution is found, through to potential disasters brought about by an under strength structural connection.

Whilst all members of AEFAC who sell anchor channels would happily assist with selection of the right product, it is highly recommended that anyone involved with selection is familiar with the details set out in this technical note.



Anchor Channel in face of Slab



Anchor Channel in Top of Slab

Figure 2: Example applications of anchor channels in a curtain wall application

5. Selection Process

The stages for selecting a cast-in solution are as follows:

1. Specification of the correct Anchor Channel type based on the direction of the applied load
2. Correct sizing of both the anchor channel and a suitable channel bolt.
3. Assessment of the corrosion protection required for the anchor channel during its temporary and permanent exposure conditions.

5.1. Anchor Channel Type

Anchor channels can be loaded in three directions as below:

- Tension
- Shear load acting perpendicular to the longitudinal axis of the channel
- Shear load acting on direction of the longitudinal axis of the channel

Anchor Channels with smooth lips and smooth T-bolts generally cannot take over any shear load acting in direction of the longitudinal axis of the channel. The designer needs to check the pre-qualification report such as European Technical Assessment (ETA) of the product to see, if it is suitable for the load direction that is applied.

5.2. Correct sizing

Correct sizing will depend on the following factors:

- Magnitude of the applied design load.
- Direction of the applied design load.
- Type of applied design load (static/dynamic/seismic, etc.).
- Proximity to the concrete edges.
- Thickness and compressive strength of the concrete.
- Details of any local reinforcement provided.
- Thickness of element (bracket) to be fixed to the anchor channel
- The existence of any packers/grout underneath the element brought about by construction tolerances.

Design and qualification requirements for anchor channels are specified in AS 5216:2018 [1].

The design method is a partial safety factor approach that deals with each failure mode separately to give an accurate design model and the flexibility to modify the design of an anchor channel to suit specific applications.

The following tensile failure modes should be considered when designing an anchor channel system:

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- Steel failure of channel bolt
- Steel failure of the anchor
- Failure of connection between anchor and channel profile
- Local flexural failure of channel lip
- Flexural failure of channel
- Pull-out failure
- Concrete failures
 - Cone
 - Splitting
 - Blow-out
- Steel failure of supplementary reinforcement, if used
- Anchorage failure of supplementary reinforcement, if used

The following shear failure modes should be considered when designing an anchor channel system:

- Steel failure of channel bolt without lever arm
- Steel failure of channel bolt with lever arm*
- Steel failure of anchor
- Failure of connection between anchor and channel
- Local flexural failure of channel lip
- Concrete failures
 - Concrete edge
 - Pry-out
- Steel failure of supplementary reinforcement, if used
- Anchorage failure of supplementary reinforcement, if used

When combined tension and shear loading is present, an interaction diagram is considered to ensure that a diagonal loading will not overload the channel.

Anchor channels should be tested and assessed in accordance with AS 5216 [1] to provide capacities for all failure modes as listed above. AS 5216 [1] deems a European Technical Approval (ETA) satisfactory to show compatibility with the standard.

Note:

While cast-in channels provide a very flexible anchoring solution, their capacity for loads acting parallel to the channel axis are limited. This is critical for seismic actions. AS 5216 [1] currently does not provide any provisions for loads in the longitudinal direction. If anchor channels are exposed to this loads the

* When introduced with a lever arm, shear loads on the channel bolt result in bending stresses for the channel bolt. For shear load applications the maximum thickness of shims should be determined by the engineer and included in the drawings

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manufacturer should provide detailed information on the capacity against longitudinal loads based on independent testing.

5.3. Anchor Channel corrosion protection

Oxidation during the temporary exposure condition might differ from the permanent service condition. For example, an anchor channel for a curtain wall panel is exposed to the elements until the curtain wall is erected. Once erected it becomes an internal application and is protected from the elements by the curtain wall. Therefore, the corrosion protection requirement for the anchor channel may be greater than that of the channel bolt. However, where different corrosion resistance is deemed necessary, care should be taken to ensure that galvanic (bi-metallic) corrosion does not become a problem.

6. References

- [1] Standards Australia, AS 5216: Design of post-installed and cast-in fastenings in concrete, SAI Global, Sydney, 2021.
- [2] AEFAC, Technical Note, "AEFAC Anchor Dictionary," Australian Engineered Fasteners and Anchors Council. www.aefac.org.au.



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