Specifier's comments:

1. Input data

General

Design standard	ACI 318
Calculation method	Modified from ACI 318-19 & Hilti Method
Research-based design methods	Allowed
Post installed rebar approach	Joints + Anchoring for yield
Loading type	Static
Yield design	yes
Application type	Beam to wall

Product

Mortar	**HIT-RE 500 V3**
Connector	**Rebar D13**
Item number	2123403 HIT-RE 500 V3 (adhesive)
Effective embedment depth	Existing concrete: $h_{ef,ex}$ = 150 mm.
Material	SD400
Evaluation Service Report	ESR-3814
Issued	01. 05. 2025
Valid	01. 01. 2027
Proof	Design method Modified from ACI 318-19 & Hilti Method
Epoxy coated reinforcement	no

Material

Concrete material	Cracked concrete, 27MPa, fc' = 27.0 N/mm^2;
Surface treatment	Mechanically roughened (1/4-in. amplitude)
Reinforcement	tension: not present
Steel strain limit	0.02

Installation and temperature

Temperature	During service: 20 °C / 20 °C (short / long term)
Installation	Hammer Drilling, Installation Condition: Dry Concrete

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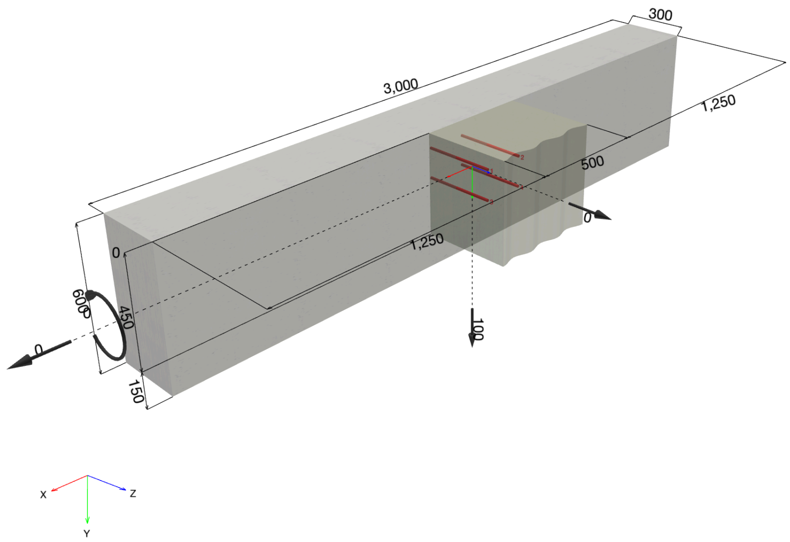
1.1. Geometry & Loading

Geometrical dimensions in [mm]. Loading values in [kN, kNm]



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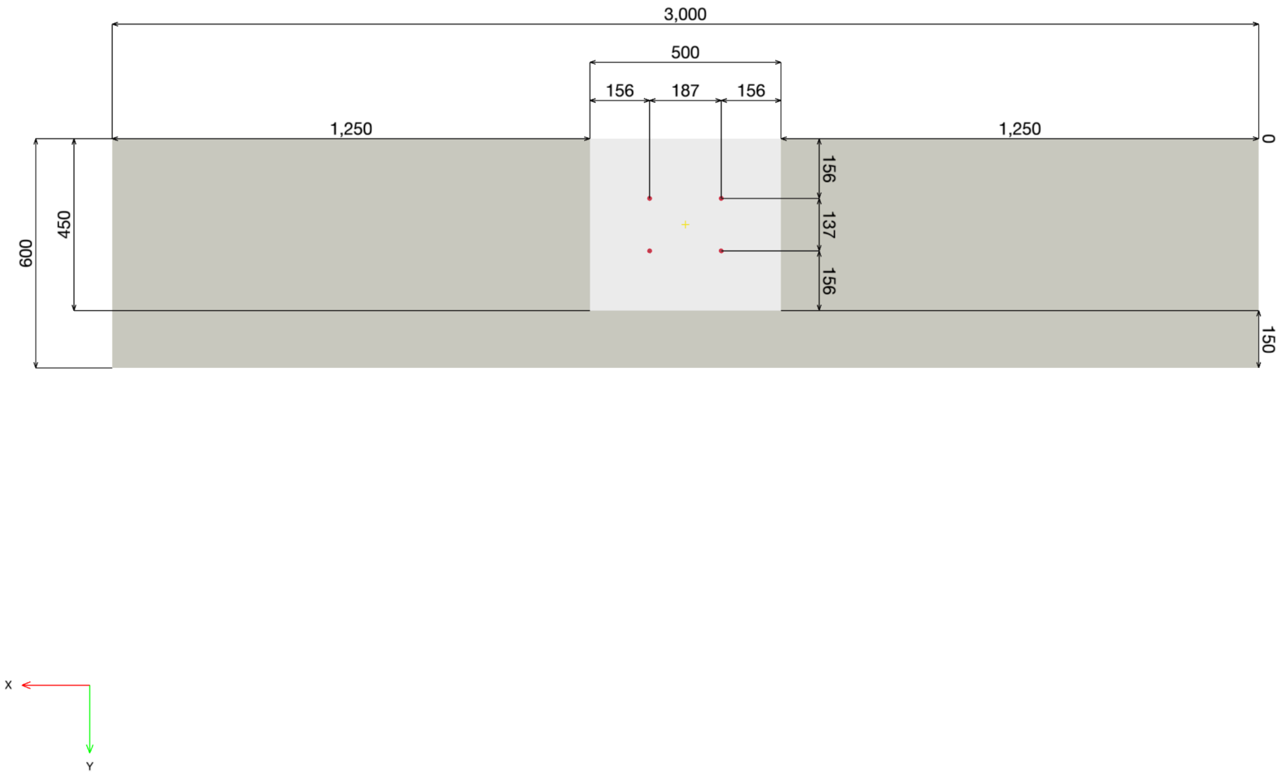
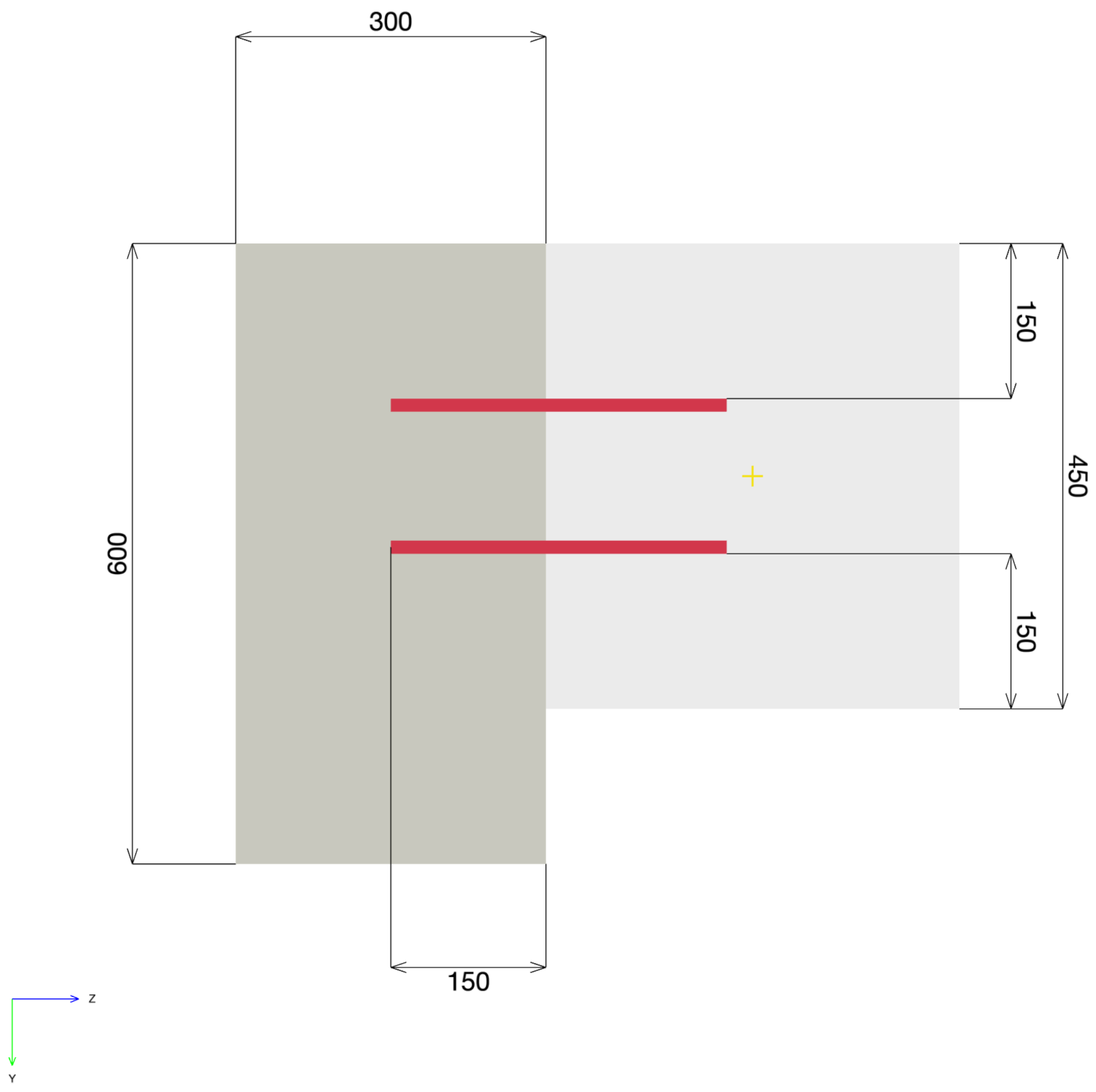
1.2. Cross section view



1.3. Side section view



2. Loads and Cross section analysis

2.1. Load combinations

Case	Description	Forces [kN] / Moments [kNm]	Load type	Max. Utilization [%]	Embedment depth [mm]
1	Combination 2	$N = 0.000$; $V_x = 0.000$; $V_y = 100.000$; $M_x = 0.000$; $M_{x,sus} = 0.000$; $N_{sus} = 0.000$;	Static	30	150

3. Overview of results

3.1. References

[1] Building Code Requirements for Structural Concrete (ACI 318-19), Commentary on Building Code Requirements for Structural Concrete (ACI318R-19)

[2] Hilti North America, POST-INSTALLED REINFORCING BAR GUIDE based on Palieraki, V. (2014). "Seismic behavior of reinforced interfaces in repaired/strengthened reinforced concrete elements," doctoral thesis, National Technical University of Athens, Greece, 578 pp. (in Greek) and (May 2022) Palieraki, et al., Interface Shear Strength under Monotonic and Cyclic Loading, ACI Structural Journal.

3.2. Anchoring to concrete ([1] Section 17)

User input

Description	Variable	Value
Rebar diameter	d_a	13 mm
User-defined steel over-strength factor	Ω_{fy}	1.000
Reinforcement yield strength, post installed	$\Omega_{fy} \cdot f_{y,PI}$	400.00 N/mm²
Concrete compressive strength	f'_c	27.00 N/mm²

Embedment for yield and strength capacities in tension

Determined embedment $h_{ef} = 150\ mm$

Overview Table

Failure Mode	Capacity ϕN_n [kN] per rebar	Status
Steel strength	51.613	Ok
Bond strength	20.319	Not Ok
Concrete breakout strength	16.364	Not Ok

Steel strength

$N_{sa} = A_{se,N} \cdot f_{y,PI}$

ϕN_{sa} [1] Table 17.5.2

Variables

$A_{se,N}$ [mm²]	$f_{y,PI}$ [N/mm²]
129	400.00

Calculations

N_{sa} [kN]
51.613

Results

N_{sa} [kN]	Ω_{fy}	$\Omega_{fy}N_{sa}$ [kN]
51.613	1.000	51.613

Bond Strength

N_{ag}	$= \frac{A_{Na}}{A_{Na0}} \cdot \psi_{ec1,Na} \cdot \psi_{ec2,Na} \cdot \psi_{ed,Na} \cdot \psi_{cp,Na} \cdot N_{ba}$	[1] Eq. (17.6.5.1b)
ϕN_{ag}		[1] Table 17.5.2
A_{Na}	see [1] Section 17.6.5.1, Fig. R 17.6.5.1(b)	
A_{Na0}	$= (2c_{Na})^2$	[1] Eq. (17.6.5.1.2a)
c_{Na}	$= 10d_a\sqrt{\frac{\tau_{uncr}}{7.6}}$	[1] Eq. (17.6.5.1.2b)
$\psi_{ec,Na}$	$= \left(\frac{1}{1+\frac{e'_N}{c_{Na}}}\right) \leq 1.0$	[1] Eq. (17.6.5.3.1)
$\psi_{ed,Na}$	$= 0.7 + 0.3\left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$	[1] Eq. (17.6.5.4.1b)
$\psi_{cp,Na}$	$= 1.0$	[1] Eq. (17.6.5.5.1b)
N_{ba}	$= \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$	[1] Eq. (17.6.5.2.1)

Variables

$\tau_{k,c,uncr}$ [N/mm²]	d_a [mm]	h_{ef} [mm]	$c_{a,min}$ [mm]	$\tau_{k,c}$ [N/mm²]
13.42	13	150	156	10.03

$e_{c1,N}$ [mm]	$e_{c2,N}$ [mm]	c_{ac} [mm]	λ_a
0	0	314	1.000

Calculations

c_{Na} [mm]	A_{Na} [mm²]	A_{Na0} [mm²]	$\psi_{ed,Na}$
169	242,696	113,933	0.978

$\psi_{ec1,Na}$	$\psi_{ec2,Na}$	$\psi_{cp,Na}$	N_{ba} [kN]
1.000	1.000	1.000	60.026

Results

N_{ag} [kN]	ϕ_{bond}	ϕN_{ag} [kN]	$\frac{\phi N_{ag}}{n}$ [kN]
125.042	0.650	81.278	20.319

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Concrete breakout strength

N_{cbg}	$= \left(\frac{A_{Nc}}{A_{Nc0}}\right) \cdot \psi_{ec,N} \cdot \psi_{ed,N} \cdot \psi_{c,N} \cdot \psi_{cp,N} \cdot N_b$	[1] Eq. (17.6.2.1b)
ϕN_{cbg}		[1] Table 17.5.2
A_{Nc}	see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)	
A_{Nc0}	$= 9 \cdot h_{ef}^2$	[1] Eq. (17.6.2.1.4)
$\psi_{ec,N}$	$= \left(\frac{1}{1+\frac{2e'_N}{3h_{ef}}}\right) \leq 1.0$	[1] Eq. (17.6.2.3.1)
$\psi_{ed,N}$	$= 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 \cdot h_{ef}}\right) \leq 1.0$	[1] Eq. (17.6.2.4.1b)
$\psi_{cp,N}$	$= 1.0$	[1] Eq. (17.6.2.6.1b)
N_b	$= k_c \cdot \lambda_a \cdot \sqrt{f'_c} \cdot h_{ef}^{1.5}$	[1] Eq. (17.6.2.2.1)

Variables

h_{ef} [mm]	$e_{c1,N}$ [mm]	$e_{c2,N}$ [mm]	$c_{a,min}$ [mm]	$\psi_{c,N}$
150	0	0	156	1.000

c_{ac} [mm]	k_c	λ_a	f'_c [N/mm²]
314	7.100	1.000	27.00

Calculations

A_{Nc} [mm²]	A_{Nc0} [mm²]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [kN]
330,536	202,500	1.000	1.000	0.908	1.000	67.912

Results

N_{cbg} [kN]	$\phi_{concrete}$	ϕN_{cbg} [kN]	$\frac{\phi N_{cbg}}{n}$ [kN]
100.704	0.650	65.458	16.364

3.3. Hilti Method Shear strength verification

User input

Description	Variable	Value
Rebar diameter	d_b	13 mm
Reinforcement yield strength, post installed	$f_{y,PI}$	400.00 N/mm²
Friction contribution factor	β_f	0.600
Uniform stress over interface due to externally applied normal force	f_{ext}	0.00 N/mm²
Concrete compressive strength	f'_c	27.00 N/mm²
Surface area of interface	A_c	225,000 mm²

Verification

Embedment $h_{ef} = l_e = 150mm$

Shear Strength	Load V_u [kN]	Capacity ϕV_n [kN]	Utilization $\frac{V_u}{\phi V_n}$ [%]	Status
	100.000	336.182	30	Ok

ϕV_n	$\geq V_u$	
V_n	$= A_c \cdot (\beta_f \cdot \tau_f + \beta_d \cdot \tau_d)$	[2] Eq. (18)
τ_f	$= 0.33 \cdot \left[(f'_c)^2 \cdot (f_{c,vf} + f_{ext})\right]^{\frac{1}{3}}$	[2] Eq. (19)
$f_{c,vf}$	$= \min\left(\frac{f_y \cdot A_{vf}}{A_c}; \frac{5 \cdot f_{bu} \cdot l_e A_{vf}}{d_b \cdot A_c}\right)$	
A_{vf}	$= n \cdot \frac{\pi \cdot d_b^2}{4}$	
τ_d	$= \frac{1.3 \cdot n \cdot d_b^2 \cdot \sqrt{f'_c \cdot f_y}}{A_c} \leq 0.6 \cdot A_{vf} \cdot \frac{f_y}{A_c}$	[2] Eq. (20)
β_d	$= 0.70 \leftarrow l_e > 8 \cdot d_b$	

Variables

d_b [mm]	$f_{y,PI}$ [N/mm²]	β_f [-]	β_d [-]	f_{ext} [N/mm²]	f'_c [N/mm²]	A_c [mm²]
13	400.00	0.600	0.700	0.00	27.00	225,000

n [-]	f_{bu} [N/mm²]	l_e [mm]
4	10.03	150

Calculations

A_{vf} [mm²]	$f_{c,vf}$ [N/mm²]	$\frac{f_y \cdot A_{vf}}{A_c}$ [N/mm²]	$\frac{5 \cdot f_{bu} \cdot l_e \cdot A_{vf}}{d_b \cdot A_c}$ [N/mm²]
507	0.90	0.90	1.33

τ_f [N/mm²]	τ_d [N/mm²]
2.87	0.39

Results

V_n [kN]	ϕ [-]	ϕV_n [kN]	V_u [kN]
448.242	0.750	336.182	100.000

4. Warnings

This design exclusively considers the local load transfer in the considered interface between new and existing concrete.

The joint surfaces for concreting must be roughened to fulfil the design assumption.

The capacity of the cross-section has to be designed separately.

The installation (drilling, cleaning, setting) must be according to the approval!

The software does not check the minimum cover requirements to meet exposure conditions and exposure classes. It is the responsibility of the user to review minimum code requirements for concrete cover.

Yielding is not possible with your current configuration. Some factors that effect the calculations include spacing, edge distance, bar diameter, bar grade, and concrete strength. The Hilti Method may provide a solution with this configuration.

Anchor Design calculation results are shown for the average resistance per anchor

Using the Anchoring to Concrete Provisions to Design for Bar Yield does not result in an embedment depth less than development length. Some factors that affect these calculations include spacing, edge distance, bar diameter, bar grade, concrete strength, and strength reduction factor for concrete breakout and bond.

The results presented in this report have been calculated using a research-based design method. This design option provides an alternative to Code-based design methods, offering a more comprehensive solution for achieving optimal design results.

Interface does not meet the design criteria!

5. Installation data

Mortar: HIT-RE 500 V3 + Rebar
Item number: 2123403 HIT-RE 500 V3 (adhesive)

Connector: Rebar D13

Connector material: SD400

Drilling method: Hammer Drilling

Hole type: Dry Concrete

Surface treatment: Mechanically roughened (1/4-in. amplitude)

Drill hole diameter in the base material: 16 mm

Drill hole depth in the base material: 150 mm

Minimum thickness of existing concrete: 150 mm

Specification text: HIT-RE 500 V3 + REBAR D13 SD400 WITH 150 MM EMBEDMENT DEPTH

Arrangements

  Number of bars: 4

  Cover: 150 mm

6. Remarks; Your cooperation duties

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