



ANCHOR DESIGN FOR SEISMIC CONDITIONS

Secure your structures with the right anchors and seismic design best practices

Approved CPD : 1

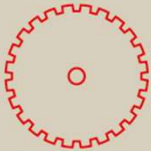
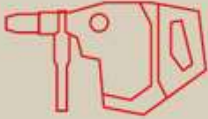
[Ref. No. : MySET/EV/CPD/HILTI/2025(81)]



THIS IS HILTI



SYSTEM SOLUTIONS FOR THE CONSTRUCTION INDUSTRY

Engineering	Cutting and grinding	Drilling and demolition	Measuring and aligning	Fastening and installation	Firestop and insulation	Services
						
• Design • Specifications • Consulting	• Cutting and grinding • Diamond systems	• Drilling and chiseling • Diamond systems	• Distance measuring • Leveling and aligning • Detection	• Post-installed Anchor & Rebar technology • Direct fastening	• Passive Firestop Solution • Joint Sealant	• Engineering services • Job Site Training • Quality and testing • Logistics • Finance and administration • Tool services

AGENDA

- **Overview of SPEC2SITE**
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- **Seismic Hazard in Malaysia**
- **Post-Installed Anchor Applications Under Seismic Loading**
- **Design Requirements for Post-Installed Anchors Under Seismic Actions as per MS EN 1992-4**
- **Qualification Guidelines in the European Assessment Documents (EADs)**
- **Seismic Design Options as per MS EN 1992-4**
- **Hilti Solutions – Seismic Approved Anchor Portfolio**
- **Streamlining Design Analysis With Value Engineering Enabler – PROFIS Engineering**
- **Engineering Solutions and Services**

Overview of SPEC2SITE



Better Specs that are:

HIGHER PERFORMING

Our better anchoring solutions, meet a wide variety of application requirements

VALUE ENGINEERED

Our software enables optimized and code-compliant designs

MORE PEACE OF MIND

Our 'faster, simpler, and safer' systems, knowledge-sharing and jobsite presence help ensure you get what you spec

MORE SUSTAINABLE

Our solutions enable you to reduce material and quantify CO₂ savings in your designs

SPEC2„SITE

Better Site Practices that are:

FASTER

Our systems allow fewer and faster installation steps, delivering the lower cost of ownership

SIMPLER

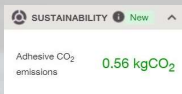
Our systems allow an intuitive and straight forward installation process, anyone can do it

SAFER

Our systems, knowledge sharing, and jobsite presence help ensure that you comply with the spec

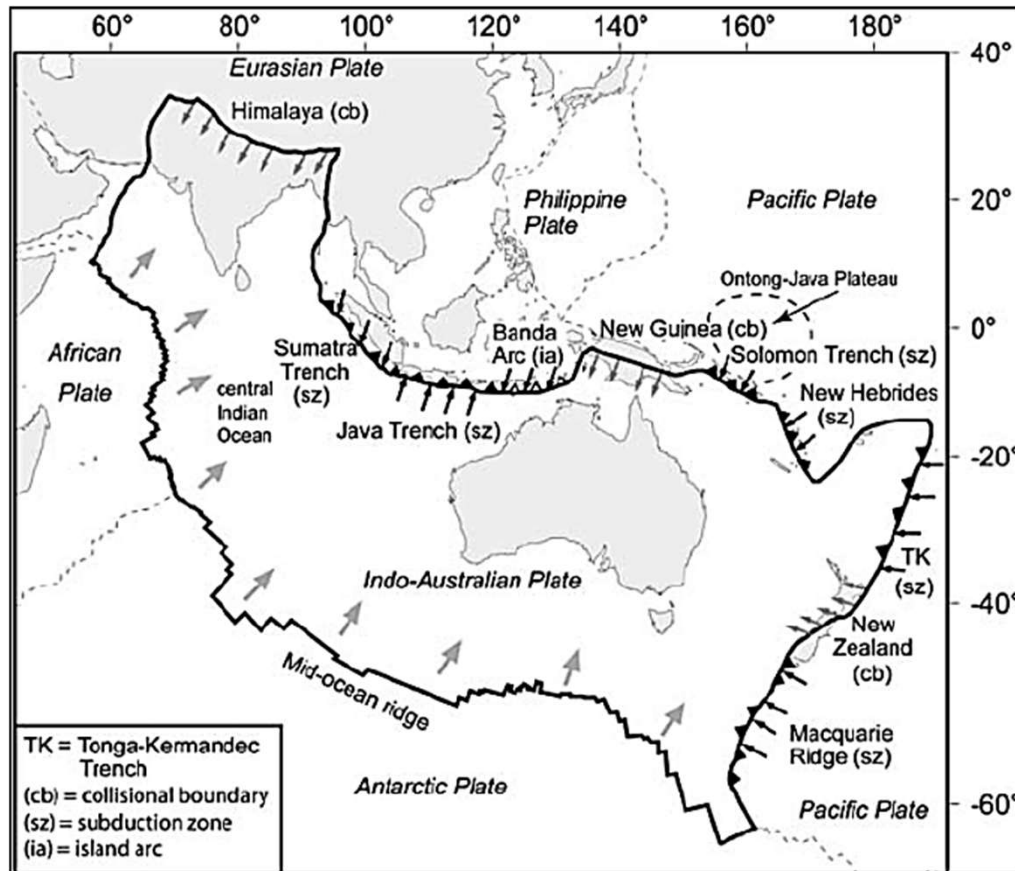
MORE SUSTAINABLE

Our systems enable you to reduce waste and quantify CO₂ on your project



Introduction

Earthquakes are Unavoidable Natural Hazards



Source: https://www.researchgate.net/figure/Indo-Australian-Plate-showing-the-plate-boundaries-and-forces-discussed-in-the-text_fig1_245025442



Bohol, Philippines (2013)

- Magnitude = 7.2;
- Mercalli Intensity Scale = VII (*Destructive*)
- Death = 222
- Injured = 976



Sumatra, Indonesia (2004)

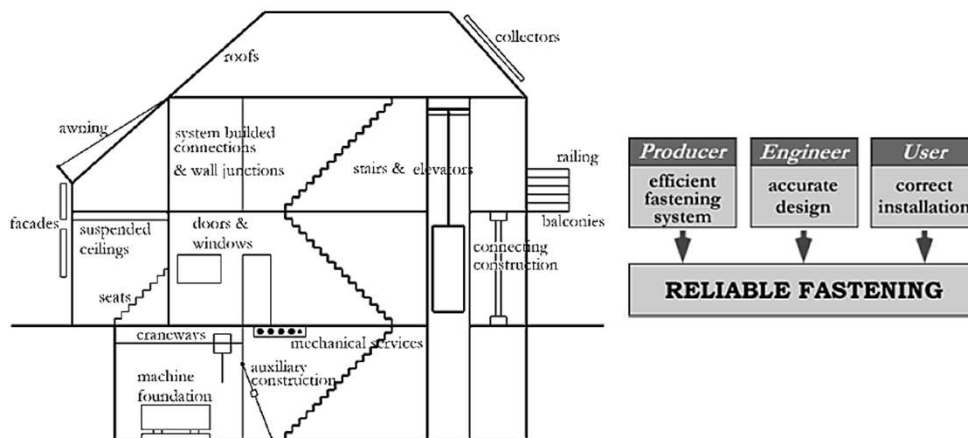
- Magnitude = 9.3
- Mercalli Intensity Scale = IX (*Violent*)
- Death = 228k
- Injured = 125k+



Christchurch, New Zealand (2010)

- Magnitude = 6.2;
- Mercalli Intensity Scale = IX (*Violent*)
- Death = 185,
- Injured = 2k+

...Causing *Avoidable* Damage to the Structure and Elements Attached to it



3.5 Definitions

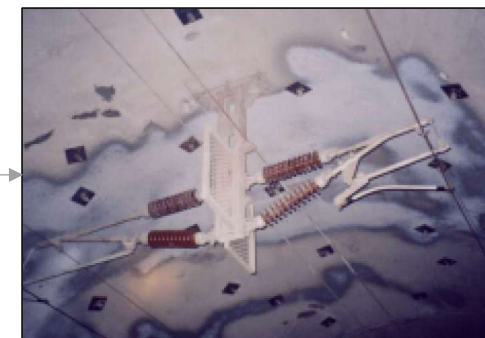
- non-structural element** = architectural, mechanical or electrical element, system or component which, whether due to lack of strength or the way it is connected to the structure, is not considered in the seismic design of the structure as load carrying element; the failure of such an element may result in medium consequence for loss of human life and considerable economic, social or environmental consequences, but does not result in the failure of the structure or part of the structure; examples: façade element, piping, etc.
- structural element** = Building element, the failure of which may result in the failure of the structure or part of the structure; examples: column, beam, slab, etc.



Concrete panels falling from the J.C. Penney store, 1964 Alaska earthquake - 2 people died



1999 Jiji earthquake in Taiwan



Repair of a collapsed fastening

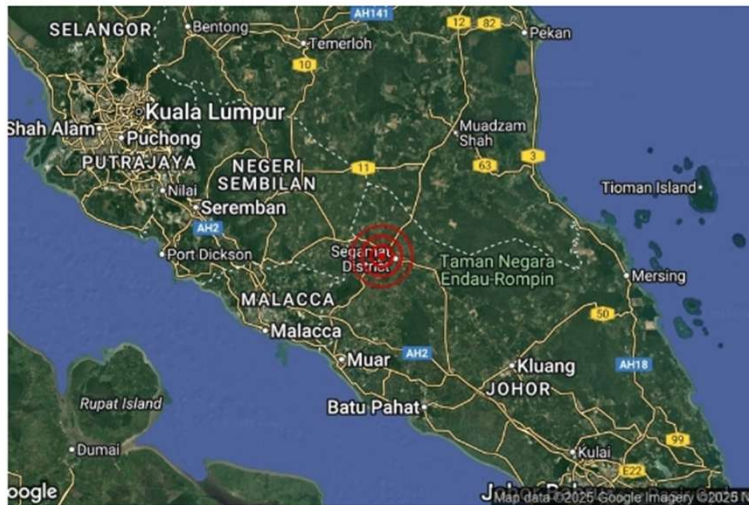
Natural hazards are unavoidable, but damage can be minimized through code compliant design & planning

Seismic Hazard in Malaysia



Malaysia is no longer a 'quake-free' zone...

Is Malaysia really quake-free? Why Johor was rattled by a rare 4.1-magnitude tremor



MetMalaysia confirmed that a 4.1-magnitude earthquake struck Segamat at 6.13am, followed by a 2.8-magnitude tremor in Kluang at 9am on August 24, 2025. — Picture from Facebook/Malaysian Meteorological Department

Source : <https://www.malaymail.com/news/malaysia/2025/08/25/is-malaysia-really-quake-free-why-johor-was-rattled-by-a-rare-4.1-magnitude-tremor/188788>

Major faults in Peninsular Malaysia



Map: Rafa Estrada Sources: ResearchGate, MetMalaysia



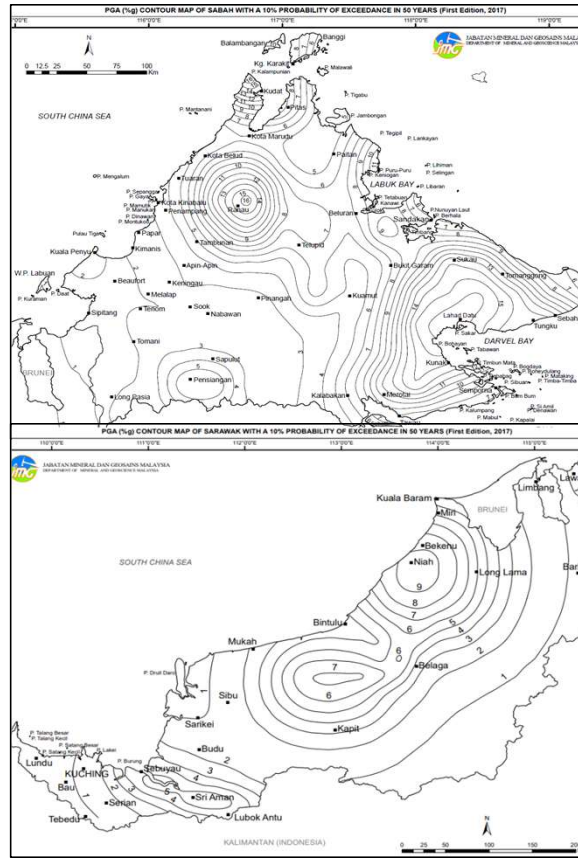
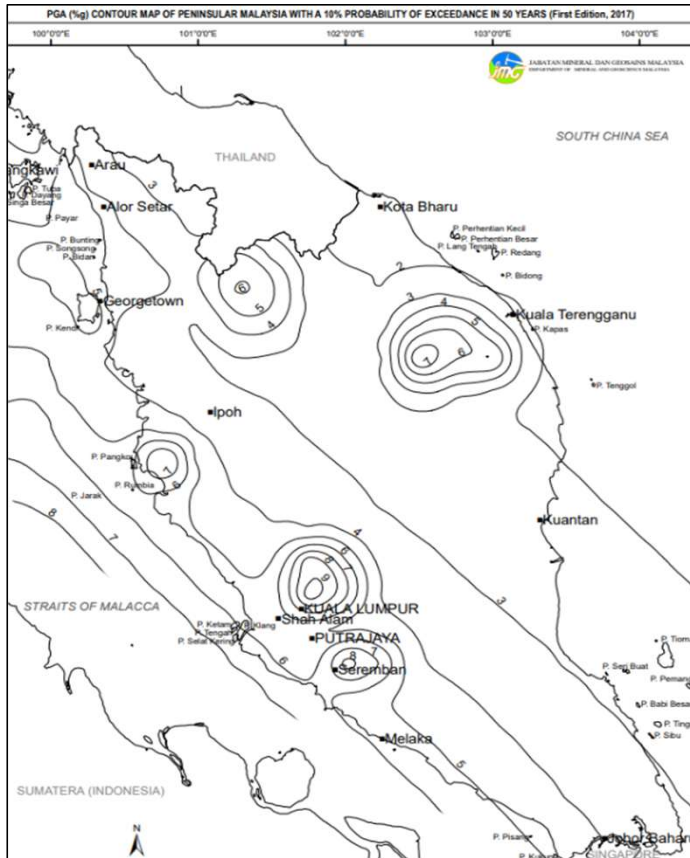
RISK OF LARGER EARTHQUAKES SMALL BUT 'NOT ZERO'

MetMalaysia's director-general Mohd Hisham Mohd Anip told CNA that while earthquakes do occur in the region, they are likely to be minor ones and the impact on life and property is expected to be small.

Source : <https://www.channelnewsasia.com/asia/malaysia-earthquake-tremors-johor-singapore-mersing-fault-zone-5314786>

Seismic Hazard Map of Malaysia

MS EN 1998-1:2015



Low Seismicity

$\neq$

***Seismic Design
Is not Relevant***

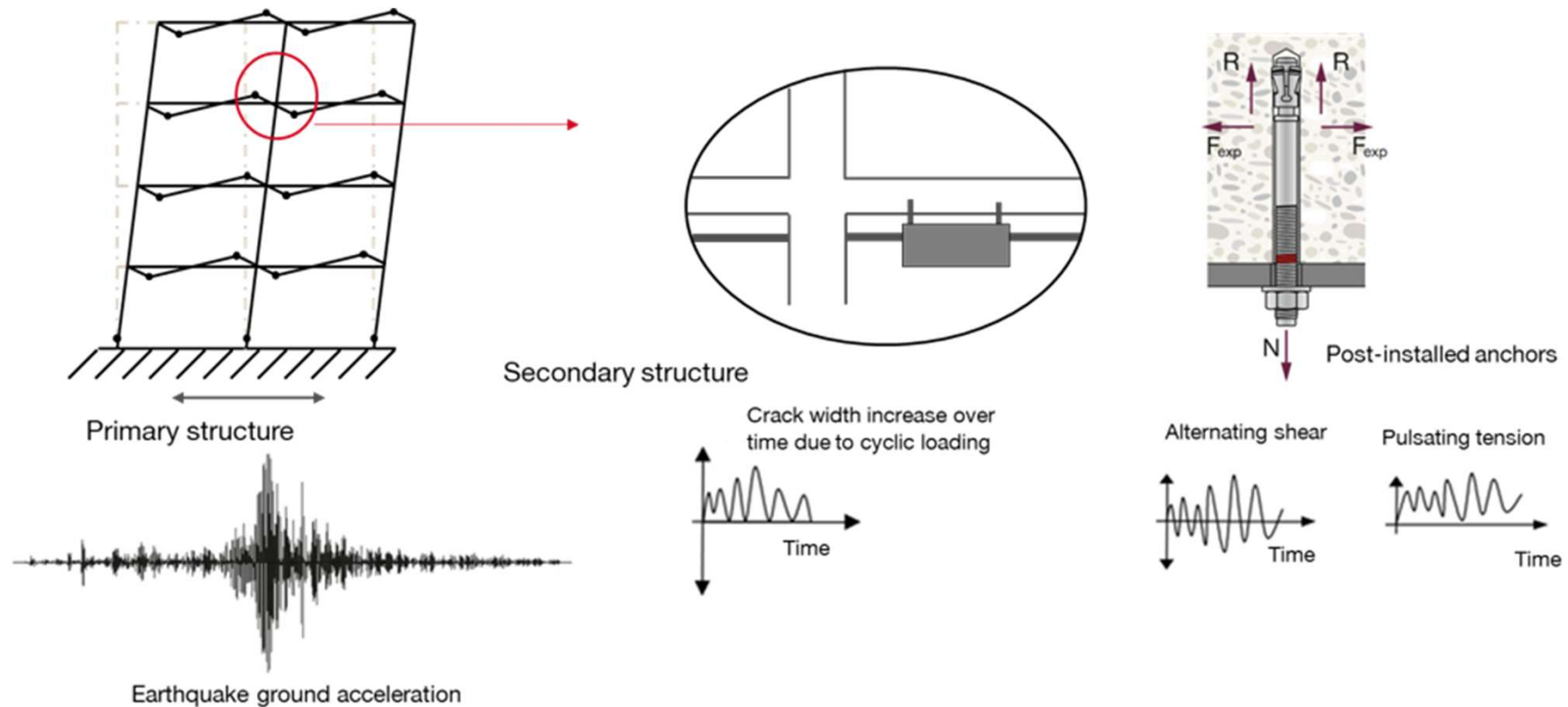
As engineers, we strive to minimize the risk of structural and non-structural damage through proper design.

Post-Installed Anchor Applications under Seismic Loading

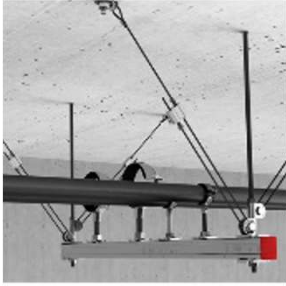
Post-installed Anchor Applications Under Seismic Loading

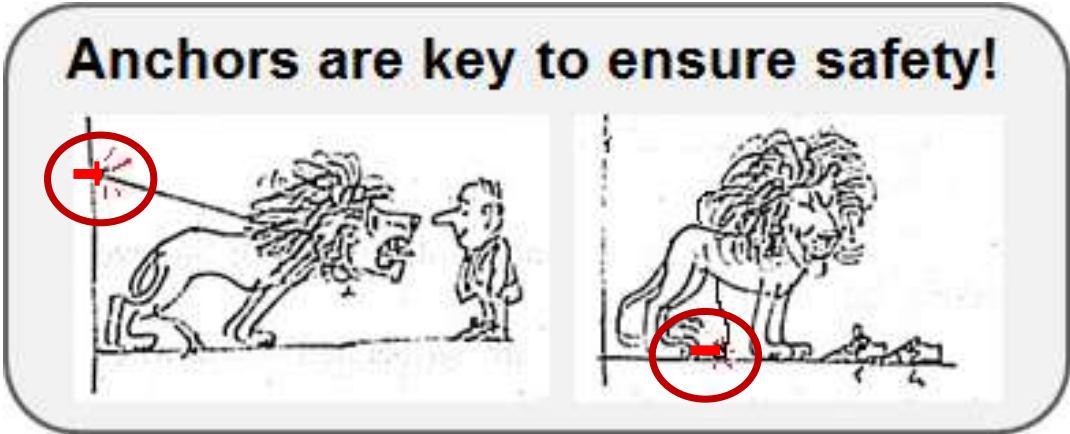
Anchors under seismic loading are usually subjected to **cyclic loading with significant amplitude** and **base material is supposed to be cracked beyond the serviceability limit state** (i.e., $> 0.3 \text{ mm}$) due to the potential significant deformations.

These conditions must be considered in the prequalification and design of anchors.



Post-installed Anchor Applications Under Seismic Loading

Structural Applications			Non-Structural Applications		
Beams, ledger angles	Columns, staircases	Strengthening elements	Façade	MEP Bracing	Machine
					



Only designing the main structure to resist seismic actions is not enough!

Design Requirements for Post-Installed Anchors Under Seismic Actions as per MS EN 1992-4



Design of Buildings as per reference to Eurocode 8

Importance factor (γ_I) for Malaysia

Table E.1. Importance factor (γ_I) for Malaysia

Building importance class	Importance factor 1 (γ_I)	Recommended building categories
I	0.8	Minor construction
II	1.0	Ordinary buildings (individual dwellings or shops in low rise buildings)
III	1.2	Buildings of large occupancies (condominiums, shopping centres, schools and public buildings)
IV	1.5	Lifeline built facilities (hospitals, emergency services, power plants and communication facilities)

4.3.5 Non-structural elements

4.3.5.1 General

(1)P Non-structural elements (appendages) of buildings (e.g. parapets, gables, antennae, mechanical appendages and equipment, curtain walls, partitions, railings) that might, in case of failure, cause risks to persons or affect the main structure of the building or services of critical facilities, shall, together with their supports, be verified to resist the design seismic action.

(2)P For non-structural elements of great importance or of a particularly dangerous nature, the seismic analysis shall be based on a realistic model of the relevant structures and on the use of appropriate response spectra derived from the response of the supporting structural elements of the main seismic resisting system.

(3) In all other cases properly justified simplifications of this procedure (e.g. as given in 4.3.5.2(2)) are allowed.

4.3.5.2 Verification

(1)P The non-structural elements, as well as their connections and attachments or anchorages, shall be verified for the seismic design situation (see 3.2.4).

Structural and Non-Structural Elements has to be designed to resist seismic action !!

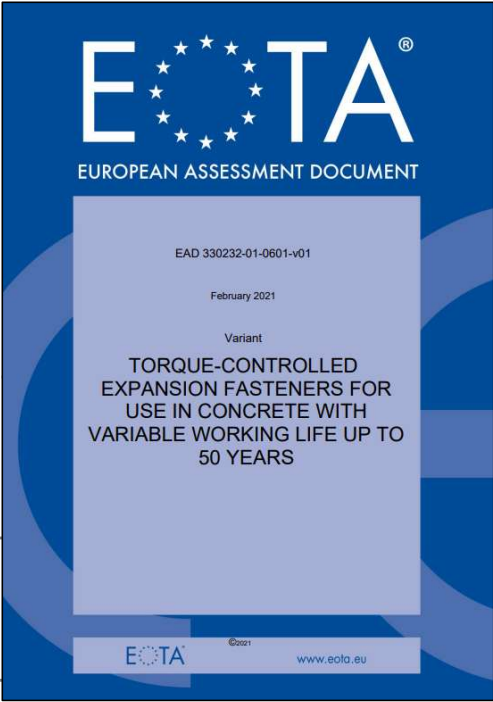
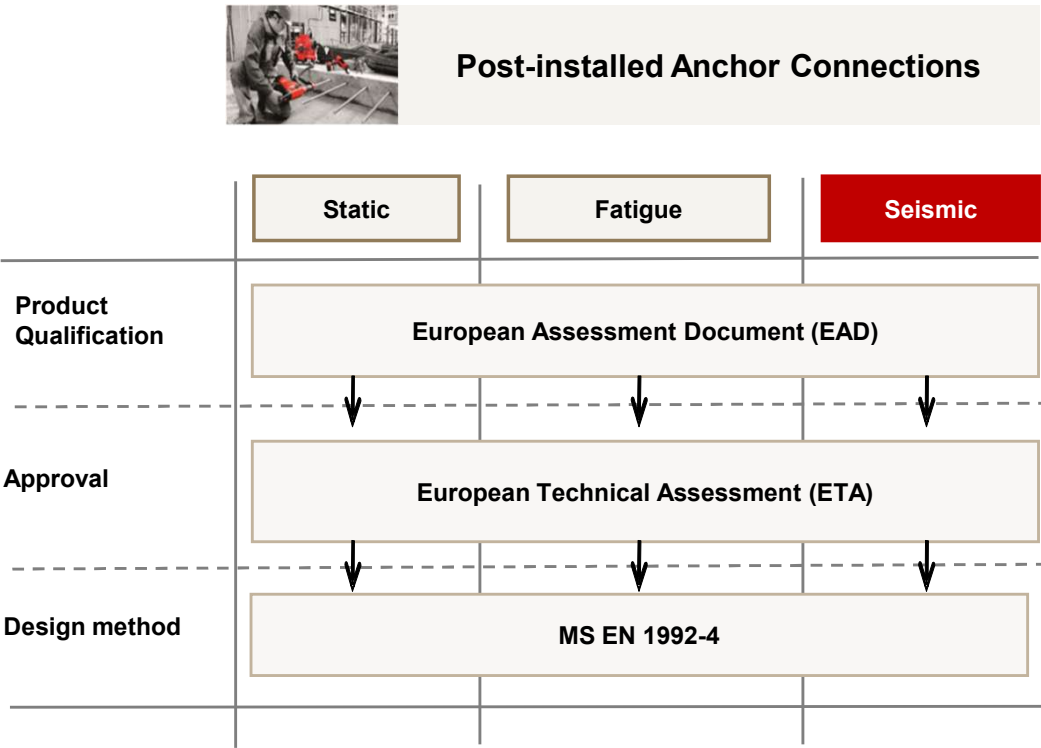
Requirements for Anchors Design to Resist Seismic Actions

MS EN 1992-4:2023 Clause 9.2

9.2 Requirements

- (1) Fasteners used to resist seismic actions shall meet all applicable requirements for non-seismic applications.
- (2) Only fasteners qualified for cracked concrete and seismic applications shall be used (see relevant European Technical Product Specification).

European Regulatory Framework For Post-installed Anchors



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le futur en construction

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European Technical Assessment

ETA-21/0878
of 09/10/2025

English translation prepared by CSTB - Original version in French language

General Part

Technical Assessment Body issuing the European Technical Assessment:
Centre Scientifique et Technique du Bâtiment (CSTB)

Trade name: Hilti HST4-R, HST4

Product family: Torque-controlled expansion anchor for use in concrete: sizes M8, M10, M12, M16 and M20.

Manufacturer: Hilti Aktiengesellschaft
Feldkircherstrasse 100
FL-9494 Schaan
Principality of Liechtenstein

Manufacturing plants: Hilti plants

This European Technical Assessment contains: 40 pages including 37 pages of annexes which form an integral part of this assessment

This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of: EAD 330232-02-0601 "Mechanical fasteners for use in concrete"

This Assessment replaces: ETA-21/0878 of 10/03/2025

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European Technical Assessment ETA-21/0878 of 09/10/2025				
<i>English translation prepared by CSTB - Original version in French language</i>				
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<table border="1"> <tr> <td data-bbox="76 660 232 860"> Technical Assessment Centre Scientifique et Technique du Bâtiment </td> <td data-bbox="232 660 734 860" style="background-color: #f0f0f0;"> ETA is a pre-recorded document </td> </tr> </table>			Technical Assessment Centre Scientifique et Technique du Bâtiment	ETA is a pre-recorded document
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Requirements for Anchors Design to Resist Seismic Action

MS EN 1992-4:2023 Cl.9.2.2

9.2 Requirements

(1) Fasteners used to resist seismic actions shall meet all applicable requirements for non-seismic applications.

(2) Only fasteners qualified for cracked concrete and seismic applications shall be used (see relevant European Technical Product Specification).



HST4

CSTB Centre Scientifique et Technique du Bâtiment 84 avenue Jean Jaures CHAMPS-SUR-MAYNE F-77447 Marne-la-Vallée Cedex 2 Tel.: (33) 01 64 68 82 82 Fax: (33) 01 60 05 70 37	 Member of ETA www.eta.eu
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ETA-21/0878

Specifications of intended use

Anchorage subject to:

- Static and quasi-static loading: all sizes.
- **Seismic performance category C1 and C2: all sizes.**
- Fire exposure: all sizes.

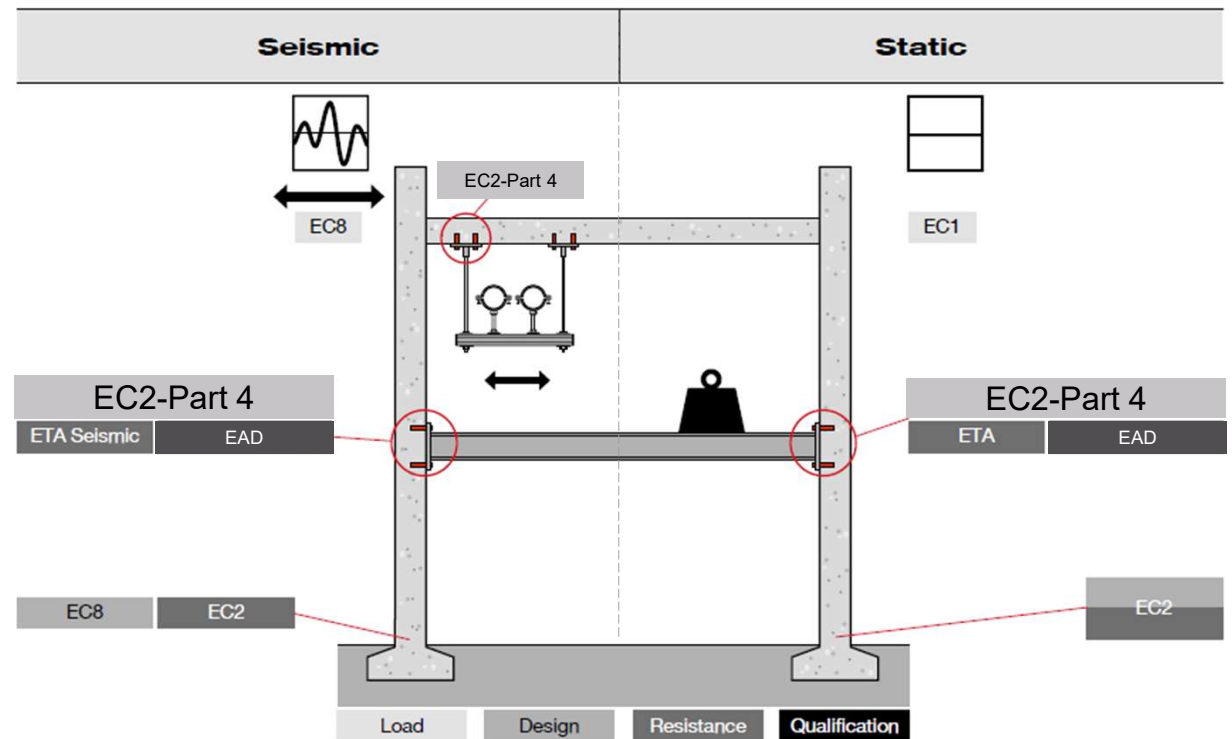
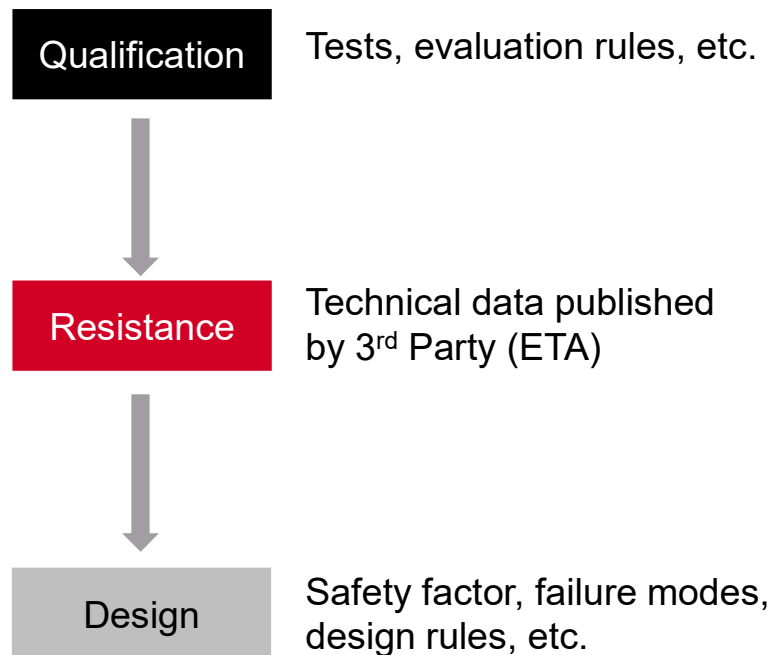
Base materials:

- Reinforced or unreinforced normal weight concrete according to EN 206:2013+ A1:2016.
- Strength classes C12/15 to C90/105 according to EN 206:2013+A1:2016.
- Cracked and uncracked concrete.
- The fastener is intended to be used in fibre reinforced concrete according to EN 206:2013+A2:2021 including steel fibres according to EN 14889-1:2006 clause 1, group I. The maximum content of steel fibres is 80 kg/m³.

Qualification Guidelines in the European Assessment Documents (EADs)



The European Assessment Documents (EADs) Capture The Behaviour & Design of Post-Installed Anchors

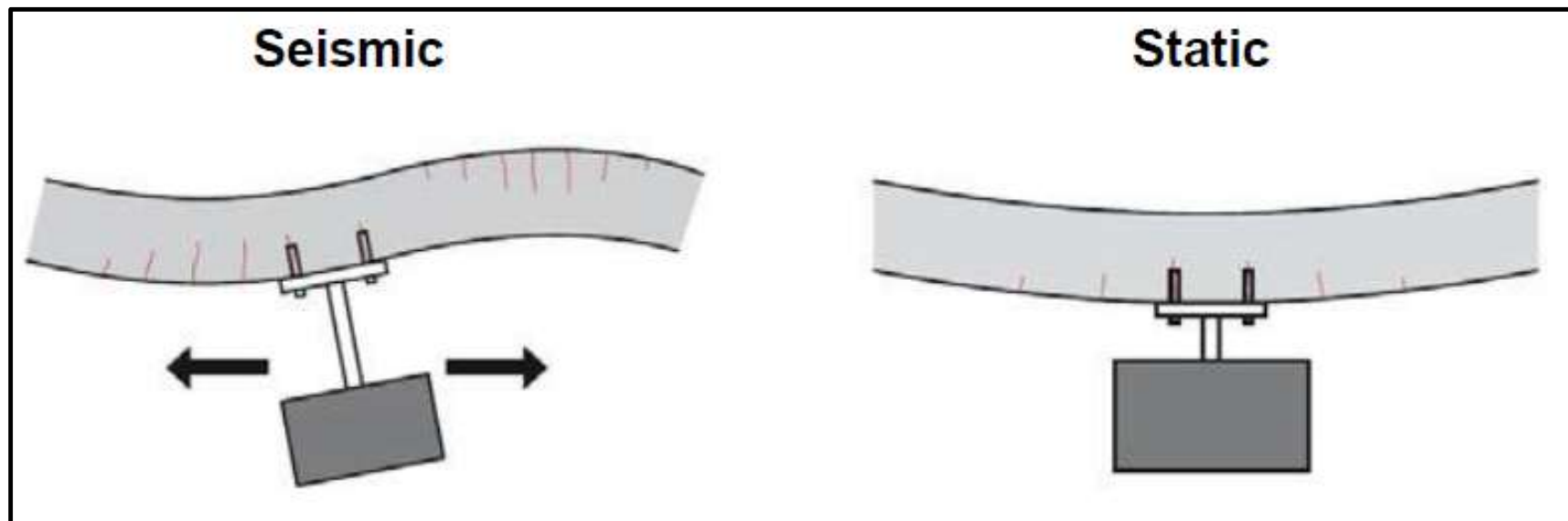


Not all ETA-approved fasteners are fit for seismic, as seismic assessment is optional under the EAD

Assessing The Anchorage Behaviour In Terms Of:

(1) Loads

- Ground movement causes displacement of a building's foundation, the building cannot withstand this movement without deforming
- Vibration induced due to the structure's stiffness → leads to stresses and strains in structural members *AND* any attached anchors
- Loads acting on these anchors depend on building characteristics, overall seismicity, and the objects fastened.

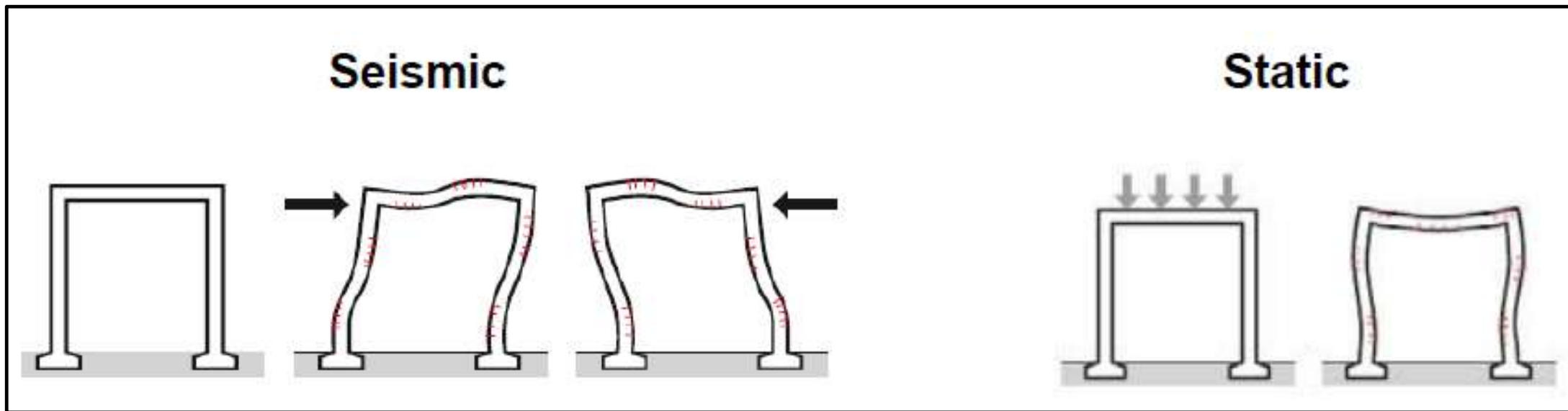


Key difference – multi-directional loading induced by the cyclical seismic loads

Assessing The Anchorage Behaviour In Terms Of:

(2) Widening Of Cracks

- Seismic action causes a previously-assumed compression zone to become the tension zone
- High probability of cracks intersecting the anchor locations
- Crack width generated from seismicity is much higher compared to static conditions ($0.3mm \rightarrow 0.8mm$)

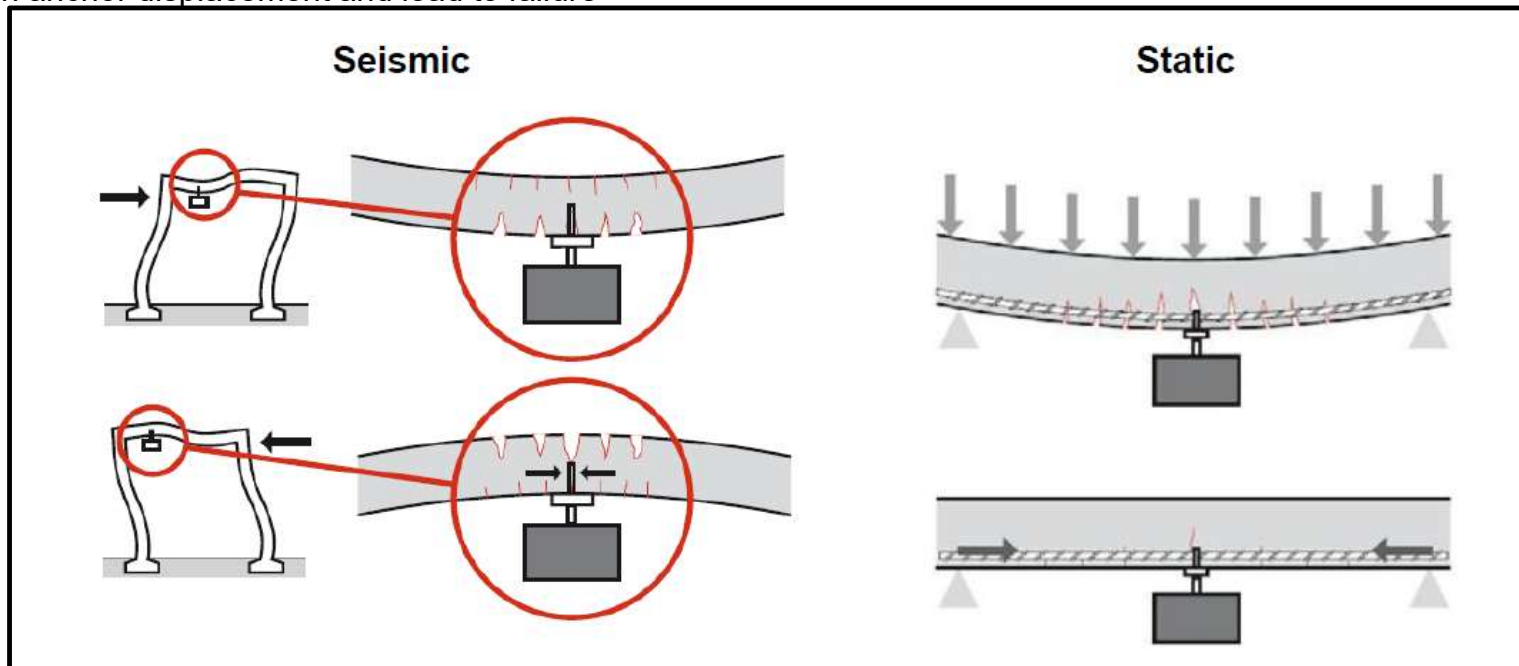


Key difference – cracks widen in tension & compression zones

Assessing The Anchorage Behaviour In Terms Of:

(3) Crack Cycling Pattern

- RC member movement AND load cycling on the anchor = opening and closing of cracks
- Can cause high anchor displacement and lead to failure



Key difference – Alternating load directions result in the worst conditions for the anchorage

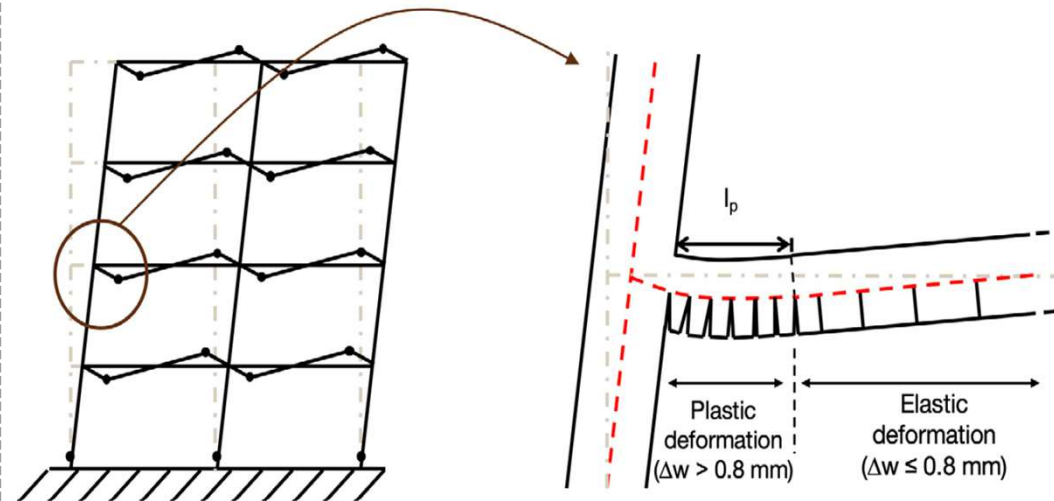
Performance Categories – C1 & C2

Performance Category - C1

- Provides anchor capacities only in terms of resistances at the ultimate limit state
- **Maximum assumed crack width $\Delta w = 0.5 \text{ mm}$**

Performance Category - C2

- provides anchor capacities in terms of both resistances at the Ultimate limit state (ULS) and displacements at the damage limitation state (DLS) and ultimate limit state (ULS)
- **Maximum assumed crack width $\Delta w = 0.8 \text{ mm}$**



In all cases, **no anchors are allowed to be installed** in areas of the concrete members where **section plasticization is expected**, i.e., in plastic hinges because the crack width will likely **exceed the limit of $\Delta w = 0.8 \text{ mm}$** , for which the anchors are assessed.

Seismic C1 & C2 Tests Are Additional Tests On Top Of Tests For Cracked Concrete

Table 2.1 Additional tests for qualification of anchors under category C1

	Purpose of test	Concrete	Crack width Δw ¹⁾ [mm]	Minimum number of tests ²⁾	Test procedure see Section	Assessment criteria see Section
C1.1	Functioning under pulsating tension load	C20/25	0,5	5	2.3.2	3.1.1
C1.2	Functioning under alternating shear load	C20/25	0,5	5	2.3.3	3.1.2

C1

Table 2.4 Additional tests for qualification of anchors under category C2

Test no.	Purpose of test	Concrete	Crack width Δw ¹⁾ [mm]	Minimum number of tests ²⁾	Test procedure see Section	Assessment criteria see Section
C2.1a	Reference tension tests in low strength concrete	C20/25	0,8	5	2.4.2	3.2.1, 3.2.2
C2.1b	Tension tests in high strength concrete	C50/60	0,8	5	2.4.2	3.2.1, 3.2.2
C2.2 ³⁾	Reference shear tests	C20/25	0,8	5	2.4.2	3.2.1, 3.2.3
C2.3	Functioning under pulsating tension load	C20/25	0,5 ($\leq 0,5 \cdot N/N_{max}$) ⁴⁾ 0,8 ($> 0,5 \cdot N/N_{max}$)	5	2.4.3	3.2.1, 3.2.4
C2.4	Functioning under alternating shear load	C20/25	0,8	5	2.4.4	3.2.1, 3.2.5
C2.5	Functioning with tension load under varying crack width	C20/25	$\Delta w_1 = 0,0$ ⁵⁾ $\Delta w_2 = 0,8$	5	2.4.5	3.2.1, 3.2.6

C2

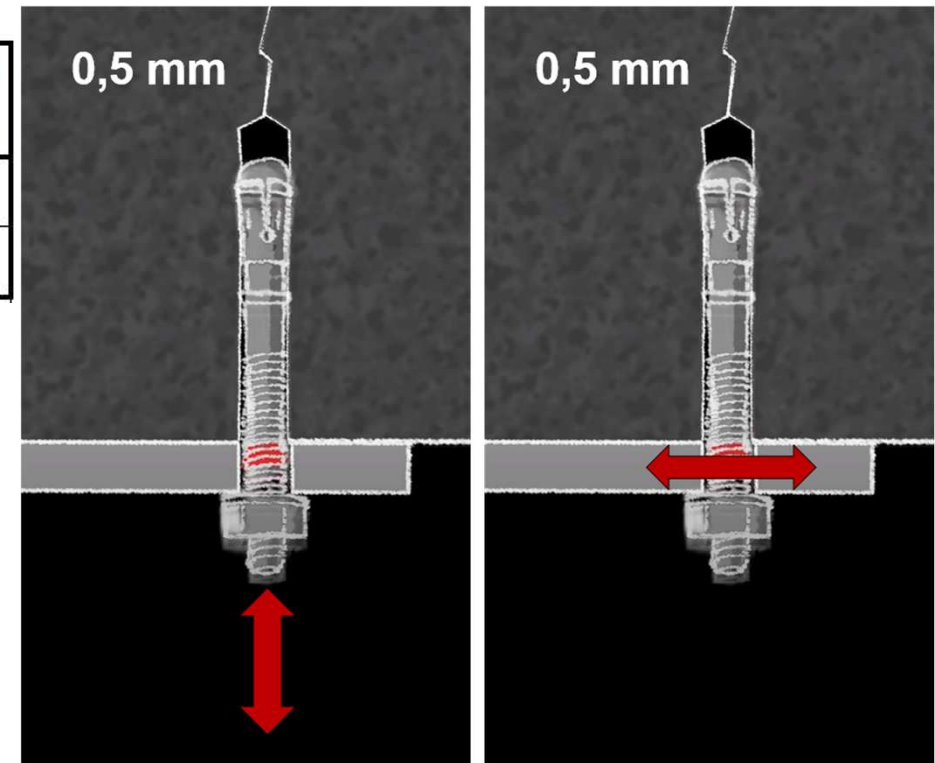
An anchor must be certified for cracked concrete before qualifying to either C1 or C2

Necessary Tests to Qualify Anchors Under Seismic Loading

Qualification for Seismic Category C1

Table 2.1 Additional tests for qualification of anchors under category C1

	Purpose of test	Concrete	Crack width Δw ¹⁾ [mm]	Minimum number of tests ²⁾	Test procedure see Section	Assessment criteria see Section
C1.1	Functioning under pulsating tension load	C20/25	0,5	5	2.3.2	3.1.1
C1.2	Functioning under alternating shear load	C20/25	0,5	5	2.3.3	3.1.2

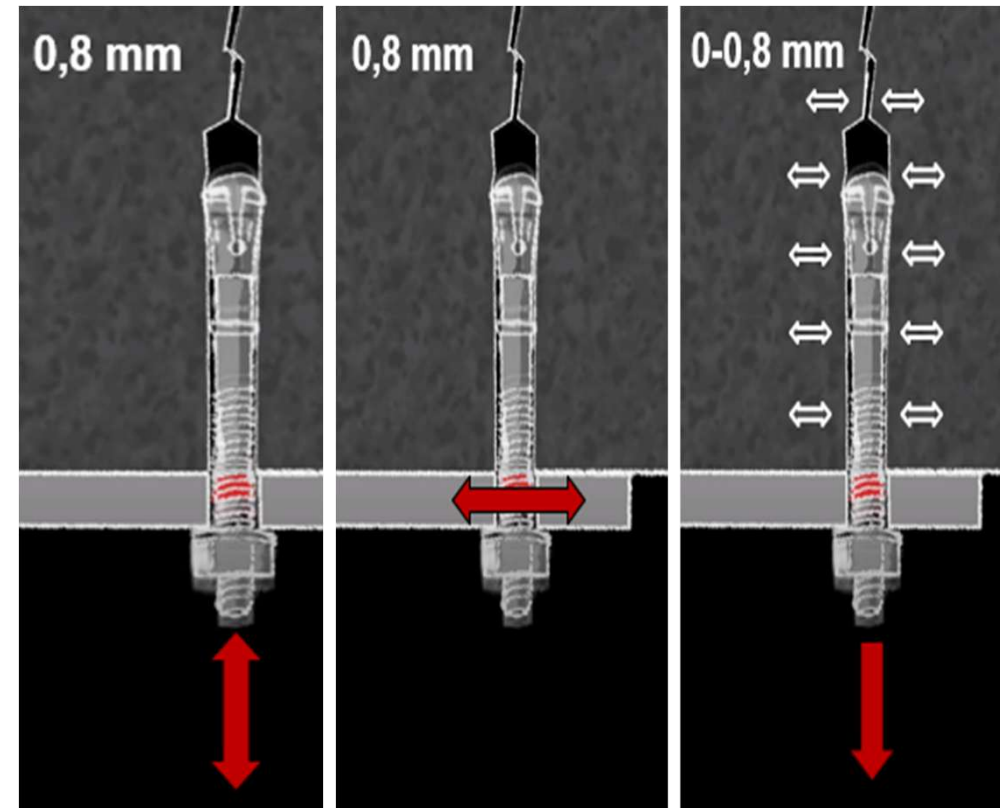


Necessary Tests to Qualify Anchors Under Seismic Loading

Qualification for Seismic Category C2

Table 2.4 Additional tests for qualification of anchors under category C2

Test no.	Purpose of test	Concrete	Crack width Δw ¹⁾ [mm]	Minimum number of tests ²⁾	Test procedure see Section	Assessment criteria see Section
C2.1a	Reference tension tests in low strength concrete	C20/25	0,8	5	2.4.2	3.2.1, 3.2.2
C2.1b	Tension tests in high strength concrete	C50/60	0,8	5	2.4.2	3.2.1, 3.2.2
C2.2 ³⁾	Reference shear tests	C20/25	0,8	5	2.4.2	3.2.1, 3.2.3
C2.3	Functioning under pulsating tension load	C20/25	$0,5 (\leq 0,5 \cdot N/N_{max})$ ⁴⁾ $0,8 (> 0,5 \cdot N/N_{max})$	5	2.4.3	3.2.1, 3.2.4
C2.4	Functioning under alternating shear load	C20/25	0,8	5	2.4.4	3.2.1, 3.2.5
C2.5	Functioning with tension load under varying crack width	C20/25	$\Delta w_1 = 0,0$ ⁵⁾ $\Delta w_2 = 0,8$	5	2.4.5	3.2.1, 3.2.6

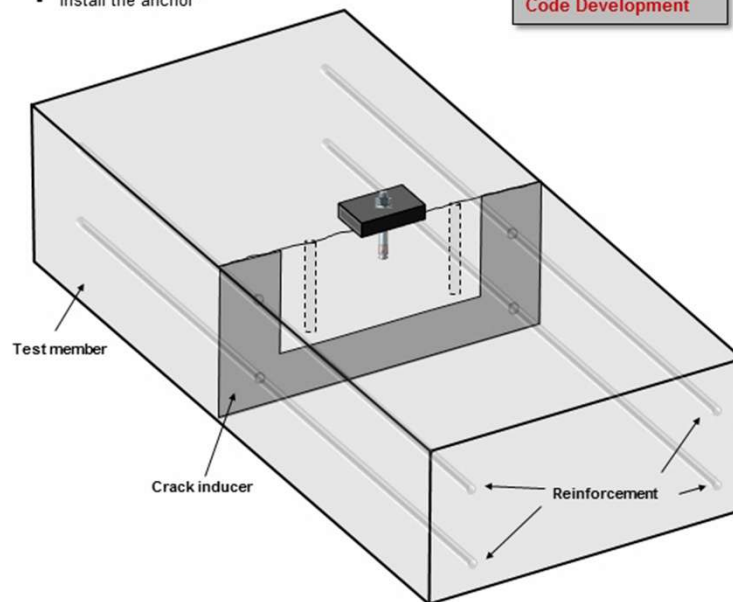


The Highly Critical C2.5 Test Is The Only One Where Cracks Cycle Between 0-0.8mm, All Other Tests Consider A Static Crack Width

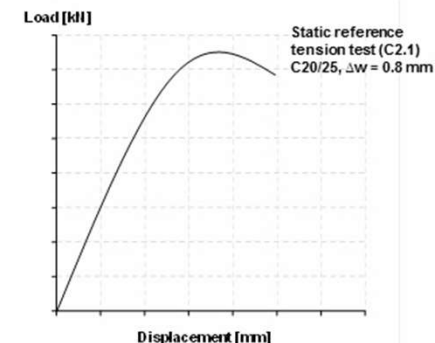
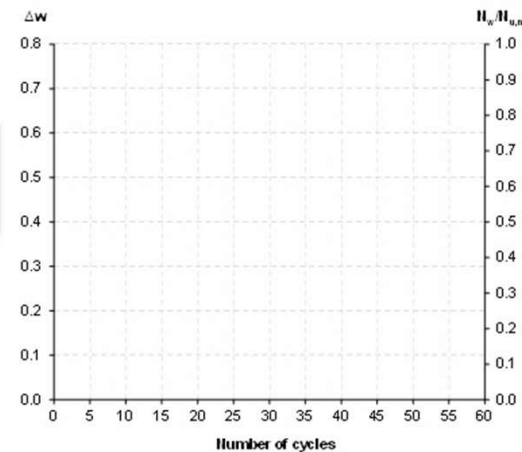
Seismic Category C2: crack cycling (C2.5)

Procedure before testing:

- Open hairline crack
- Drill in hairline crack, verify location with borescope
- Install the anchor



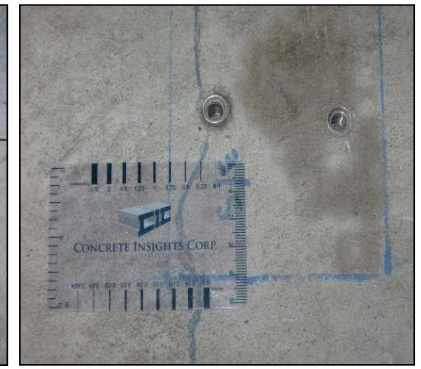
BU Anchors
Philipp Grosser
Seismic Research for
Code Development



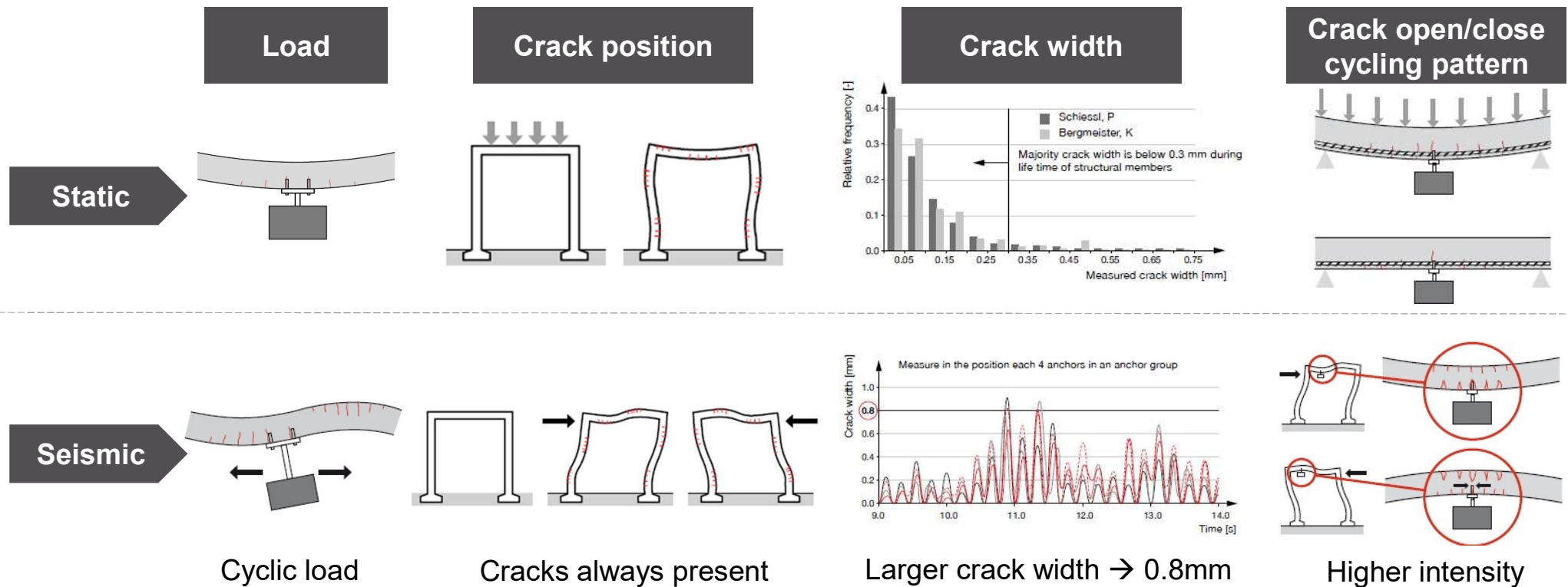
The Well-known BNCS Shake-table Test Confirms the Assumptions of The Seismic Testing Criteria



All variables were fully monitored



An Anchor Qualified For Seismic Conditions Will Show Good Performance During An Earthquake



Seismic Design Options as per MS EN 1992-4



Seismic Design Options

MS EN 1992-4:2023 Cl.9.2.3

(3) In the design of fastenings one of the following options a1), a2) or b) shall be satisfied.

- a) Design **without requirements on the ductility of the fasteners**. It shall be assumed that fasteners are non-dissipative elements and they are not able to dissipate energy by means of ductile hysteretic behaviour and that they do not contribute to the overall ductile behaviour of the structure.

a1) Capacity design: The fastener or group of fasteners is designed for the maximum tension and/or shear load that can be transmitted to the fastening based on either the development of a ductile yield mechanism in the fixture or the attached element taking into account strain hardening and material over-strength or the capacity of a non-yielding attached element.

a2) Elastic design: The fastening is designed for the maximum load obtained from the design load combinations that include seismic actions E_{Ed} corresponding to the ultimate limit state (see EN 1998-1) assuming elastic behaviour of the fastening and the structure. Furthermore, uncertainties in the model to derive seismic actions on the fastening shall be taken into account.

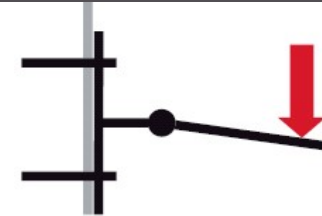
- b) Design **with requirements on the ductility of the fasteners:**

This option is applicable only for the tension component of the load acting on the fastener.

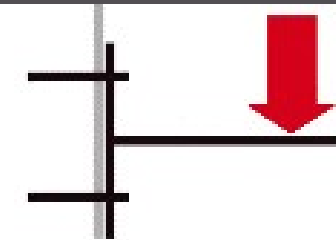
The fastener or group of fasteners is designed for the design actions including the seismic actions E_{Ed} corresponding to the ultimate limit state (see EN 1998-1). The tension steel capacity of the fastening shall be smaller than the tension capacity governed by concrete related failure modes. Sufficient elongation capacity of the fasteners is required.

The fasteners should not be accounted for energy dissipation in the global structural analysis or in the analysis of a non-structural element. The contribution of the fastening to the energy dissipation capacity of the structure (see EN 1998-1:2004, 4.2.2) is not addressed within this standard.

a1) Capacity Design



a2) Elastic Design



b) Ductile Anchor Design



Seismic Design Options

a1) Capacity Design



C1

C2

Design for the max. tension and/or shear loading

- a) Yielding in attached element;
- b) Yielding in baseplate;
- c) Capacity of attached element

The anchorage is designed for the force corresponding to the yield of a ductile component or, if lower, the maximum force that can be transferred by the fixture or the attached element

a2) Elastic Design



C1

C2

Design under the assumptions of an elastic behavior of the fastenings and the structure at ultimate limit state

*The fastening is designed for the **maximum load assuming an elastic behavior** of the fastening and of the structure*

b) Ductile Anchor Design



C2

The tension steel capacity of the fastening shall be smaller than the tension capacity governed by concrete related failure modes

*This design for ductile steel failure **requires an anchor classified as ductile**. Applicable only for the tension component and some provisions require to be observed in order to ensure that the cause of failure is steel failure.*

Hilti Solution – Seismic Approved Anchors Portfolio

Hilti Solution – Seismic Approved Anchors Portfolio

CHEMICAL ANCHOR



MECHANICAL ANCHOR



**HIT-RE 500 V4
+ HAS rod**



**HIT-HY 200-R V3
+ HAS rod**



**HVU2 +
HAS-U rod**

- + Lower spacing and edge distance
- + Flexibility on embedment depth



HST4



HST2 V3



HUS4

- + Immediate loading
- + Less sensitive to external conditions
- + Simpler installation

Disclaimer: Products shown are part of our portfolio and may not represent the full range available. For the complete product offering, please visit www.hilti.com.my.
For detailed performance and application information, please refer to the relevant ETA document for each product.

Working Time & Curing Time



HIT-RE 500 V4 + HAS rod

European technical assessment ETA-20/0541
English translation prepared by CSTB

Page 17 sur 68 | 09/06/2023

Table B7: Working and curing time^{1) 2)}

Temperature in the base material T	Maximum working time t_{work}	Minimum curing time $t_{cure}^{1)}$
-5°C to -1°C	2 hours	168 hours
0°C to 4°C	2 hours	48 hours
5°C to 9°C	2 hours	24 hours
10°C to 14°C	1,5 hours	16 hours
15°C to 19°C	1 hour	12 hours
20°C to 24°C	30 min	7 hours
25°C to 29°C	20 min	6 hours
30°C to 34°C	15 min	5 hours
35°C to 39°C	12 min	4,5 hours
40°C	10 min	4 hours

¹⁾ The curing time data are valid for dry base material only. In wet base material the curing times must be doubled.

²⁾ The minimum temperature of the foil pack is +5°C.



HIT-HY 200-R V3 + HAS rod

Page 19 of European Technical Assessment
ETA-19/0601 of 29 January 2024

English translation prepared by DIBt



Table B6: Maximum working time and minimum curing time

Temperature in the base material $T^{1)}$	HIT-HY 200-A V3		HIT-HY 200-R V3	
	Maximum working time t_{work}	Minimum curing time t_{cure}	Maximum working time t_{work}	Minimum curing time t_{cure}
-10 °C to -5 °C	1,5 hours	7 hours	3 hours	20 hours
> -5 °C to 0 °C	50 min	4 hours	1,5 hours	8 hours
> 0 °C to 5 °C	25 min	2 hours	45 min	4 hours
> 5 °C to 10 °C	15 min	75 min	30 min	2,5 hours
> 10 °C to 20 °C	7 min	45 min	15 min	1,5 hours
> 20 °C to 30 °C	4 min	30 min	9 min	1 hour
> 30 °C to 40 °C	3 min	30 min	6 min	1 hour

¹⁾ The minimum foil pack temperature is 0 °C.

HST4: THE ONLY STUD ANCHOR WITH THE SAME CONCRETE CONE CAPACITY OF A CAST-IN ANCHOR



Disclaimer: For detailed performance and application information, please refer to the relevant ETA document for each product.

HST4: our **highest** performing Hilti stud anchor



The HST4 offers the **greatest Value Engineering opportunities** by delivering reduced diameters & lengths, reduced baseplate dimensions by utilizing the **highest performance**

Article : [HILTI HST4: Performance That Matches Cast-In Headed Fasteners](#)



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Application conditions

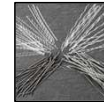
Base Materials



Cracked Concrete

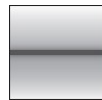


Uncracked Concrete



Fibre Reinforced Concrete

Loading Conditions



Static & Quasi Static



Seismic C1 & C2



Fire

Carbon Steel, galvanized, $\geq 5\mu\text{m}$
A4 Stainless steel

- ✓ European Technical Assessment (ETA)
- ✓ Non-cleaning installation
- ✓ Adaptive Torque (AT) Module

Key Applications

- Structural Baseplate
- Non-structural Baseplate
- Façade
- MEP Fastening
- Industrial



HST4: THE ONLY STUD ANCHOR WITH THE SAME CONCRETE CONE CAPACITY OF A CAST-IN ANCHOR



According to the EN1992-4, the characteristic resistance of a group of fasteners in case of concrete cone failure is obtained by:

$$N_{Rk,c} = N_{Rk,c}^0 \cdot \frac{A_{c,N}}{A_{c,N}^0} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec,N} \cdot \psi_{M,N}$$

These coefficients account for concrete cone interference in group of anchors (spacing), proximity to slab edge (edge distance), presence of dense reinforcement, load eccentricities, compression forces between fixture and concrete

Characteristic resistance of one anchor in an infinite slab

$$N_{Rk,c}^0 = k_1 \cdot \sqrt{f_{ck}} \cdot h_{ef}^{1.5}$$

f_{ck} = concrete nominal characteristic compressive cylinder strength
 h_{ef} = Effective embedment depth

k₁ factor for cast-in and post-installed fasteners by EN1992-4.

	Cast-in (EN1992-4)	Post-installed (EN1992-4)	HST4 M10-M16	HST4 M8 & M20	HST2 V3 M8 to M10
Cracked concrete	8.9	7.7	8.9	7.7	7.7
Uncracked concrete	12.7	11.0	12.7	11.0	11.0



HST4: the 1st stud anchor in the market with the same concrete cone resistance as a cast-in headed fastener for M10 to M16 diameters.
 At equivalent embedment depths, HST4 has 16% larger resistance to concrete cone failure than any other stud anchor in the market

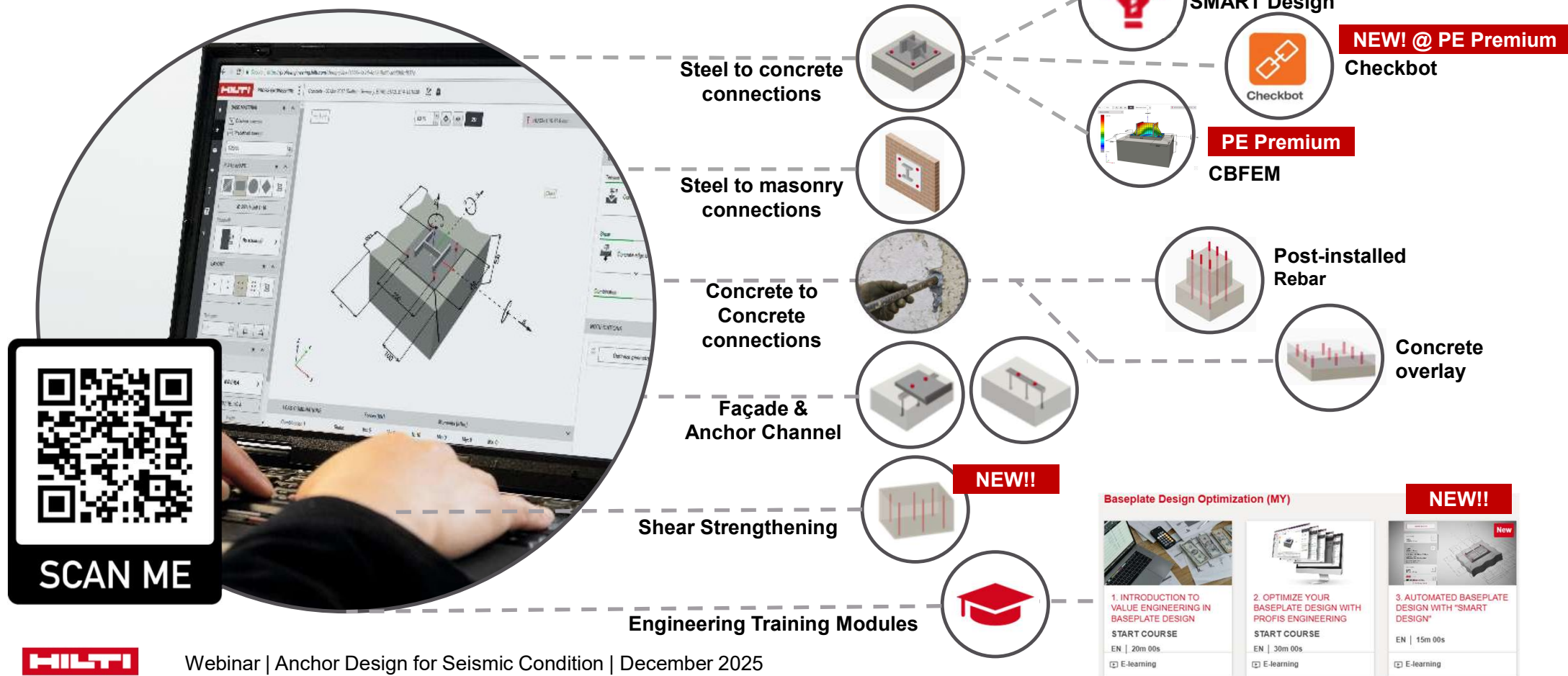
Streamlining Design Analysis With Value Engineering Enabler – PROFIS Engineering



PROFIS Engineering: All In One Cloud-Based Solution

Design Your Post-Installed Connections and Generate Comprehensive Reports in a Single Click!

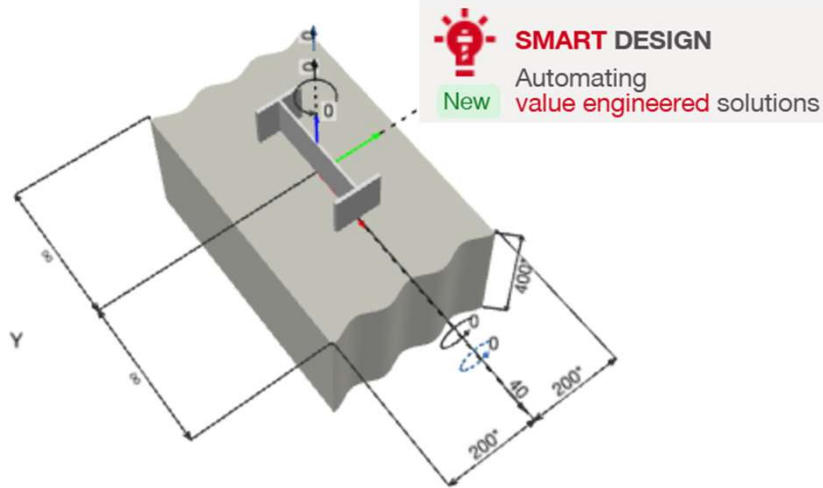
<https://profisengineering.hilti.com/>



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PROFIS Demo – Example of the Day

Anchoring to Concrete



I Beam Profile : UKB 254x102x25

Base Material : Cracked concrete

Concrete Grade : C30/37

RC Column Size : 400x400

Seismic Design : Category C2 & Elastic Design

Preferred solution: HILTI HST4 / HIT-RE 500 V4 + HAS 8.8

Reaction Loading Combination 1 : 40kN Shear + 8kNm Bending Moment

Reaction Loading Combination 2 : 30kN Shear + 12kNm Bending Moment

PROFIS
ENGINEERING



ANCHOR DESIGN		
DESIGN		
Tension		
Steel		49%
Concrete breakout		88%
Pullout		70%
Splitting		0%
Shear		
Steel		34%
Concrete edge breakout		30%
Pryout		21%
Combination		
Steel		35%
Concrete		97%

HILTI

HilTI PROFIS Engineering 3.1.24

REPORT

www.hilti.group/content/hilti/CP/XX/en/non-transactional/light-pages/malaysia.html

Company:

Page:

Address:

Specifier:

Phone / Fax:

E-Mail:

Design:

Date:

Fastering point:

Concrete - Nov 28, 2025

1/12/2025

Specifier's comments:

1 Input data

Anchor type and diameter:

HST4 M12

Return period (service life in years):

50

Item number:

2329067 HST4 M12x145 5-80

No hole clearance between the base plate and the anchor.

This can be achieved by filling the annular gap between the base plate and the anchor, for instance with the Hilti Filling Set.

Specification text:

Hilti HST4 stud anchor with 106 mm embedment, M12, Steel galvanized, installation per ETA-21/0878, No hole clearance between the base plate and the anchor (annular gaps filled), for instance with the Hilti Filling Set

Effective embedment depth:

$h_{eff} = 106.0 \text{ mm}$ ($h_{min} = - \text{mm}$), $h_{max} = 115.0 \text{ mm}$

Material:

Carbon Steel

Evaluation Service Report:

ETA-21/0878

Issued / Valid:

10/03/2025 | -

Proof:

Design Method MS EN 1992-4, Mechanical+ Seismic (Section 9, Annex C)

Seismic performance category:

C2

Seismic proof type:

9.2(3) a2) elastic design

Seismic load percentage <=20%:

no

Required DLS displacements:

Tension load $\delta_{t,req(DLS)} = 4.000 \text{ mm}$; Shear load $\delta_{v,req(DLS)} = 5.000 \text{ mm}$

Stand-off installation:

$s_{ef} = 0.0 \text{ mm}$ (no stand-off); $t = 12.0 \text{ mm}$

Anchor plate⁸:

$l_p \times l_p \times t = 365.0 \text{ mm} \times 140.0 \text{ mm} \times 12.0 \text{ mm}$; (Recommended plate thickness: not calculated)

Profile:

Advance UKB, 254 x 102 x 25; (L x W x T x FT) = 257.2 mm x 101.9 mm x 6.0 mm x 8.4 mm

Base material:

cracked concrete, C30/37, $f_{ct,sp} = 30.00 \text{ N/mm}^2$, $h = 400.0 \text{ mm}$, partial material safety factor $\gamma_c = 1.500$; $\gamma_{c,seismic} = 1.500$

Installation:

Hammer drilled hole, Installation condition: Dry

Reinforcement:

no reinforcement or reinforcement spacing $\geq 150 \text{ mm}$ (any Ø) or $\geq 100 \text{ mm}$ (Ø $\leq 10 \text{ mm}$)
no longitudinal edge reinforcement

⁸ - The anchor calculation is based on a rigid anchor plate assumption.

SPECIFICATION TEXT	SPEC TEXT
Hilti HST4 stud anchor with 106 mm embedment, M12, Steel galvanized, installation per ETA-21/0878, No hole clearance between the base plate and the anchor (annular gaps filled), for instance with the Hilti Filling Set	
Close Copy to clipboard	



Hilti Engineering Solution and Services

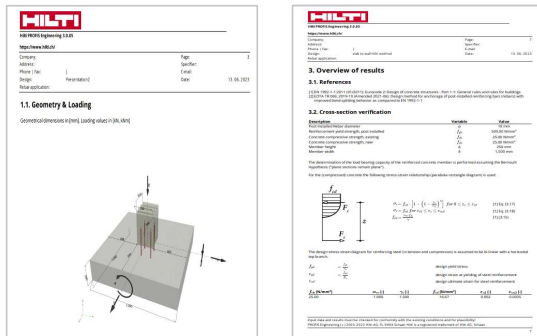


How does Hilti help translate a spec from PROFIS engineering to the jobsite?

Design

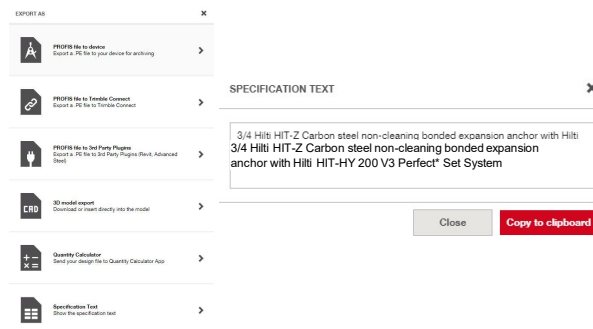
Fast and compliant designs with easy-to-use PROFIS Engineering

- Optimize your design in a few clicks
- Report provides a clear representation of the application
- Full Transparency on Design Method



Designs easily transferred to specs and drawings

- Recommended and customizable specification text
- Detail export in BIM/CAD
- Quantity Calculator to create Bill of Materials (BOM)



Build

Onsite support, product submittals, and simplified installation

- Field team members provide onsite training and support
- Installation systems that are faster, simpler, and safer



Hilti Engineering Solution And Services

Our experienced certified Hilti engineers and technical specialists can help throughout your project lifecycle from design to installation to building management.

SPEC

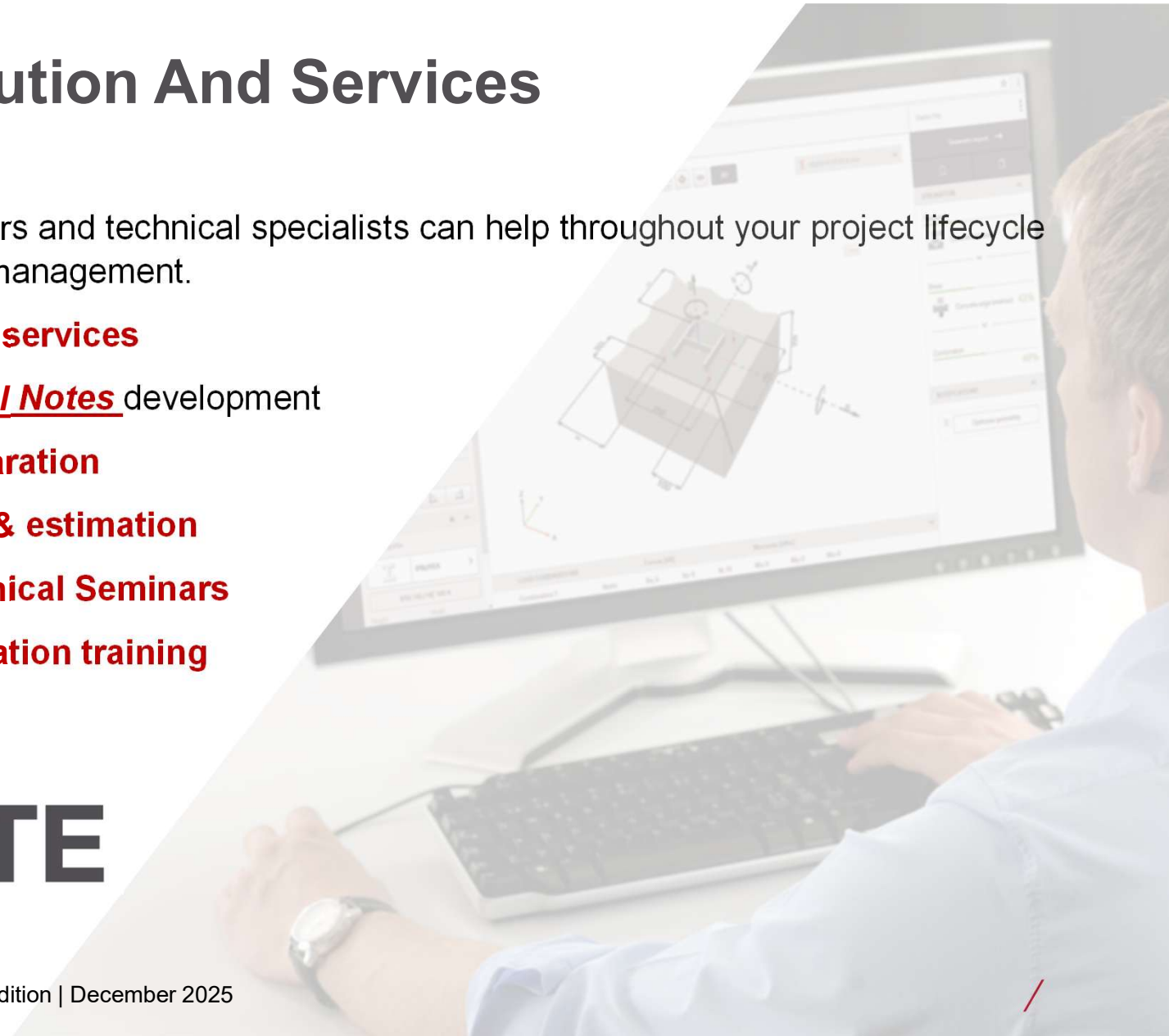
SITE

- HILTI solutions **consultation services**
- **Specification text & General Notes** development
- **Bill of Quantity (BoQ) preparation**
- **Consumption calculations & estimation**
- **Technical supports & Technical Seminars**
- **Jobsite support and installation training**
- **On-site testing**

SPEC2„SITE



Webinar | Anchor Design for Seismic Condition | December 2025



General Notes & Master Specification Library

Access to General Notes & Master Spec Library: [Specifications, General Notes and CAD Details - Hilti Malaysia](#)

General notes for Post-Installed Anchors (Anchoring to Concrete)

1. POST-INSTALLED ANCHOR CONNECTIONS TO CONCRETE SHALL BE DESIGNED AS PER EC2-4 FOR STATIC/QUASI-STATIC LOADS/ SEISMIC LOADS USING PRODUCTS WITH EUROPEAN TECHNICAL ASSESSMENT REPORT (ETA) WITH ASSUMED WORKING LIFE OF THE ANCHOR OF MINIMUM 50 YEARS. THE EXPANSION ANCHORS SHALL BE TESTED UNDER:
 - i. EUROPEAN TECHNICAL APPROVAL (ETA-11/0374) FOR HSA FOR DESIGN OF UNCRACKED CONCRETE CONDITION AND STATIC LOADS
 - ii. EUROPEAN TECHNICAL APPROVAL (ETA-21/0878) FOR HST4 FOR DESIGN OF CRACKED CONCRETE CONDITION OR/AND SEISMIC LOADS
 - iii. EUROPEAN TECHNICAL APPROVAL (ETA-19/0601) FOR HY200-R V3 WITH HAS ROD FOR DESIGN OF CRACKED CONCRETE CONDITION OR/AND SEISMIC LOADS
 - iv. EUROPEAN TECHNICAL APPROVAL (ETA-23/0277) FOR HY200-R V3 OR RE500 V4 WITH HAS-U A4 FOR DESIGN UNDER FATIGUE CYCLIC LOADING
 - v. EUROPEAN TECHNICAL APPROVAL (ETA-20/0867) FOR HUS4 DESIGN OF CRACKED CONCRETE CONDITION OR IN STEEL FIBRE REINFORCED CONCRETE (SFRC)
 - vi. EUROPEAN TECHNICAL APPROVAL (ETA-19/0556) FOR HSL4 FOR DESIGN OF CRACKED CONCRETE CONDITION WITH FIRE CONSIDERATIONS OR/AND SEISMIC LOAD OR/AND FATIGUE (ETA-19/0858)
 - vii. CHARACTERISTIC RESISTANCE FOR CRACK AND/OR UNCRACK CONCRETE AND DISPLACEMENT
2. THE CONDITION OF CONCRETE FOR ITS SERVICE LIFE IS ASSUMED TO BE CRACKED AS PER EC2-4, UNLESS DETERMINED AND PROVEN OTHERWISE. ANCHORS SUITABLE FOR CRACKED CONCRETE CONDITION, I.E. HST4, HST2V3, HUS4, HSL4 OR HY200V3 WITH HAS ROD SHALL BE USED UNLESS PROVEN CONCRETE IS UNCRACKED.
3. ANCHOR CAPACITY USED IN DESIGN SHALL BE BASED ON THE EUROPEAN TECHNICAL ASSESSMENT (ETA) AND DETAILED CALCULATIONS AS APPROVED BY THE STRUCTURAL ENGINEER OF RECORD. SUBSTITUTION REQUESTS FOR ALTERNATE PRODUCTS MUST BE APPROVED IN WRITING BY THE STRUCTURAL ENGINEER OF RECORD PRIOR TO USE. CONTRACTOR SHALL PROVIDE CALCULATIONS DEMONSTRATING THAT THE SUBSTITUTED PRODUCT IS CAPABLE OF ACHIEVING THE PERFORMANCE VALUES OF THE SPECIFIED PRODUCT. SUBSTITUTIONS WILL BE EVALUATED BY THEIR HAVING AN ETA SHOWING COMPLIANCE WITH THE RELEVANT REQUIREMENTS.
4. FOR CONDITION WHERE ANCHORS ARE ENCLOSED OR POSSIBLE TO EXPOSE TO WEATHER, HOT-DIP GALVANIZED OR 304 STAINLESS STEEL ANCHORS SHALL BE ADOPTED WITH APPROVAL FROM THE CONSULTANT.
5. FOR CONDITION WHERE ANCHORS ARE EXPOSED DIRECTLY TO WEATHER, 316 STAINLESS STEEL OR EQUIVALENT GRADE SHALL BE ADOPTED WITH APPROVAL FROM THE CONSULTANT.
6. CONTRACTOR MUST FOLLOW APPROVED METHOD FOR THE INSTALLATION. METHOD STATEMENT MUST SUBMIT FOR APPROVAL BEFORE COMMENCEMENT OF WORK. ANCHOR MUST BE SET USING A CALIBRATED TORQUE WRENCH ACCORDING TO THE INSTALLATION TORQUE MOMENT OUTLINED IN THE ETA, OR ALTERNATIVELY, USING MACHINE TORQUEING, "AT MODULE"
7. TO ENSURE FAST AND RELIABLE INSTALLATION WITH AUTOMATIC HOLES CLEANING, SAFESET SYSTEM IS TO BE USED.
8. ANCHOR CAPACITY IS DEPENDENT UPON SPACING BETWEEN ADJACENT ANCHORS AND PROXIMITY OF ANCHORS TO EDGE OF CONCRETE. INSTALL ANCHORS IN ACCORDANCE WITH SPACING AND EDGE CLEARANCES INDICATED ON THE DRAWING OR/AND AS PER REQUIREMENT STATED IN ETA.
9. POST-INSTALLED ANCHOR INSTALLATION SHALL BE PERFORMED BY PERSONNEL TRAINED TO INSTALL THE SYSTEM PER THE MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII), AS INCLUDED IN THE MATERIAL PACKAGING. THE CONTRACTOR SHALL ARRANGE FOR

REPRESENTATIVE TO PROVIDE ONSITE INSTALLATION TRAINING FOR AND THE TRAINING RECORD MUST SUBMIT FOR APPROVAL.

TO IDENTIFY OR TO LOCATE THE POSITION OF EXISTING CONCRETE STRUCTURE PRIOR TO POST-INSTALLING ANCHORS. LOCATED USING HILTI FERROSCAN PS300 OR X-RAY OR CHIPPING

SHALL BE CARRY OUT IN ACCORDANCE TO BRITISH STANDARD BS58539 OR OTHER CLAUSES ACCORDINGLY. ON-SITE PULL OUT TEST LOAD UNLESS OTHERWISE SPECIFIED.

TEST LOAD FACTOR = 1.5, $\geq 2.5\%$ OF ALL ANCHORS OF THE TOTAL INSTALLED ON A JOB; MINIMUM 3 ANCHORS OF THE SAME TYPE BE MATERIAL, ETC. TESTING, TO VALIDATE THE QUALITY OF INSTALLATION, MIGHT NOT BE REQUIRED IF ANCHORS ARE INSTALLED BY TRAINED OPERATIVES WORKING UNDER THIS CONDITION IS NOT SATISFIED THEN PROOF TESTING MIGHT

CAN BE USED TO SUPPLEMENT/ SUPPORT BS58539 CLAUSE 9 (E.G. HILTI SAFESET SYSTEM) CAN BE ADOPTED FOR BS58539 CLAUSE 9 EXEMPTION.

APPLICATIONS SHALL INCLUDE BUT NOT LIMITED TO THE SHOWN IN THE DIAGRAMME:

CONCRETE / MASONRY | POST-INSTALLED ANCHORS



Scan to access to
General Notes &
Typical Details Library



Handbook | Steel-to-Concrete Connections



2. APPLICATIONS

On a jobsite, many different types of steel-to-concrete (S2C) connections may be present. S2C connections are required for both structural and non-structural applications. This type of connections is already well established among designers for many kinds of projects, such as buildings, infrastructure, industrial applications and many other areas. Among the category of **structural connections**, members such as steel columns, beams and bracings that transfer loads to concrete can be often found. **Non-structural connections** include the fixing of utilities, equipment, façade and many more applications that are key elements for the functioning of a building or a civil structure. If cast-in connecting elements such as headed bolts or anchor channels are misplaced, we may encounter **unplanned** applications. If a project needs flexibility, post-installed anchors are a handy solution (**planned** applications). Some typical S2C applications for building constructions are illustrated below in Fig. 2.1 and Fig. 2.2.

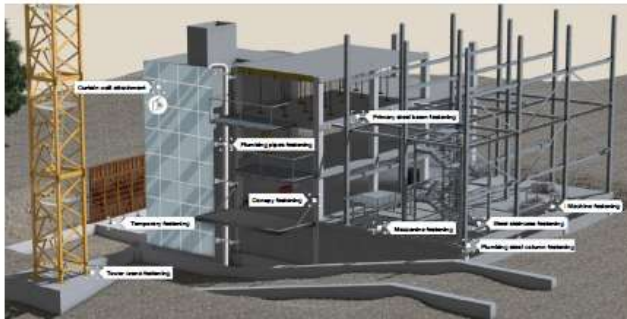


Fig. 2.1: Illustration of typical applications in a building under construction



Fig. 2.2: Illustration of typical applications for building finishings

3. POST-INSTALLED FASTENING SYSTEMS

3.1 Load-bearing mechanisms

Fastening systems transfer applied loads to the base material in different ways. Under both tension (Fig. 3.1 a)) and shear loading (Fig. 3.1 b)), the load transfer mechanism involves the utilization of concrete tensile strength. We refer in this case to **fastening design theory** in opposition to the reinforced concrete theory, where the concrete tensile strength is usually neglected in design. The load-transfer mechanisms for various fastening systems are typically identified as **mechanical interlock**, **friction**, and **adhesive bond** mechanisms.

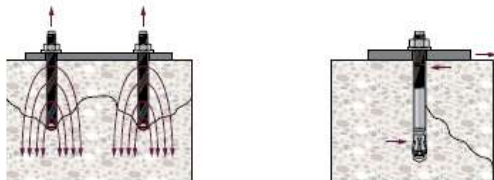


Fig. 3.1: Illustration of tensile capacity of concrete being utilized for load transfer by post-installed anchors (fastening design theory)

Mechanical interlock/keying defines the working principle where the load is transferred by means of a bearing surface between the anchor and the base material (see Fig. 3.2 a)). Some post-installed fasteners develop a mechanical interlock between the anchor and the base material. To achieve this, a cylindrically drilled hole is modified to create a notch, or undercut, of a specific dimension at a defined location either by means of a special drill bit, or by the undercutting action of the anchor itself.

Friction mechanism is the load-transfer mechanism typical of systems where expansion force is generated by a clip or a wedge pressed against the walls of the borehole during the installation process. Frictional resistance equilibrates the external tension force on anchors. The tensile load, N , is transferred to the base material by friction, R (Fig. 3.2 b)).

Adhesive bond mechanism involves the transfer of the external load to the concrete base material via an adhesive bond (see Fig. 3.2 c)). The forces are transferred from the anchor element (e.g., a threaded rod) to the mortar via mechanical interlocking and to the base material via a combination of micro-interlock and chemical adhesion between the mortar and the lateral surface of the borehole.

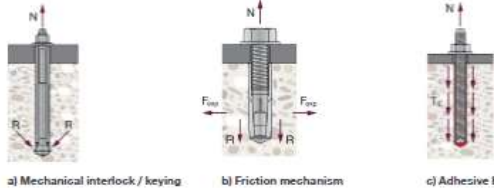


Fig. 3.2: Different types of load-bearing mechanisms in fastening technology

Handbook | Steel-to-Concrete Connections



DOWNLOAD S2C HANDBOOK

2. APPLICATIONS

On a jobsite, many different types of steel-to-concrete connections may be required. S2C connections are required for many kinds of projects, such as buildings, infrastructure, industrial applications and many other areas. Among the category of structural connections, members such as steel columns, beams and non-structural connections are used. Applications that are key elements for the functioning of a building or a civil structure. If cast-in connecting elements such as headed bolts or anchor channels are misplaced, we may encounter unplanned applications. It is a planned application. Some applications are shown in Fig. 2.1 and Fig. 2.2.

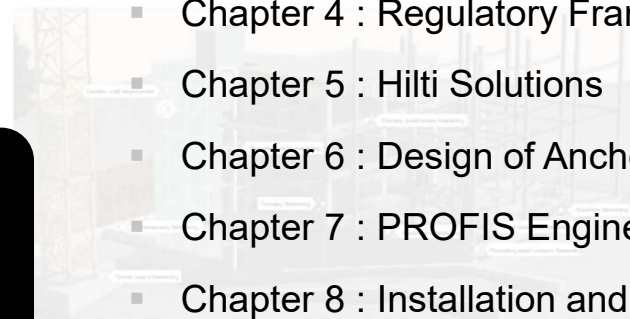


Fig. 2.1: Illustration of typical applications in a building under construction

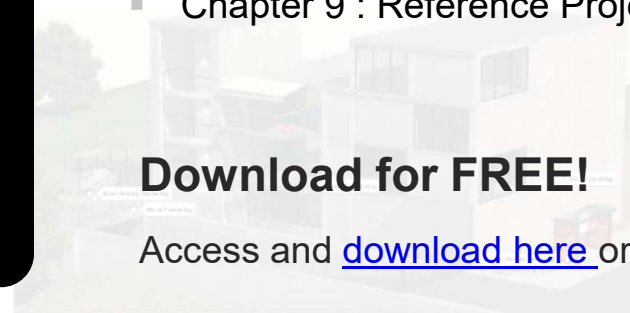


Fig. 2.2: Illustration of typical applications for building finishing

Chapter 1 : Introduction

Chapter 2 : Applications

Chapter 3 : Post-installed Fastening Systems

- Chapter 4 : Regulatory Framework for Qualification and Design
- Chapter 5 : Hilti Solutions
- Chapter 6 : Design of Anchors
- Chapter 7 : PROFIS Engineering Suite – Software Design
- Chapter 8 : Installation and Inspection
- Chapter 9 : Reference Projects

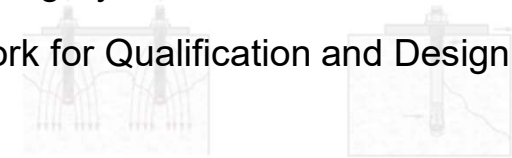
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3. POST-INSTALLED FASTENING SYSTEMS

3.1 Load-bearing mechanisms

Fastening systems transfer applied loads to the base material in different ways. Under both tension (Fig. 3.1 a) and shear loading (Fig. 3.1 b), the load transfer mechanism involves the utilization of concrete tensile strength. We refer in this case to fastening design theory in opposition to the reinforced concrete theory, where the concrete tensile strength is usually neglected in design. The load-transfer mechanisms for various fastening systems are typically identified as mechanical interlock, friction, and adhesive bond mechanisms.



a) Post-installed anchors under tension loading

b) Post-installed anchors under shear loading

Fig. 3.1: Illustration of tensile capacity of concrete being utilized for load transfer by post-installed anchors (fastening design theory)

Mechanical interlock mechanisms involve the anchor element where the load is transferred by means of a clip or a wedge pressed against the walls of the borehole during the installation process. Frictional resistance equilibrates the external tension force on anchors. The tensile load, N , is transferred to the base material by friction, R (Fig. 3.2 b).

Friction mechanism is the load-transfer mechanism typical of systems where expansion force is generated by a clip or a wedge pressed against the walls of the borehole during the installation process. Frictional resistance equilibrates the external tension force on anchors. The tensile load, N , is transferred to the base material by friction, R (Fig. 3.2 b).

Adhesive bond mechanism involves the transfer of the external load to the concrete base material via an adhesive bond (see Fig. 3.2 c). The forces are transferred from the anchor element (e.g., a threaded rod) to the mortar via mechanical interlocking and to the base material via a combination of mechanical interlock and chemical adhesion between the mortar and the lateral surface of the borehole.



a) Mechanical interlock / keying

b) Friction mechanism

c) Adhesive bond mechanism

Fig. 3.2: Different types of load-bearing mechanisms in fastening technology

THANK YOU!