TECHNICAL NOTE: SELECTION OF CAST-IN CHANNEL FOR SAFETY-CRITICAL APPLICATIONS

1 SCOPE

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

2 TERMINOLOGY

The following terminology and definitions are adopted in this document. Additional terminology and definitions may be found in the AEFAC Anchor Dictionary [1].

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 – Steel "channel" profile with rigidly connected "anchors" installed prior to concreting.

Attachment – Metal assembly that transmits loads to the anchor.

Channel bolt – Screw (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.

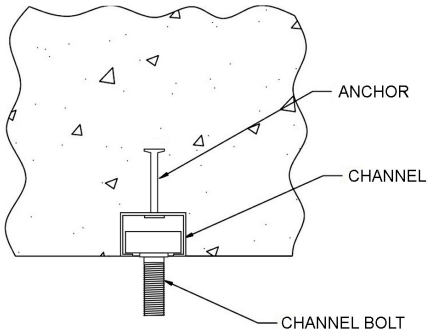

Figure 1: Components of a cast-in channel system.

4 DESIGN CONSIDERATIONS

Due to the typical applications of cast-in 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 cast-in channel would happily assist with anchor selection, it is highly recommended that anyone involved with selection is familiar with the details set out in this guidance note.

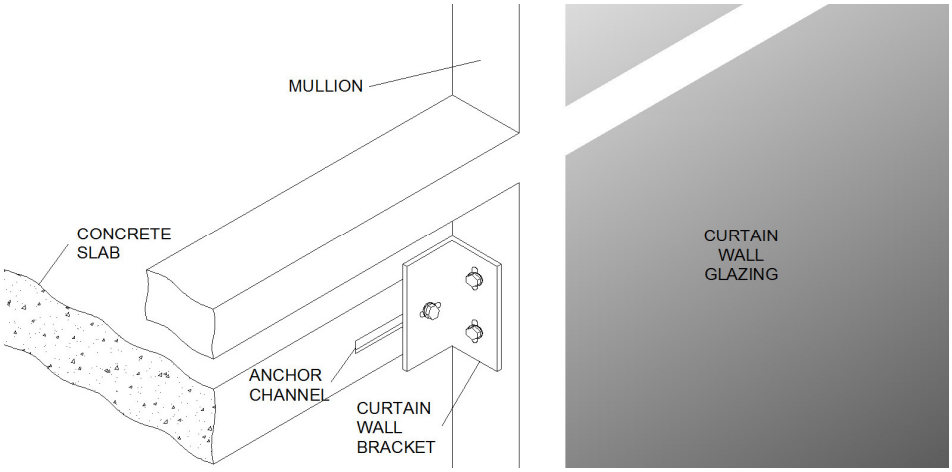

Figure 2: Example application of an anchor channel in a curtain wall application.

5 SELECTION PROCESS

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

1. Correct sizing of both the cast-in channel and a suitable channel bolt.
2. Assessment of the corrosion protection required for the cast-in channel during its temporary and permanent exposure conditions.

5.1 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 edge.
- Details of any local reinforcement provided.
- Thickness of element (bracket) to be fixed to the cast-in channel.
- The existence of any packers/grout underneath the element brought about by construction tolerances.

Members of AEFAC have recognised that the Concrete Capacity (CC) Method used in Europe is the most appropriate design model for anchorages in concrete and that the design strengths (design resistances) found in the relevant ETA is a reliable source of data. This comes with the added peace of mind that the tests have been carried out, assessed and verified by an independent body.

The design method for cast-in anchorages based on the CC Method is found in the Standard Recommendation CEN/TS 1992-4-3:2009 “Design of Fastenings for Use in Concrete – Part 4-3 Anchor Channels” [3], and is summarised in the European Engineered Construction Systems Association publication “Design of Anchor Channels” [4]. The draft European Standard prEN 1992-4 [5] has been published and will eventually supersede CEN/TS 1992-4-3:2009 when it becomes a harmonised European Standard.

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 a channel to suit specific applications.

The following tensile failure modes should be considered when designing a cast-in channel system:

- Steel failure of the anchor
- Failure of connection between anchor and channel
- Local flexural failure of channel lip
- Steel failure of channel bolt
- Flexural failure of channel
- Pull-out failure
- Concrete cone failure
- Splitting failure
- Blow-out failure
- Steel failure of supplementary reinforcement
- Anchorage failure of supplementary reinforcement

The following shear failure modes should be considered when designing a cast-in channel system:

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

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

Note: While cast-in channels provide a very flexible anchoring solution, their capacity can be limited if the load acts parallel to the channel unless a serrated channel type is used. This is critical for seismic actions.

5.2 CHANNEL CORROSION PROTECTION

Oxidation during the temporary exposure condition might differ from the permanent service condition. For example, a cast-in 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 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] AEFAC Technical Note, “AEFAC Anchor Dictionary”, www.aefac.org.au
[2] ETAG 001, “Guideline for European Technical Approval of Metal Anchors for Use in Concrete, Annex C: Design Methods for Anchorages”, European Organisation for Technical Approvals, 2010, www.eota.be
[3] CEN/TR 1992 Design of Fastenings for Use in Concrete
[4] ECS, “Design of Anchor Channels”, European Engineered Construction Systems Association, www.ecs-association.com
[5] prEN 1992-4 “Eurocode 2: Design of concrete structures – Part 4: Design of fastenings for use in concrete”