Hilti (New Zealand) Limited
600 Great South Rd
Ellerslie, Auckland 1051

HILTI Market Organization: New Zealand	Page:	1/2
HILTI Contact Partner: Engineering Team NZEngineers@hilti.com	Date:	23.01.2023
	Tel:	+64 800 444 584

Anchoring into grout-filled masonry

1. SCOPE

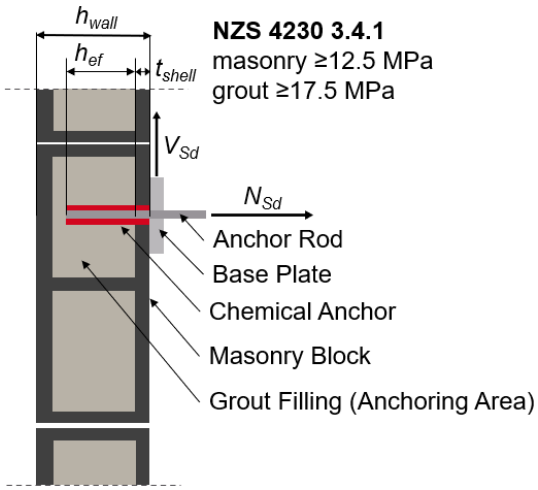
This document aims to assist Engineers to evaluate alternatives for applications with base materials not covered in current design standards by providing engineering advice. This document shall not be used as an engineering judgement, or as a substitute for the evaluation, design, revision, and approval of a Chartered Professional Engineer.

2. APPLICATION: Grout-filled masonry

NZS 4230:2004 provides information for the design of reinforced concrete masonry structures. This standard, however, does not cover post-installed anchor applications, but cast-in bolts only (Appendix C), which are not applicable for anchoring into existing structures.

NZS 3101:2006 defines, in clause 17.5.5, how post-installed adhesive anchors and mechanical anchors shall be designed and prequalified. The design provisions of NZS 3101 are applicable for self-compacting concrete and for conventionally placed concrete with specified compressive strength of 20 MPa to 100 MPa.

To facilitate the understanding of the elements of a typical post-installed anchor application into a grout-filled masonry block, refer to the figure below:



3. ENGINEERING ADVICE

It is Hilti's Engineering advice to not consider the masonry block's shell to contribute to the capacity of the connection. This comes from the interpretation that, in an event of high loading, the shell being the weaker part may spall out from the wall.

If the specified compressive strength of the grout is at least 20 MPa then the grout is assumed to behave as concrete of the same compressive strength.

Notes:

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2. This document shall not be used as an engineering judgement, or as a substitute for the evaluation, design, revision, and approval of a CPEng before being used for any design.
3. The considerations in this document assume the concrete wall to be in an undamaged condition.
4. Installation to be carried out strictly in accordance with the written Hilti Instructions for Use (IFU).

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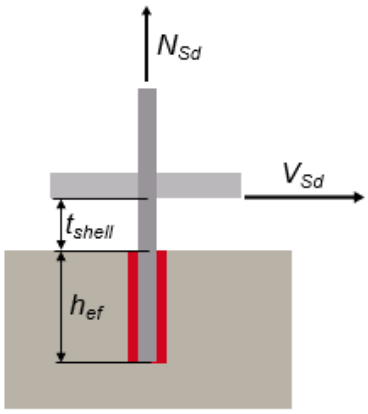
3. ENGINEERING ADVICE

Option 1: *Shell thickness as a stand-off and grout to be modeled as concrete (≥20 MPa) base material.*



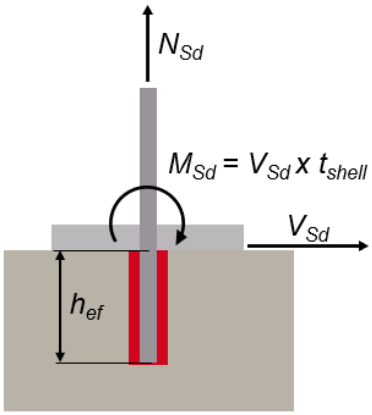
Considerations:

- t_{shell} = thickness of the shell.
- h_{ef} = effective embedment into the grout.
- Design to be done on Profis Engineering for a concrete fixing.
- Stand-off without clamping, or stand-off with grouting may be selected, but for the latter, the compressive strength shall be the shell's compressive strength (≥12.5 MPa).
- Concrete thickness and edge distance to consider the grout thickness/edge distance only (ignoring shell thickness)

Limitations:

- Cannot be used for seismic design due to the stand-off being likely greater than 0.5 x diameter of the anchor.
- Boundary condition: Avoiding lever arm by considering a thin concrete column.

Option 2: *Shear force converted into a bending moment, and grout to be modeled as concrete (≥20 MPa) base material.*



Considerations:

- t_{shell} = thickness of the shell.
- h_{ef} = effective embedment into the grout.
- Design to be done on Profis Engineering for a concrete fixing.
- When a Shear force is applied, a concentrated Bending Moment equal to V_{sd} (Shear load) x t_{shell} to be applied to the baseplate.
- Concrete thickness and edge distance to consider the grout thickness/edge distance only (ignoring shell thickness)

Limitations:

- Bending moment will likely increase the tension forces applied to the anchors.
- Unless the baseplate is fixed directly to the grout, this cannot be used for seismic design due to the stand-off being likely greater than 0.5 x diameter of the anchor.
- Anchor's steel capacity for shear needs to be manually calculated to check if the anchors are capable to resist the additional bending forces.
- Boundary condition: Avoiding lever arm by considering a thin concrete column.

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