

NEW
DEVELOPMENT
Ultra-High Bonding Strength

High Performance Chemical Anchor

- Applicable in Cracked & Uncracked Concrete
- Eurocode 2 Post-installed Rebar Design
- Heavy Anchoring and Fastening Design
- High Viscosity, Long Working Time
- Under Water Applicable
- High Compressive Strength
- High Chemical Resistance
- Low odour, Non-Shrinkage
- CSTB 4hrs Fire Resistance
- 2 yrs Longer Shelf Life
- Resealable Hard Cartridge



Epoxy Technology

The pure epoxy technology is the advanced high performance chemical anchoring technology with an outstanding chemical resistance and industrial strength. Good compound properties achieve outstanding load values, always giving professional solution for specialized applications.

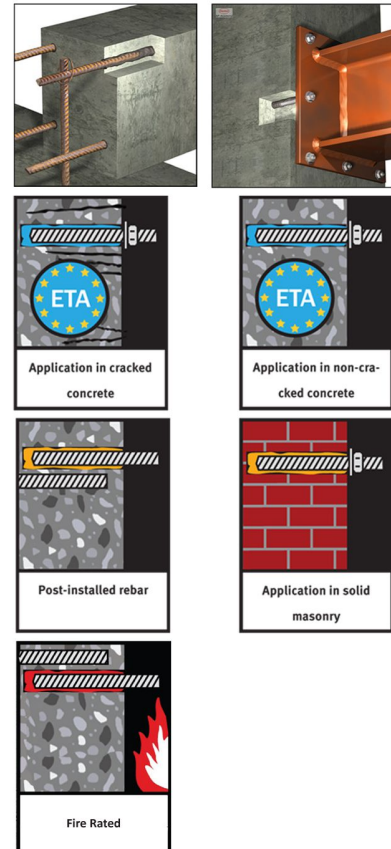
Product Description

MASON® C-RE chemical anchor is a 2-component reaction resin mortar based on a pure epoxy and will be delivered in an exclusive 2-C cartridge system. This high performance product was designed especially for the anchoring of threaded rods, reinforcing bars or internal threaded rod sleeves into concrete as well as solid masonry. Based on the excellent standing behaviour the usability in combination with a special plastic sleeve in hollow material is given. MASON® C-RE chemical anchor is characterised, by a high range of applications with an installation temperature from +5°C and a service temperature up to 72°C as well as by high chemical resistance for applications in extreme ambiances e.g. in swimming pools(chlorine) or closeness to the sea(salt). The wide range of certificates, national and international approvals, allows nearly every application.



Special Properties and Benefits

- For heavy anchoring - doweling and post-installed rebar connection
- Hammer drilled and diamond drilled holes possible
- Overhead application; waterfilled bore holes applicable
- Suitable for attachment point with small edge and axial distances due to an anchoring free of expansion forces
- Suitable for dynamic load; Cracked concrete applicable
- Strong and secure anchoring even under water
- Mortar is water-impermeable acc. to DIN EN 12390-8
- Fire resistance and high chemical resistance
- Low shrinkage: ideal for larger annular gap
- Low odour
- Flexible working time at elevated temperatures
- Resealable cartridge: can be reused up to the end of the shelf life



Application and Intended Use

- **Base materials:**
cracked concrete, non-cracked concrete, light-concrete, porous-concrete, solid masonry, natural stone; hollow brick; hammer drilled and diamond drilled holes
- **Anchor elements:**
Threaded rods (zinc plated or hot dip, stainless steel and high corrosion resistance steel), reinforcing bars, internal threaded rods, profiled rod, steel section with undercuts (e.g. perforated section)
- **Temperature range:**
+5°C up to +40°C installation temperature ; cartridge temperature min. +5°C; optimal +20°C; -40°C to +72°C base material temperature after full curing

Approvals and Achievements



European Technical Assessment
European Technical Assessment for bonded fasteners acc. to EAD 330499-01-0601: (Option 1) ETA-21/0957



European Technical Assessment for post-installed rebar acc. to EAD 330087-01-0601: ETA-21/0956: EN 1992-1-1, Eurocode 2 post-installed rebar connection design.



Centre Scientifique et Technique du Batiment (CSTB) France

C-RE is 4 hrs fire resistance tested by CSTB.

HOUSING & DEVELOPMENT BOARD

Singapore HDB Approved Material
with HDB - Centre of Building Research
Tensile & Shear Test Report



SETSCO (Singapore)

Product performance verified by SETSCO
Ultimate Tensile Pullout Test Report



SIRIM QAS International (Malaysia)

Product Performance Verified by SIRIM
Tensile Pullout Test Report

Reactivity

Temperature of Base Material	Gelling and Working Time	Full Curing Time in Dry Base Material	Full Curing Time in Wet Base Material
+5°C to +9°C	80 min	60 h	120 h
+10°C to +14°C	60 min	48 h	96 h
+15°C to +19°C	40 min	24 h	48 h
+20°C to +24°C	30 min	12 h	24 h
+25°C to +34°C	12 min	10 h	20 h
+35°C to +39°C	8 min	7 h	14 h
+40°C	8 min	4 h	8 h

Properties

Properties	Test Method	Result
Density	-	1.5 kg/dm ³
Compressive Strength	EN 196	122 N/mm ²
Shrinkage	DIN 52450	< 1.4%
Watertightness	DIN EN 12390-8	0 mm
UV resistance	-	Pass
Electrical Resistance	IEC 93	8.0*10 ¹² Ω
Thermal conductivity	DIN EN 993-15	0.5 W/m · K

Product Accessories



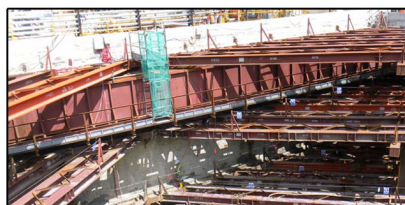
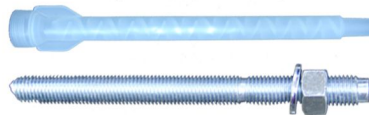
CRE with Threaded Rod

- High strength Pure Epoxy
- High viscosity - Ideal for overhead application
- Non-shrinkage - Ideal for larger annular gaps
- Cracked concrete applicable
- Suitable for Seismic action performance
- Suitable for dry, wet and water filled holes
- Underwater holes applicable
- Long working time in hot weather
- Outstanding chemical resistant
- Odourless pure epoxy

C-RE (585 ml)
Resealable
Hard Plastic Cartridge

Static Mixing Nozzle

Property Class 5.8
Property Class 8.8
Stainless Steel A4 - 70



European Technical Approval

HDB Approved Material

SETSCO Tested

4 Hours Fire Resistance
Report No. 26050230

SIRIM QAS Malaysia Tested

KMITL Thailand Tested

French VOC Tested

LEED Tested

Concrete

ETA Option 7
Non-cracked Concrete

ETA Option 1
Cracked Concrete

Masonry

Fire Resistance

Close Edge & Spacing

High Load

ETA Seismic Design C1

Chemical Resistance

Design Software

SETTING PROCEDURES

- (1) Drill hole with hammer drill to the required anchor size and depth.
- (2a) Blow the hole clean with hand pump up to hole diameter 20mm.
- (2b) Use compressed air (min.6 bar) hole diameter >20mm or depth >240mm.
- (3) Brush the hole with appropriate size wire brush.
- (4a) Blow the hole clean again with hand pump minimum 2 times.
- (4b) Blow the hole clean again with compressed air (min. 6 bar).
- (5) Attached static nozzle and load the cartridge into dispensing tool.
- (6) Mark embedment depth on the anchor rod.
- (7) Discard non-uniformly mixed until mortar shows consistent grey colour.
- (8) Fill the hole up to approximately 2/3 with adhesive.
- (9) Push the threaded rod into the hole while slightly turning action.
- (10) Be sure the anchor is fully embedded and excess mortar is visible.
- (11) Allow the adhesive to cure prior to applying any load or torque.
- (12) After full curing add-on part can be installed with specified torque.

SETTING PARAMETERS

Threaded Rod Size			M8	M10	M12	M16	M20	M24	M27	M30	M39
Threaded rod diameter	d	(mm)	8	10	12	16	20	24	27	30	39
Drill bit diameter	d ₀	(mm)	10	12	14	18	24	28	32	35	46
Effective Anchorage Depth	h _{ef}	(mm)	80	90	110	125	170	210	250	270	350
Min. Base Material Thickness	h _{min}	(mm)	h _{ef} + 30mm ≥ 100mm				h _{ef} + 2d ₀				
Minimum edge distance	c _{min}	(mm)	40	50	60	80	100	120	135	150	195
Critical edge distance	c _{cr}	(mm)	113	135	165	188	255	304	342	379	472
Minimum spacing distance	s _{min}	(mm)	40	50	60	80	100	120	135	150	195
Critical spacing distance	s _{cr}	(mm)	226	270	330	375	510	607	683	759	945
Installation torque	T _{inst.}	(Nm)	10	20	40	60	120	150	200	250	350
Consumption per hole	Vol.	(ml)	5.1	8.2	13.6	25.6	61.8	104.0	161.7	208.9	467.7

Basic Loading Data For Single Anchor

- Concrete C20/25, $f_{ck,cube} = 25 \text{ N/mm}^2$
- Correct setting as setting procedures and parameters
- No spacing and edge distance influence
- Steel failure
- Base material temperature range I: -40°C to $+40^\circ\text{C}$ (max. long term temperature $+24^\circ\text{C}$ & max. short term temperature $+40^\circ\text{C}$)

Tensile Resistance

Threaded Rod 5.8 Size		M8	M10	M12	M16	M20	M24	M27	M30	M39
Non Cracked Concrete										
Ultimate Strength	$N_{Ru,m} \text{ (kN)}$	<u>19.1</u>	<u>33.9</u>	<u>49.8</u>	<u>84.8</u>	<u>128.2</u>	<u>186.9</u>	<u>243.9</u>	<u>298.2</u>	<u>488.9</u>
Characteristic Strength	$N_{Rk} \text{ (kN)}$	<u>18.1</u>	<u>32.2</u>	<u>47.3</u>	72.1	111.5	155.1	190.2	223.7	342.2
Design Strength	$N_{Rd} \text{ (kN)}$	12.1	21.5	31.5	34.3	53.1	73.9	90.6	106.5	163.0
Recommended Strength	$N_{Rec} \text{ (kN)}$	8.6	15.4	22.5	24.5	37.9	52.8	64.7	76.1	116.4
Cracked Concrete										
Ultimate Strength	$N_{Ru,m} \text{ (kN)}$	17.1	24.1	35.5	64.1	105.8	146.4	178.1	213.9	244.4
Characteristic Strength	$N_{Rk} \text{ (kN)}$	16.2	22.9	33.7	44.9	74.1	109.8	133.6	160.4	195.5
Design Strength	$N_{Rd} \text{ (kN)}$	9.0	12.7	18.7	21.4	35.3	52.3	63.6	76.4	93.1
Recommended Strength	$N_{Rec} \text{ (kN)}$	6.4	9.1	13.4	15.3	25.2	37.4	45.4	54.6	66.5

$N_{Rd} = N_{Rk} / \gamma_{Mc,N}$ [Safety Factor for concrete, $\gamma_{Mc,N} = 1.5$ (Non cracked), 1.8 (Cracked) for M8 ~ M12] [$\gamma_{Mc,N} = 2.1$ for M16 ~ M39]

$N_{Rec} = N_{Rd} / \gamma_F$ [Safety Factor for load action, $\gamma_F = 1.4$]

Shear Resistance

Threaded Rod 5.8 Size		M8	M10	M12	M16	M20	M24	M27	M30	M39
Non Cracked and Cracked Concrete										
Ultimate Strength	$V_{Ru,m} \text{ (kN)}$	<u>9.5</u>	<u>15.8</u>	<u>22.1</u>	<u>41.0</u>	<u>64.1</u>	<u>92.4</u>	<u>120.8</u>	<u>147.0</u>	<u>256.2</u>
Characteristic Strength	$V_{Rk} \text{ (kN)}$	<u>9.0</u>	<u>15.0</u>	<u>21.0</u>	<u>39.0</u>	<u>61.0</u>	<u>88.0</u>	<u>115.0</u>	<u>140.0</u>	<u>244.0</u>
Design Strength	$V_{Rd} \text{ (kN)}$	7.2	12.0	16.8	31.2	48.8	70.4	92.0	112.0	195.2
Recommended Strength	$V_{Rec} \text{ (kN)}$	5.1	8.6	12.0	22.3	34.9	50.3	65.7	80.0	139.4

$V_{Rd} = V_{Rk} / \gamma_{Ms,V}$ [Safety Factor for steel, $\gamma_{Ms,V} = 1.25$]

$V_{Rec} = V_{Rd} / \gamma_F$ [Safety Factor for load action, $\gamma_F = 1.4$]

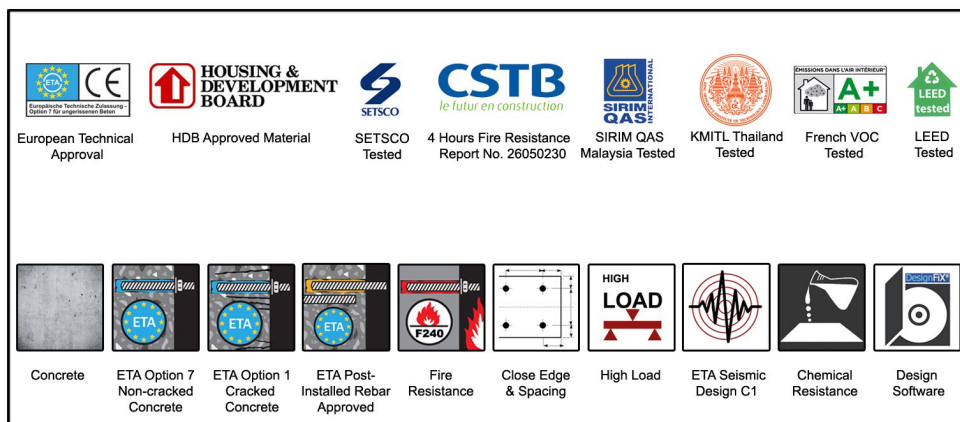
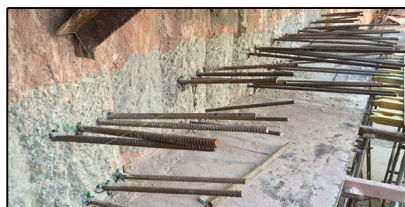
CRE with Rebar

- High strength pure epoxy
- High viscosity - Ideal for overhead application
- Non-shrinkage - Ideal for larger annular gaps
- Cracked concrete applicable
- Suitable for Seismic action performance
- Suitable for dry, wet and water filled holes
- Underwater holes applicable
- Long working time in hot weather
- Outstanding chemical resistant
- Odourless pure epoxy

C-RE (585 ml)
Resealable
Hard Plastic Cartridge

Static Mixing Nozzle

Rebar 500



SETTING PROCEDURES

(1) Drill hole with hammer drill to the required rebar size and depth.

(2a) Blow the hole clean with hand pump up to hole diameter 20mm.

(2b) Use compressed air (min.6 bar) hole diameter >20mm or depth >240mm.

(3) Brush the hole with appropriate size wire brush.

(4a) Blow the hole clean again with hand pump minimum 2 times.

(4b) Blow the hole clean again with compressed air (min. 6 bar).

(5) Attached static nozzle and load the cartridge into dispensing tool.

(6) Mark embedment depth on the rebar. The bar should be free of dirt.

(7) Discard non-uniformly mixed until mortar shows consistent grey colour.

(8) Fill the hole up to approximately 2/3 with adhesive.

(9) Use piston plug for overhead installation.

(10) Push the rebar into the hole while slightly turning action.

(11) Be sure the rebar is fully embedded and excess mortar is visible.

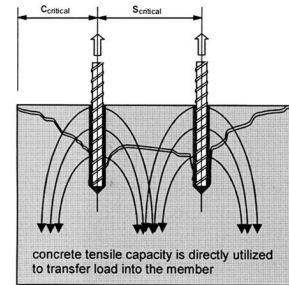
(12) Allow the adhesive to cure prior to applying any load or torque.

SETTING PARAMETERS

Rebar Size			Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
Rebar diameter	d	(mm)	8	10	13	16	20	25	28	32	40
Drill bit diameter	d ₀	(mm)	12	14	16	20	25	32	35	40	50
Effective Anchorage Depth	h _{ef}	(mm)	80	90	115	125	170	210	250	300	350
Min. Base Material Thickness	h _{min}	(mm)	h _{ef} +30mm ≥ 100mm				h _{ef} + 2d ₀				
Minimum edge distance	c _{min}	(mm)	40	50	70	80	100	125	140	160	200
Critical edge distance	c _{cr}	(mm)	97	121	170	180	219	274	298	330	413
Minimum spacing distance	s _{min}	(mm)	40	50	70	80	100	125	140	160	200
Critical spacing distance	s _{cr}	(mm)	194	242	339	360	438	548	596	661	826
Consumption per hole	Vol.	(ml)	7.3	11.1	18.6	31.6	67.1	135.8	193.4	303.1	552.5

Basic Loading Data For Single Rebar

- Concrete C20/25, $f_{ck,cube} = 25 \text{ N/mm}^2$
- Correct setting as setting procedures and parameters
- No spacing and edge distance influence
- Steel failure
- Base material temperature range I: -40°C to $+40^\circ\text{C}$
(max. long term temperature $+24^\circ\text{C}$ & max. short term temperature $+40^\circ\text{C}$)



Tensile Resistance

Rebar BSt 500 S Size		Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
Non Cracked Concrete										
Ultimate Strength	$N_{Ru,m}$ (kN)	<u>30.2</u>	<u>42.5</u>	<u>79.0</u>	<u>96.0</u>	146.8	216.4	281.8	347.8	450.9
Characteristic Strength	N_{Rk} (kN)	<u>28.7</u>	40.4	67.1	81.6	117.4	173.1	219.8	271.3	351.7
Design Strength	N_{Rd} (kN)	16.0	22.5	37.3	38.9	55.9	82.4	104.7	129.2	167.5
Recommended Strength	N_{Rec} (kN)	11.4	16.0	26.6	27.8	39.9	58.9	74.8	92.3	119.6
Cracked Concrete										
Ultimate Strength	$N_{Ru,m}$ (kN)	23.0	32.3	53.6	62.8	103.7	153.1	204.1	258.4	302.2
Characteristic Strength	N_{Rk} (kN)	16.1	22.6	37.6	44.0	72.6	107.2	142.9	180.9	241.8
Design Strength	N_{Rd} (kN)	8.9	12.6	20.9	20.9	34.6	51.0	68.0	86.1	115.1
Recommended Strength	N_{Rec} (kN)	6.4	9.0	14.9	15.0	24.7	36.4	48.6	61.5	82.2

$$N_{Rd} = N_{Rk} / \gamma_{Mc,N} \quad [\text{Safety Factor for concrete, } \gamma_{Mc,N} = 1.8 \text{ for T8 ~ T13}] \quad [\gamma_{Mc,N} = 2.1 \text{ for T16 ~ T40}]$$

$$N_{Rec} = N_{Rd} / \gamma_F \quad [\text{Safety Factor for load action, } \gamma_F = 1.4]$$

Shear Resistance

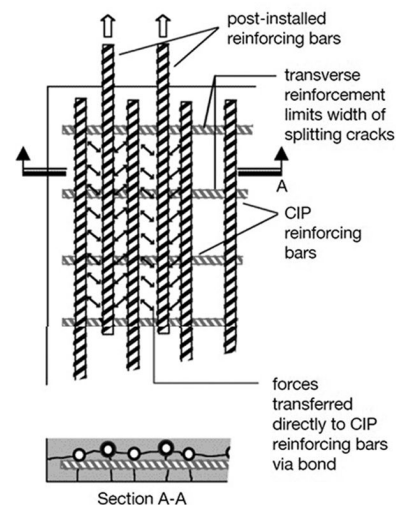
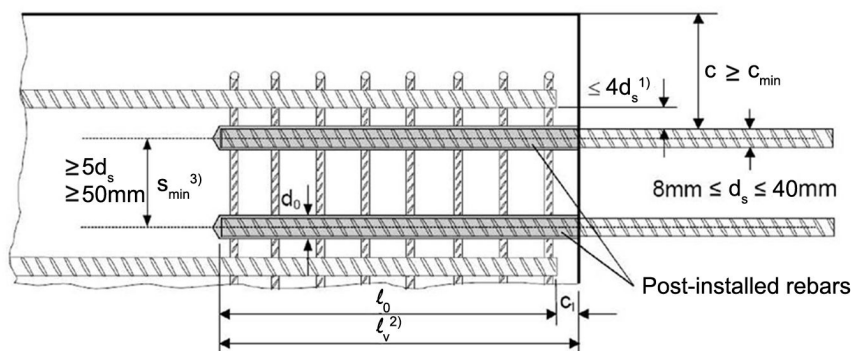
Rebar BSt 500 S Size		Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
Non Cracked Concrete and Cracked Concrete										
Ultimate Strength	$V_{Ru,m}$ (kN)	<u>14.5</u>	<u>22.7</u>	<u>38.3</u>	<u>58.1</u>	<u>90.7</u>	<u>141.7</u>	<u>177.8</u>	<u>232.3</u>	<u>362.9</u>
Characteristic Strength	V_{Rk} (kN)	<u>13.8</u>	<u>21.6</u>	<u>36.5</u>	<u>55.3</u>	<u>86.4</u>	<u>135.0</u>	<u>169.3</u>	<u>221.2</u>	<u>345.7</u>
Design Strength	V_{Rd} (kN)	9.2	14.4	24.3	36.9	57.6	90.0	112.9	147.4	230.5
Recommended Strength	V_{Rec} (kN)	6.6	10.3	17.4	26.3	41.1	64.3	80.6	105.3	164.6

$$V_{Rd} = V_{Rk} / \gamma_{Ms,V} \quad [\text{Safety Factor for steel, } \gamma_{Ms,V} = 1.5]$$

$$V_{Rec} = V_{Rd} / \gamma_F \quad [\text{Safety Factor for load action, } \gamma_F = 1.4]$$

Post-Installed Rebars

General design rule of construction of post-installed rebars



d_s = diameter of post-installed rebar

d_o = drill bit diameter

ℓ_o = lap length

1) If the clear distance between overlapped bars exceeds $4d_s$, then the lap length, ℓ_o shall be increase by the difference between the actual clear distance and $4d_s$.

ℓ_v = effective embedment depth ($\ell_v \geq \ell_o + c_i$)

2) For calculation of the effective embedment depth of overlap joints the concrete cover at end-face of the post-installed rebar c_i shall be considered.

c_i = concrete cover at end-face of post-installed rebar

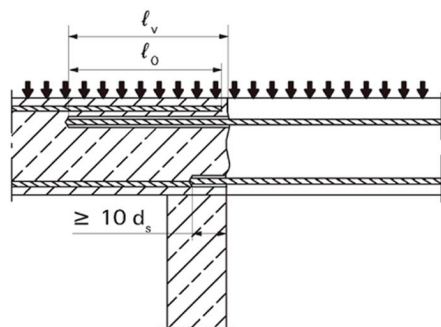
c = concrete cover for post-installed rebar

$c_{\min}$ = minimum concrete cover

$s_{\min}$ = minimum spacing for post-installed rebars

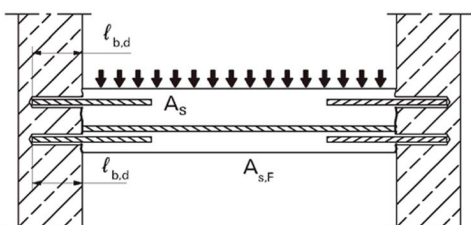
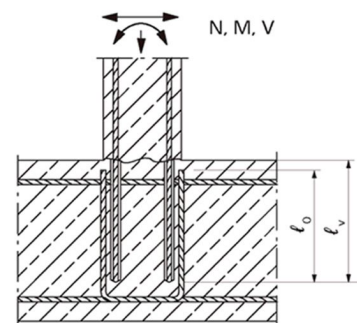
3) The spacing between post-installed rebars shall be greater than the minimum of $5d_s$ and 50mm

Application examples of post-installed rebar



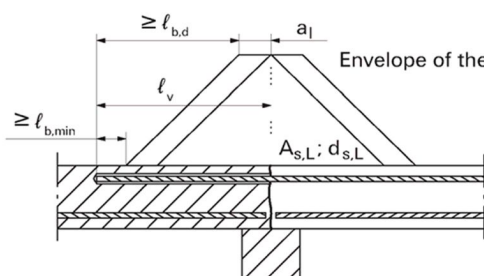
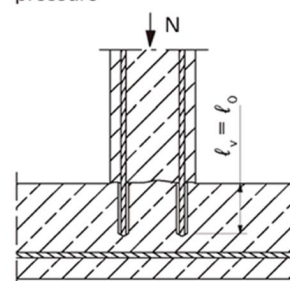
Reinforcement lap for rebar connections of slabs and beams

Reinforcement lap of a column or a wall under bending stress to a foundation.



End anchoring of slabs or beams which have been designed as simply supported

Rebar connection of building members under predominant pressure



Anchoring of reinforcement to cover the envelope of the tensile force

Drill bit diameters, d_0

Rebar Size			Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
Hammer drilling	HD	mm	12	14	16	20	25	32	35	40	50
Compressed air drilling	CD	mm	12	14	16	20	26	32	35	40	57
Diamond core drilling	DD	mm	12	14	16	20	25	32	35	40	52

The multiplication factor for minimum anchorage length shall be considered as 1.0 for all drilling methods

Minimum anchorage and lap lengths for C20/25 and maximum hole lengths, l_{max}

Rebar, $f_{y,k}$ 500 N/mm ²			Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
Hammer drilling and compressed air drilling											
Min. anchorage length	$l_{b,min}$	mm	113	142	184	227	284	354	397	454	616
Min. lap length	$l_{o,min}$	mm	200	200	200	240	300	375	420	480	621
Diamond core drilling											
Min. anchorage length	$l_{b,min}$	mm	170	213	275	340	425	532	595	681	925
Min. lap length	$l_{o,min}$	mm	300	300	315	360	450	563	630	720	932
All drilling method											
Max. hole length	l_{max}	mm	1000	1000	1300	1600	2000	2500	2800	3200	3200

According to EC2 EN 1992-1-1:2004, $l_{b,min}$ (8.6) and $l_{o,min}$ (8.11) are calculated for good bond conditions and $a_b = 1.0$ with maximum rebar yield strength $f_{y,k}$ 500 N/mm²

Minimum concrete cover c_{min} of post-installed rebar depending of drilling method

Drilling method		Rebar diameter	Without drilling aid	With drilling aid
Hammer drilling	HD	< 25mm	$30mm + 0.06 l_v \geq 2d_s$	$30mm + 0.02 l_v \geq 2d_s$
		$\geq 25mm$	$40mm + 0.06 l_v \geq 2d_s$	$40mm + 0.02 l_v \geq 2d_s$
Compressed air drilling	CD	< 25mm	$50mm + 0.08 l_v$	$50mm + 0.02 l_v$
		$\geq 25mm$	$60mm + 0.08 l_v$	$60mm + 0.02 l_v$
Diamond core drilling	DD	< 25mm	Drill stand is used as drilling aid	$30mm + 0.02 l_v \geq 2d_s$
		$\geq 25mm$		$40mm + 0.02 l_v \geq 2d_s$

Furthermore the minimum concrete cover must be observed according EC2: EN 1992-1-1:2004, Section 4.4.1.2

Design values of the ultimate bond resistance f_{bd} in N/mm² for hammer drilling, compressed air drilling methods for good conditions

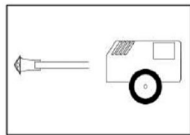
Rebar (mm)	Concrete Class								
d_s	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Ø8 - Ø32	1.6	2.0	2.3	2.7	3.0	3.4	3.7	4.0	4.3
Ø40	1.5	1.8	2.1	2.5	2.8	3.1	3.4	3.7	4.0

Design values of the ultimate bond resistance f_{bd} in N/mm² for diamond core drilling method for good conditions

Rebar (mm)	Concrete Class								
d_s	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Ø8 - Ø25	1.6	2.0	2.3	2.7	3.0	3.4	3.7	4.0	4.3
Ø28 - Ø32	1.6	2.0	2.3	2.7	2.7	2.7	2.7	2.7	2.7
Ø40	1.5	1.8	2.1	2.5	2.5	2.5	2.5	2.5	2.5

SETTING INSTRUCTION

Dry, wet/damp and water-saturated concrete, hammer drilling method



C-RE (585 ml)
Resealable
Hard Plastic Cartridge



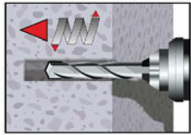
Static Mixing Nozzle



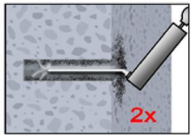
Rebar 500



Property Class 5.8
Property Class 8.8
Stainless Steel A4 - 70

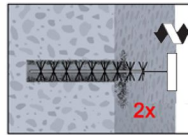


(1) Drill hole with hammerdrill to the required rebar size and depth.

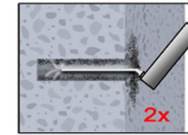


(2a) Manual Cleaning

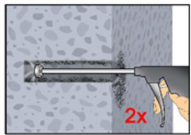
(i) Blow the hole clean with hand pump up to hole diameter 20mm.



(ii) Brush the hole with appropriate size wire brush.

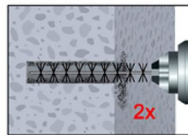


(iii) Blow the hole clean again with hand pump minimum 2 times.

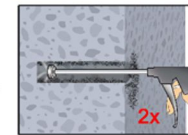


(2b) Compressed air cleaning

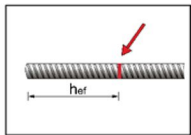
(i) Use compressed air (min. 6 bar) hole diameter >20mm or depth >240mm.



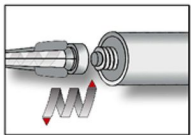
(ii) Attached the appropriate size wire brush to a drilling machine or battery screwdriver



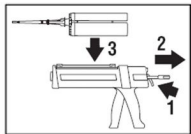
(iii) Blow the hole clean again with compressed air (min. 6 bar).



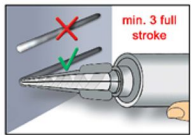
(3) Mark embedment depth on the rebar. The bar should be free of dirt.



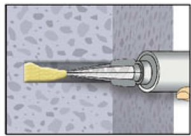
(4) Attached static nozzle to the cartridge.



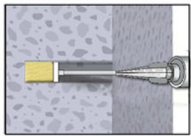
(5) Load the cartridge into dispensing tool.



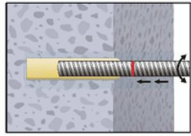
(6) Discard non-uniformly mixed until mortar shows consistent grey colour.



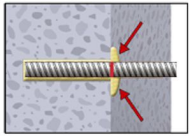
(7) Starting from bottom and back of the cleaned hole fill the hole up to approximately 2/3 with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets.



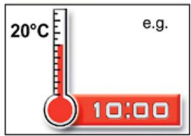
(8) Use piston plug for overhead installation.



(9) Push the rebar into the hole while slightly turning action.



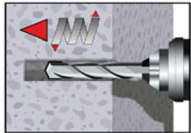
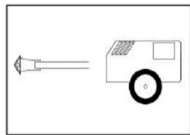
(10) Be sure the rebar is fully embedded and excess mortar is visible.



(11) Allow the adhesive to cure prior to applying any load or torque.

SETTING INSTRUCTION

Water flooded bore hole or submerged concrete, hammer drilling method



(1) Drill hole with hammerdrill to the required rebar size and depth.

C-RE (585 ml)
Resealable
Hard Plastic Cartridge



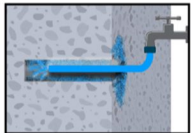
Static Mixing Nozzle



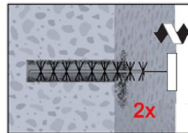
Rebar 500



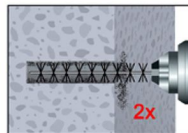
Property Class 5.8
Property Class 8.8
Stainless Steel A4 - 70



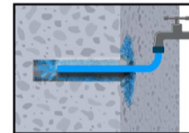
(2a) Rinsing with water until clear water comes out.



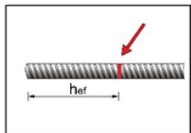
2b(i) Brush the hole with appropriate size wire brush.



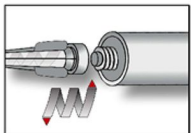
2b(ii) Attached the appropriate size wire brush to a drilling machine or battery screwdriver



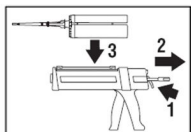
(2c) Rinsing again with water until clear water comes out.



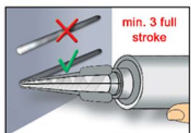
(3) Mark embedment depth on the rebar. The bar should be free of dirt.



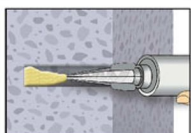
(4) Attached static nozzle to the cartridge.



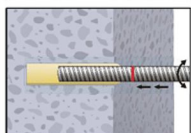
(5) Load the cartridge into dispensing tool.



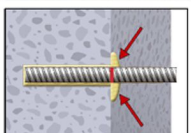
(6) Discard non-uniformly mixed until mortar shows consistent grey colour.



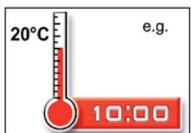
(7) Starting from bottom and back of the cleaned hole fill the hole up to approximately 2/3 with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets.



(8) Push the rebar into the hole while slightly turning action.



(9) Be sure the rebar is fully embedded and excess mortar is visible.



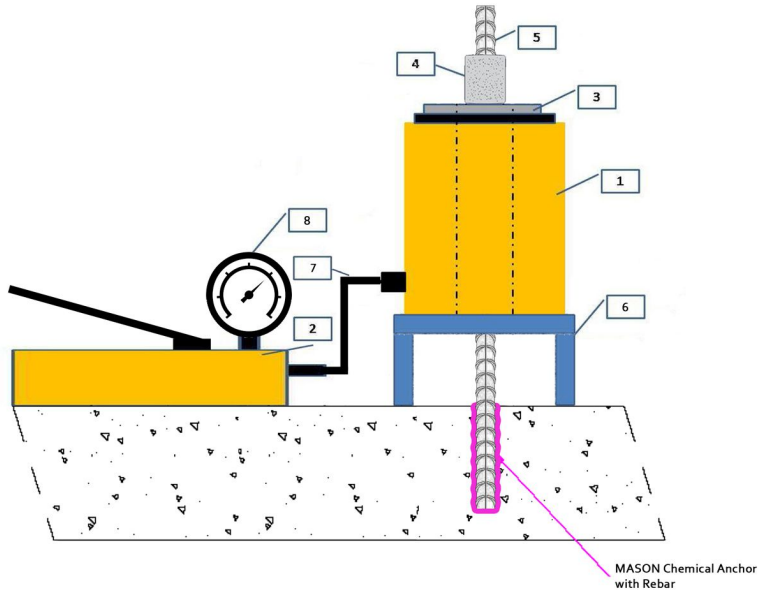
(11) Allow the adhesive to cure prior to applying any load or torque.

Tensile Pull-Out Test Method

- 1) Place the loading frame over the rebar/ threaded rod anchor to be tested.
- 2) For threaded rod testing, connect the coupler with high tensile threaded rod / anchor to be tested.
- 3) Place the suitable hollow plunger cylinder on the frame and through the rebar/ anchor.
- 4) For rebar testing, assemble the rebar wedge c/w wedge blocks on the set up. Apply a firm tap on the wedge to have full engagement of the rebar.
- 5) Connect the hydraulic hand pump, pressure gauge and hose assembly and then check for the leakages.
- 6) Apply the load gradually to the required proof load (design load for non-destructive testing) or ultimate load (for destructive testing).
- 7) Observe the mode of failure.
- 8) Record the achieved load and mode of failure.

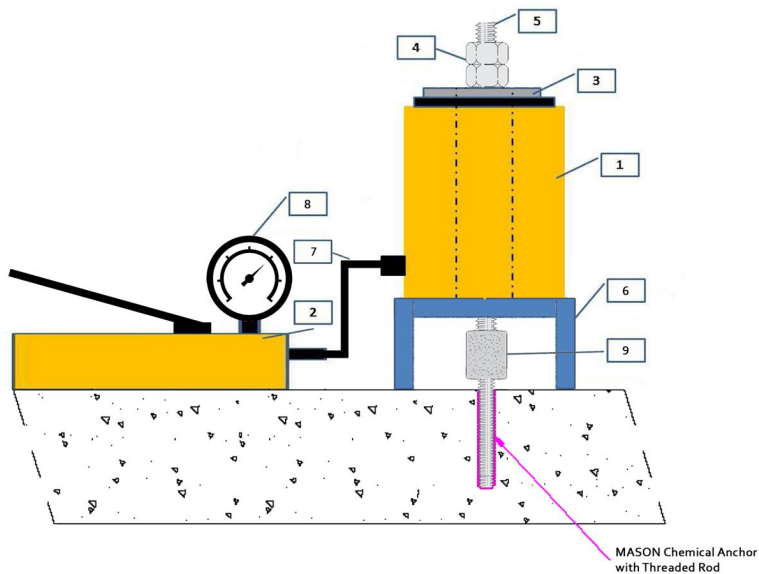
Rebar Testing

Equipment List	Description
1	Center pull hollow plunger cylinder
2	Hydraulic hand pump
3	Metal washer plate
4	Rebar wedges
5	Rebar to be tested
6	Loading frame
7	Hydraulic hose
8	Pressure gauge



Threaded Rod Testing

Equipment List	Description
1	Center pull hollow plunger cylinder
2	Hydraulic hand pump
3	Metal washer plate
4	Nuts
5	High tensile threaded rod
6	Loading frame
7	Hydraulic hose
8	Pressure gauge
9	Threaded rod coupler



Epoxy Technology

The pure epoxy technology is the advanced high performance chemical anchoring technology with an outstanding chemical resistance and industrial strength. Good compound properties achieve outstanding load values, always giving professional solution for specialized applications.

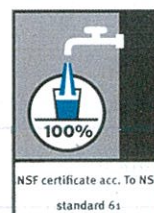
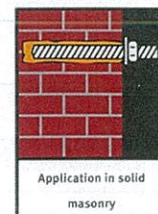
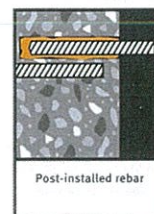
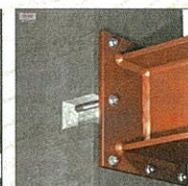
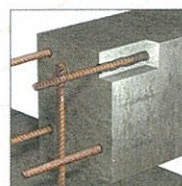
Product Description

MASON® C-RE 585 mortar is a 2-component reaction resin mortar based on a pure epoxy and will be delivered in a exclusive 2-C cartridge system. This high performance product may be used in combination with a hand-, battery-, or pneumatic tool and a static mixer. It was designed especially for the anchoring of threaded rods, reinforcing bars or internal threaded rod sleeves into concrete (also porous and light) as well as solid masonry. Based on the excellent standing behaviour the usability in combination with a special plastic sleeve in hollow material is given. MASON® C-RE 585 mortar product is characterised, by a huge range of applications with an installation temperature from +5°C and a service temperature up to 72°C as well as by high chemical resistance for applications in extreme ambiances e.g. in swimming pools(chlorine) or closeness to the sea(salt). The wide range of certificates, national and international approvals, allows nearly every application.



Special Properties and Benefits

- For heavy anchoring - doweling and post-installed rebar connection
- Hammer drilled and diamond drilled holes possible
- Overhead application; waterfilled bore holes applicable
- Suitable for attachment point close to the edge, since anchoring is free of expansion forces.
- Suitable for dynamic load; Cracked concrete applicable
- High bending- and pressure strength
- Strong and secure anchoring even under water
- Mortar is water-impermeable acc. to DIN EN 12390-8
- Fire resistance and high chemical resistance
- Low shrinkage: ideal for larger annular gap
- Low odour
- Safe for use as a component in a drinking water system
- Flexible working time at elevated temperatures
- Mechanical properties acc. to EN 196 Part 1
 - + Density: 1,41 kg/dm³
 - + Compressive strength: 137 N/mm²
 - + Bending strength: 47 N/mm²
 - + Dynamic modulus of elasticity: 3240 N/mm²
- Resealable cartridge: can be reused up to the end of the shelf life



Approvals and Achievements



European Technical Approval

ETA -14/0206 for C-RE is an European approval acc. to EN 206:2000-12 in cracked and uncracked concrete (Option 1 and 7) for a bonded anchor (injection type) with anchor rod and rebar.



ETA -14/0201 for C-RE is an European approval for post-installed rebar connection acc. to EN 206-1:2000 and Eurocode 2 design method



Centre Scientifique et Technique du Batiment (CSTB) France

C-RE is 4 hrs fire resistance tested by CSTB.



HOUSING & DEVELOPMENT BOARD

HDB Approved Material with Tensile & Shear Test Report (Adopted ETAG 001)



International Code Council-Evaluation Service

ICC-ES for C-RE is an US approval acc. to AC 308 in concrete: ESR-2538 for a bonded anchor(injection type) with anchor rod & rebar.



National Sanitation Foundation

NSF/ANSI Standard 61 recognized C-RE is safe for use as a component in a drinking water system.



LEED and VOC Tested

LEED Green Product and Volatile Organic Compound Tested



SETSCO (Singapore)

Product Performance Verified by SETSCO Ultimate Tensile Pullout Test Report



SIRIM QAS International (Malaysia)

Product Performance Verified by SIRIM Tensile Test Report No.2012CB6972

Reactivity

Temperature of base material	Gelling- and working time	Full curing time in dry base material	Full curing time in wet base material
+5 °C	120 Min.	50 h	100 h
+10 °C	90 Min.	30 h	60 h
+20 °C	30 Min.	10 h	20 h
+30 °C	20 Min.	6 h	12 h
+40 °C	12 Min.	4 h	8 h

Application and Intended Use

➤ Base materials:

cracked concrete, non-cracked concrete, light-concrete, porous-concrete, solid masonry, natural stone; hammer drilled and diamond drilled holes

➤ Anchor elements:

Threaded rods (zinc plated or hot dip, stainless steel and high corrosion resistance steel), reinforcing bars, internal threaded rods, profiled rod, steel section with undercuts (e.g. perforated section)

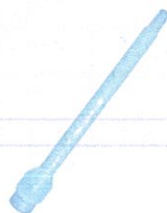
➤ Temperature range:

+5 °C up to +40 °C temperature of the base material; cartridge temperature min.+5 °C; optimal +20 °C; -40 °C to +72 °C base material temperature after full curing

Product Accessories



C-RE 385 ml C-RE 585 ml
(Pure Epoxy 3:1)



Special Static Nozzle



Universal Dispenser



Blower



Plastic/ Steel Wire Brush



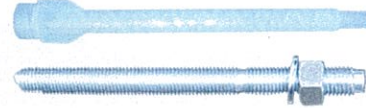
Threaded Rod
(Chemical Bolt & Nut)

CRE-585 with Threaded Rod

- High strength Pure Epoxy
- High viscosity - Ideal for overhead application
- Non-shrinkage - Ideal for larger annular gaps
- Cracked concrete applicable
- Suitable for Seismic action performance
- Suitable for dry, wet and water filled holes
- Underwater holes applicable
- Long working time in hot weather
- Outstanding chemical resistant
- Odourless pure epoxy

C-RE 585 (585 ml)
C-RE 585 (385 ml)
Resealable
Hard Plastic Cartridge

Static Mixing Nozzle
Property Class 4.6/4.8
Property Class 5.8
Property Class 8.8
Stainless Steel A4 - 70



European Technical Approval
ETA-14/0206

HDB Approved Material

SETSCO Tested

4 Hours Fire Resistance
Report No. 26050230

SIRIM QAS Malaysia Tested

KMITL Thailand Tested

French VOC Tested

LEED Tested

Concrete

ETA Option 7
Non-cracked Concrete

ETA Option 1
Cracked Concrete

Masonry

Fire Resistance
F240

Close Edge & Spacing

High Load

ETA Seismic Design C1

Chemical Resistance

Design Software

SETTING PROCEDURES

(1) Drill hole with hammer drill to the required anchor size and depth.

(2a) Blow the hole clean with hand pump up to hole diameter 20mm.

(2b) Use compressed air (min. 6 bar) hole diameter >20mm or depth >240mm.

(3) Brush the hole with appropriate size wire brush.

(4a) Blow the hole clean again with hand pump minimum 2 times.

(4b) Blow the hole clean again with compressed air (min. 6 bar).

(5) Attached static nozzle and load the cartridge into dispensing tool.

(6) Mark embedment depth on the anchor rod.

(7) Discard non-uniformly mixed until mortar shows consistent grey colour.

(8) Fill the hole up to approximately 2/3 with adhesive.

(9) Push the threaded rod into the hole while slightly turning action.

(10) Be sure the anchor is fully embedded and excess mortar is visible.

(11) Allow the adhesive to cure prior to applying any load or torque.

(12) After full curing add-on part can be installed with specified torque.

SETTING PARAMETERS

Threaded Rod Size			M8	M10	M12	M16	M20	M24	M27	M30	M39
Threaded rod diameter	d	(mm)	8	10	12	16	20	24	27	30	39
Drill bit diameter	d ₀	(mm)	10	12	14	18	24	28	32	35	46
Effective Anchorage Depth	h _{ef}	(mm)	80	90	110	125	170	210	250	270	350
Min. Base Material Thickness	h _{min}	(mm)	h _{ef} + 30mm ≥ 100mm			h _{ef} + 2d ₀					
Minimum edge distance	c _{min}	(mm)	40	50	60	80	100	120	135	150	195
Critical edge distance	c _{cr}	(mm)	113	135	165	188	255	304	342	379	472
Minimum spacing distance	s _{min}	(mm)	40	50	60	80	100	120	135	150	195
Critical spacing distance	s _{cr}	(mm)	226	270	330	375	510	607	683	759	945
Installation torque	T _{inst.}	(Nm)	10	20	40	60	120	150	200	250	350
Consumption per hole	Vol.	(ml)	5.1	8.2	13.6	25.6	61.8	104.0	161.7	208.9	467.7

CRE-585 with Threaded Rod

Basic Loading Data For Single Anchor

- Concrete C20/25, $f_{ck,cube} = 25 \text{ N/mm}^2$
- Correct setting as setting procedures and parameters
- No spacing and edge distance influence
- Steel failure
- Base material temperature range I: -40°C to $+40^\circ \text{C}$ (max. long term temperature $+24^\circ \text{C}$ & max. short term temperature $+40^\circ \text{C}$)

Tensile Resistance

Threaded Rod 5.8 Size		M8	M10	M12	M16	M20	M24	M27	M30	M39
Non Cracked Concrete										
Ultimate Strength	$N_{Ru,m}$ (kN)	19.1	33.9	49.8	84.8	128.2	186.9	243.9	298.2	488.9
Characteristic Strength	N_{Rk} (kN)	18.1	32.2	47.3	72.1	111.5	155.1	190.2	223.7	342.2
Design Strength	N_{Rd} (kN)	12.1	21.5	31.5	34.3	53.1	73.9	90.6	106.5	163.0
Recommended Strength	N_{Rec} (kN)	8.6	15.4	22.5	24.5	37.9	52.8	64.7	76.1	116.4
Cracked Concrete										
Ultimate Strength	$N_{Ru,m}$ (kN)	17.1	24.1	35.5	64.1	105.8	146.4	178.1	213.9	244.4
Characteristic Strength	N_{Rk} (kN)	16.2	22.9	33.7	44.9	74.1	109.8	133.6	160.4	195.5
Design Strength	N_{Rd} (kN)	9.0	12.7	18.7	21.4	35.3	52.3	63.6	76.4	93.1
Recommended Strength	N_{Rec} (kN)	6.4	9.1	13.4	15.3	25.2	37.4	45.4	54.6	66.5

$N_{Rd} = N_{Rk} / \gamma_{Mc,N}$ [Safety Factor for concrete, $\gamma_{Mc,N} = 1.5$ (Non cracked), 1.8 (Cracked) for M8 ~ M12] [$\gamma_{Mc,N} = 2.1$ for M16 ~ M39]

$N_{Rec} = N_{Rd} / \gamma_F$ [Safety Factor for load action, $\gamma_F = 1.4$]

Shear Resistance

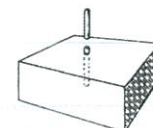
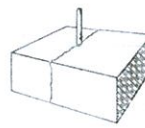
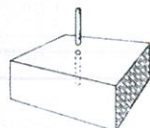
Threaded Rod 5.8 Size		M8	M10	M12	M16	M20	M24	M27	M30	M39
Non Cracked and Cracked Concrete										
Ultimate Strength	$V_{Ru,m}$ (kN)	9.5	15.8	22.1	41.0	64.1	92.4	120.8	147.0	256.2
Characteristic Strength	V_{Rk} (kN)	9.0	15.0	21.0	39.0	61.0	88.0	115.0	140.0	244.0
Design Strength	V_{Rd} (kN)	7.2	12.0	16.8	31.2	48.8	70.4	92.0	112.0	195.2
Recommended Strength	V_{Rec} (kN)	5.1	8.6	12.0	22.3	34.9	50.3	65.7	80.0	139.4

$V_{Rd} = V_{Rk} / \gamma_{Ms,V}$ [Safety Factor for steel, $\gamma_{Ms,V} = 1.25$]

$V_{Rec} = V_{Rd} / \gamma_F$ [Safety Factor for load action, $\gamma_F = 1.4$]

TENSILE - Concrete Capacity CC Design Method

Design tensile resistance $N_{Rd} = \min (N_{Rd,p} ; N_{Rd,c} ; N_{Rd,sp} ; N_{Rd,s})$



$$N_{Rd,p} = N_{Rd,p}^0 * f_B$$

$$N_{Rd,c} = N_{Rd,c}^0 * f_{1,N} * f_{2,N} * f_{3,N} * f_B * f_{hef}$$

$$N_{Rd,sp} = N_{Rd,c}^0 * f_{1,sp} * f_{2,sp} * f_{3,sp} * f_B * f_{hef}$$

$$N_{Rd,s}$$

Design Combined Pull-out and Concrete Cone Resistance, $N_{Rd,p}$

Threaded Rod Size		M8	M10	M12	M16	M20	M24	M27	M30	M39
$N_{Rd,p}^0$ Non Cracked Concrete	(kN)	16.7	23.3	34.4	48.9	77.2	105.5	141.1	176.1	284.4
$N_{Rd,p}^0$ Cracked Concrete	(kN)	8.6	13.8	20.0	28.0	38.1	52.3	67.9	80.5	127.0

CRE-585 with Threaded Rod

Design Concrete Cone Resistance, $N_{Rd,c}$

Design Splitting Resistance, $N_{Rd,sp}$

Threaded Rod Size		M8	M10	M12	M16	M20	M24	M27	M30	M39
$N_{Rd,c}$ Non Cracked Concrete	(kN)	17.2	22.3	28.1	33.8	51.9	70.9	87.9	103.7	169.8
$N_{Rd,c}$ Cracked Concrete	(kN)	13.8	16.6	24.0	25.2	34.3	49.7	61.1	72.5	101.6

Design Steel Resistance, $N_{Rd,s}$

Threaded Rod Size		M8	M10	M12	M16	M20	M24	M27	M30	M39
$N_{Rd,s}$ (property class 4.6/4.8)	(kN)	9.8	15.5	22.5	41.9	65.3	94.1	122.4	149.6	260.3
$N_{Rd,s}$ (property class 5.8)	(kN)	12.0	19.3	28.0	52.0	81.3	117.3	153.3	186.7	325.3
$N_{Rd,s}$ (property class 8.8)	(kN)	19.3	30.7	44.7	83.3	130.7	188.0	245.3	299.3	520.7
$N_{Rd,s}$ (stainless steel A4-70)	(kN)	13.9	21.9	31.5	58.8	92.0	132.1	112.2	137.4	182.2

INFLUENCING FACTORS

Influence of Concrete Strength

Concrete Strength Designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = \sqrt{f_{ck,cube} / 25 \text{ N/mm}^2}$	1.00	1.10	1.22	1.34	1.41	1.48	1.55

$f_{ck,cube}$ = 150mm concrete cube compressive strength

Influence of edge distance¹⁾

c/c_{cr}	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
$f_{1,N} = 0.7 + 0.3 \cdot c/c_{cr} = 1$	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00
$f_{1,sp} = 0.7 + 0.3 \cdot c/c_{cr} = 1$										
$f_{2,N} = 0.5 \cdot (1 + c/c_{cr}) = 1$	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
$f_{2,sp} = 0.5 \cdot (1 + c/c_{cr}) = 1$										

1) The above influencing factors must apply for every edge distance smaller than critical edge distance c_{cr} . Actual edge distance shall not be smaller than minimum edge distance c_{min} .

Influence of anchor spacing²⁾

s/s_{cr}	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
$f_{3,N} = 0.5 \cdot (1 + s/s_{cr,N}) = 1$	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
$f_{3,sp} = 0.5 \cdot (1 + s/s_{cr,sp}) = 1$										

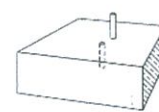
2) The above influencing factors must apply for every anchor spacing smaller than critical spacing distance s_{cr} . Actual anchor spacing distance shall not be smaller than minimum spacing distance s_{min} .

Influence of anchorage depth

f_{hef}	$f_{hef} = (h_{act} / h_{ef})^{1.5}$
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SHEAR - Concrete Capacity CC Design Method

Design shear resistance $V_{Rd} = \min(V_{Rd,c}; V_{Rd,cp}; V_{Rd,s})$



$$V_{Rd,c} = V_{Rd,c}^0 \cdot f_{\beta} \cdot f_{sc} \cdot f_B \cdot f_{hef}$$

$$V_{Rd,cp} = \text{lower value of } k \cdot N_{Rd,p} \text{ and } k \cdot N_{Rd,c}$$

$$V_{Rd,s}$$

CRE-585 with Threaded Rod

Design Concrete Edge Resistance, $V_{Rd,c}$

Threaded Rod Size			M8	M10	M12	M16	M20	M24	M27	M30	M39
$V_{Rd,c}$	Non Cracked Concrete	(kN)	5.3	8.8	11.2	17.3	27.1	35.2	43.8	53.3	81.3
$V_{Rd,c}$	Cracked Concrete	(kN)	4.1	6.7	8.0	12.3	19.3	23.5	29.2	35.5	50.8

Design Concrete Pryout Resistance, $V_{Rd,cp}$

$V_{Rd,cp}$ = lower value of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$	$k = 1$ for $h_{ef} < 60\text{mm}$ $k = 2$ for $h_{ef} \geq 60\text{mm}$
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Design Steel Resistance, $V_{Rd,s}$

Threaded Rod Size			M8	M10	M12	M16	M20	M24	M27	M30	M39
$V_{Rd,s}$	(property class 4.6/4.8)	(kN)	5.9	9.3	13.5	25.1	39.2	56.5	73.4	89.8	156.2
$V_{Rd,s}$	(property class 5.8)	(kN)	7.2	12.0	16.8	31.2	48.8	70.4	92.0	112.0	195.2
$V_{Rd,s}$	(property class 8.8)	(kN)	12.0	18.4	27.2	50.4	78.4	112.8	147.2	179.2	312.0
$V_{Rd,s}$	(stainless steel A4-70)	(kN)	8.3	12.8	19.2	35.3	55.1	79.5	48.3	58.8	102.5

INFLUENCING FACTORS

Influence of Concrete Strength

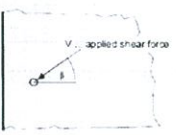
Concrete Strength Designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = \sqrt{f_{ck,cube} / 25\text{N/mm}^2}$	1.00	1.10	1.22	1.34	1.41	1.48	1.55

$f_{ck,cube}$ = 150mm concrete cube compressive strength

Influence of anchorage depth

f_{hef}	$f_{hef} = (h_{act} / h_{ef})^{1.5}$
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Influence of shear loading angle

Angle β	0°	10°	20°	30°	40°	50°	60°	70°	80°	=90°
f_β 	1.00	1.01	1.05	1.13	1.24	1.40	1.64	1.97	2.32	2.50

Influence of anchoring spacing and edge distance for concrete edge resistance

Formula for single-anchor fastening influenced only by edge

$$f_{sc} = \frac{c}{c_{min}} \sqrt{\frac{c}{c_{min}}}$$

For Single Anchor

C/C_{min}	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
f_{sc}	1.0	1.3	1.7	2.0	2.4	2.8	3.3	3.7	4.2	4.7	5.2	5.7	6.3	6.8	7.4	8.0

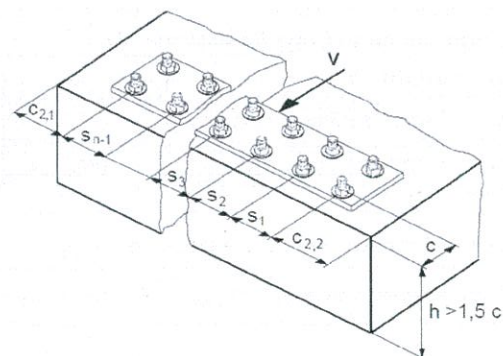
CRE-585 with Threaded Rod

Formula for two-anchor fastening valid for $S < 3c$

$$f_{sc} = \frac{3c+s}{6c_{min}} \sqrt{\frac{c}{c_{min}}}$$

General formula for n-anchor fastening (edge plus n-1 spacing)
only valid where s_1 to s_{n-1} are all $< 3c$ and $c_2 > 1.5c$

$$f_{sc} = \frac{3c + s_1 + s_2 + \dots + s_{n-1}}{3nc_{min}} \sqrt{\frac{c}{c_{min}}}$$



Note: It is assumed that only the row of anchors closed to the free concrete edge carries the centric shear load.

For 2 anchors

C/C _{min}	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16	3.44	3.73	4.03	4.33
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31	3.60	3.89	4.19	4.50
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.13	2.38	2.63	2.90	3.18	3.46	3.75	4.05	4.35	4.67
2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61	3.90	4.21	4.52	4.83
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76	4.06	4.36	4.68	5.00
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91	4.21	4.52	4.84	5.17
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05	4.36	4.68	5.00	5.33
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20	4.52	4.84	5.17	5.50
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35	4.67	5.00	5.33	5.67
5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50	4.82	5.15	5.49	5.83
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65	4.98	5.31	5.65	6.00
6.5							3.24	3.54	3.84	4.16	4.47	4.80	5.13	5.47	5.82	6.17
7.0								3.67	3.98	4.29	4.62	4.95	5.29	5.63	5.98	6.33
7.5									4.11	4.43	4.76	5.10	5.44	5.79	6.14	6.50
8.0										4.57	4.91	5.25	5.59	5.95	6.30	6.67
8.5											5.05	5.40	5.75	6.10	6.47	6.83
9.0											5.20	5.55	5.90	6.26	6.63	7.00
9.5												5.69	6.05	6.42	6.79	7.17
10.0													6.21	6.58	6.95	7.33
10.5														6.74	7.12	7.50
11.0															7.28	7.67
11.5																7.83
12.0																8.00

COMBINED LOAD - Tension and Shear

$\beta_N = N_{sd} / N_{Rd} \leq 1$ (N_{sd} = Tensile design action)

$\beta_V = V_{sd} / V_{Rd} \leq 1$ (V_{sd} = Shear design action)

Design check: $\beta_N + \beta_V \leq 1.2$ or $\beta_N^\alpha + \beta_V^\alpha \leq 1$ ($\alpha = 1.5$ for all failure mode)

CRE-585 with Threaded Rod

Basic Loading Data With Variable Embedment Depth For Single Anchor

- Non cracked concrete G40, $f_{ck,cube} = 40 \text{ N/mm}^2$
- Threaded rod property class 5.8, Tensile Strength $f_{uk,s} = 500 \text{ N/mm}^2$
- Correct setting as setting procedures
- No spacing and edge distance influence
- Steel failure
- Base material temperature range I: -40°C to $+40^\circ\text{C}$

- Influence of concrete strength = 1.22
- Min. Edge distance = 5ϕ
- Min. Spacing distance = 5ϕ
- Partial safety factor for steel = 1.5
- Partial safety factor for bond = 1.8

Threaded Rod Size	ϕ	mm	M8	M10	M12	M16	M20	M24	M27	M30	M39
Drilled Hole (mm)	d_0	mm	10	12	14	18	24	28	32	35	46
Cross-Section Area	A_s	mm ²	36.6	58.0	84.3	157.0	245.0	353.0	459.0	561.0	976.0
Char. Steel Strength	$N_{Rk,s}$	kN	18.0	29.0	42.0	78.0	122.0	176.0	230.0	280.0	488.0
Design Steel Strength	$N_{Rd,s}$	kN	12.0	19.3	28.0	52.0	81.3	117.3	153.3	186.7	325.3
Edge Distance	c	mm	40	50	60	80	100	120	135	150	200
Spacing Distance	s	mm	40	50	60	80	100	120	135	150	200
Design Tensile Loads (kN)	Effective Embedment Depth, h_{ef}	60	mm	9.8	15.4						
		70	mm	11.4	18.0	21.6					
		75	mm	12.2	19.3	23.1					
		80	mm	13.0	20.5	24.7	36.8				
		90	mm	14.6	23.1	27.7	41.4	46.2			
		100	mm	16.3	25.7	30.8	46.0	51.4	60.7		
		110	mm	17.9	28.3	33.9	50.6	56.5	66.8	72.9	
		115	mm		29.5	35.4	52.9	59.1	69.8	76.2	
		120	mm		30.8	37.0	55.2	61.6	72.9	79.5	86.9
		125	mm			38.5	57.5	64.2	75.9	82.8	90.6
		130	mm			40.1	59.8	66.8	78.9	86.1	94.2
		140	mm			43.1	64.4	71.9	85.0	92.7	101.4
		150	mm				69.0	77.0	91.1	99.4	108.7
		160	mm				73.6	82.2	97.1	106.0	115.9
		170	mm				78.2	87.3	103.2	112.6	123.2
		175	mm					89.9	106.3	115.9	126.8
		180	mm					92.5	109.3	119.2	130.4
		195	mm					100.2	118.4	129.2	141.3
		200	mm					102.7	121.4	132.5	144.9
		210	mm					107.9	127.5	139.1	152.1
		240	mm					123.3	145.7	159.0	173.9
		250	mm						151.8	165.6	181.1
		260	mm						157.9	172.2	188.4
		280	mm						170.0	185.5	202.9
		290	mm						176.1	192.1	210.1
		300	mm							198.7	217.3
		350	mm							231.8	253.6
		380	mm								275.3
		400	mm								289.8
		450	mm								390.2
		500	mm								433.5
		550	mm								476.9
		565	mm								489.9

CRE-585 with Threaded Rod

Basic Loading Data With Variable Embedment Depth For Single Anchor

- Non cracked concrete G40, $f_{ck,cube} = 40 \text{ N/mm}^2$
- Threaded rod property class 8.8, Tensile Strength $f_{uk,s} = 800 \text{ N/mm}^2$
- Correct setting as setting procedures
- No spacing and edge distance influence
- **Steel failure**
- Base material temperature range I: -40°C to $+40^\circ\text{C}$

- Influence of concrete strength = 1.22
- Min. Edge distance = 5ϕ
- Min. Spacing distance = 5ϕ
- Partial safety factor for steel = 1.5
- Partial safety factor for bond = 1.8

Threaded Rod Size	ϕ	mm	M8	M10	M12	M16	M20	M24	M27	M30	M39
Drilled Hole (mm)	d_0	mm	10	12	14	18	24	28	32	35	46
Cross-Section Area	A_s	mm ²	36.6	58.0	84.3	157.0	245.0	353.0	459.0	561.0	976.0
Char. Steel Strength	$N_{Rk,s}$	kN	29.3	46.4	67.4	125.6	196.0	282.4	367.2	448.8	780.8
Design Steel Strength	$N_{Rd,s}$	kN	19.5	30.9	45.0	83.7	130.7	188.3	244.8	299.2	520.5
Edge Distance	c	mm	40	50	60	80	100	120	135	150	200
Spacing Distance	s	mm	40	50	60	80	100	120	135	150	200
Design Tensile Loads (kN)	Effective Embedment Depth, h_{ef}	60	mm	9.8	15.4						
		70	mm	11.4	18.0	21.6					
		80	mm	13.0	20.5	24.7	36.8				
		90	mm	14.6	23.1	27.7	41.4	46.2			
		100	mm	16.3	25.7	30.8	46.0	51.4	60.7		
		110	mm	17.9	28.3	33.9	50.6	56.5	66.8	72.9	
		115	mm	18.7	29.5	35.4	52.9	59.1	69.8	76.2	83.3
		125	mm	20.3	32.1	38.5	57.5	64.2	75.9	82.8	90.6
		146	mm	23.7	37.5	45.0	67.2	75.0	88.6	96.7	105.8
		150	mm	24.4	38.5	46.2	69.0	77.0	91.1	99.4	108.7
		160	mm	26.0	41.1	49.3	73.6	82.2	97.1	106.0	115.9
		170	mm	27.6	43.7	52.4	78.2	87.3	103.2	112.6	123.2
		180	mm	29.3	46.2	55.5	82.8	92.5	109.3	119.2	130.4
		200	mm			61.6	92.0	102.7	121.4	132.5	144.9
		210	mm			64.7	96.6	107.9	127.5	139.1	152.1
		220	mm			67.8	101.2	113.0	133.6	145.7	159.4
		250	mm				115.0	128.4	151.8	165.6	181.1
		260	mm				119.6	133.6	157.9	172.2	188.4
		280	mm				128.8	143.8	170.0	185.5	202.9
		300	mm					154.1	182.2	198.7	217.3
		310	mm					159.2	188.2	205.3	224.6
		350	mm					179.8	212.5	231.8	253.6
		360	mm					184.9	218.6	238.5	260.8
		370	mm					190.1	224.7	245.1	268.1
		385	mm					197.8	233.8	255.0	278.9
		400	mm						242.9	265.0	289.8
		415	mm						252.0	274.9	300.7
		450	mm						273.2	298.1	326.0
		470	mm						285.4	311.3	340.5
		500	mm							331.2	362.2
		555	mm							367.6	402.1
		600	mm								434.7
		620	mm								449.2
		650	mm								563.6
		700	mm								607.0*
		800	mm								693.7*
		900	mm								780.4*

*Test Load Cell limits at 600kN

CRE-585 with Threaded Rod

Basic Loading Data With Variable Embedment Depth For Single Anchor

- Non cracked concrete G45, $f_{ck,cube} = 45 \text{ N/mm}^2$
- Threaded rod property class 8.8, Tensile Strength $f_{uk,s} = 800 \text{ N/mm}^2$
- Correct setting as setting procedures
- No spacing and edge distance influence
- **Steel failure**
- Base material temperature range I: -40°C to $+40^\circ\text{C}$

- Influence of concrete strength = 1.34
- Min. Edge distance = 5ϕ
- Min. Spacing distance = 5ϕ
- Partial safety factor for steel = 1.5
- Partial safety factor for bond = 1.8

Threaded Rod Size	ϕ	mm	M8	M10	M12	M16	M20	M24	M27	M30	M39
Drilled Hole (mm)	d_0	mm	10	12	14	18	24	28	32	35	46
Cross-Section Area	A_s	mm ²	36.6	58.0	84.3	157.0	245.0	353.0	459.0	561.0	976.0
Char. Steel Strength	$N_{Rk,s}$	kN	29.3	46.4	67.4	125.6	196.0	282.4	367.2	448.8	780.8
Design Steel Strength	$N_{Rd,s}$	kN	19.5	30.9	45.0	83.7	130.7	188.3	244.8	299.2	520.5
Edge Distance	c	mm	40	50	60	80	100	120	135	150	200
Spacing Distance	s	mm	40	50	60	80	100	120	135	150	200
Design Tensile Loads (kN)	Effective Embedment Depth, h_{ef}	60	mm	10.7	16.9						
		70	mm	12.5	19.7	23.7					
		80	mm	14.3	22.6	27.1	40.4				
		90	mm	16.1	25.4	30.5	45.5	50.8			
		100	mm	17.9	28.2	33.9	50.5	56.4	66.7		
		110	mm	19.6	31.0	37.2	55.6	62.1	73.4	80.0	
		125	mm	22.3	35.3	42.3	63.2	70.5	83.4	90.9	99.5
		135	mm	24.1	38.1	45.7	68.2	76.2	90.0	98.2	107.4
		150	mm	26.8	42.3	50.8	75.8	84.6	100.0	109.1	119.4
		160	mm	28.6	45.1	54.2	80.8	90.3	106.7	116.4	127.3
		165	mm	29.5	46.5	55.9	83.4	93.1	110.0	120.0	131.3
		170	mm			57.5	85.9	95.9	113.4	123.7	135.3
		180	mm			60.9	90.9	101.6	120.0	131.0	143.2
		200	mm			67.7	101.0	112.8	133.4	145.5	159.1
		210	mm				106.1	118.5	140.1	152.8	167.1
		235	mm				118.7	132.6	156.7	171.0	187.0
		250	mm				126.3	141.0	166.7	181.9	198.9
		260	mm					146.7	173.4	189.2	206.9
		280	mm					158.0	186.7	203.7	222.8
		300	mm					169.3	200.1	218.3	238.7
		340	mm					191.8	226.7	247.4	270.6
		350	mm					197.5	233.4	254.6	278.5
		360	mm						240.1	261.9	286.5
		370	mm						246.8	269.2	294.4
		376	mm						250.8	273.6	299.2
		380	mm						253.4	276.5	302.4
		400	mm						266.8	291.0	318.3
		425	mm						283.4	309.2	338.2
		450	mm							327.4	358.1
		470	mm							341.9	374.0
		500	mm							363.8	397.9
		505	mm							367.4	401.9
		545	mm								433.7
		565	mm								449.6
		650	mm								619.0*
		700	mm								666.7*
		800	mm								761.9*
		820	mm								780.9*

*Test Load Cell limits at 600kN

CRE-585 with Rebar

- High strength pure epoxy
- High viscosity - Ideal for overhead application
- Non-shrinkage - Ideal for larger annular gaps
- Cracked concrete applicable
- Suitable for Seismic action performance
- Suitable for dry, wet and water filled holes
- Underwater holes applicable
- Long working time in hot weather
- Outstanding chemical resistant
- Odourless pure epoxy

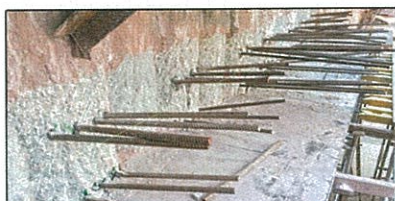
C-RE 585 (585 ml)
C-RE 585 (385 ml)
Resealable
Hard Plastic Cartridge



Static Mixing Nozzle



Rebar FE460
Rebar Grade 500



European Technical Approval
ETA-14/0206
ETA-14/0201 (Rebar)

HDB Approved Material

SETSCO Tested

4 Hours Fire Resistance
Report No. 26050230

SIRIM QAS Malaysia Tested

KMITL Thailand Tested

French VOC Tested

LEED Tested

Concrete

ETA Option 7
Non-cracked Concrete

ETA Option 1
Cracked Concrete

ETA Post-Installed Rebar
Approved

Fire Resistance

Close Edge & Spacing

High Load

ETA Seismic Design C1

Chemical Resistance

Design Software

SETTING PROCEDURES

(1) Drill hole with hammer drill to the required rebar size and depth.

(2a) Blow the hole clean with hand pump up to hole diameter 20mm.

(2b) Use compressed air (min. 6 bar) hole diameter >20mm or depth >240mm.

(3) Brush the hole with appropriate size wire brush.

(4a) Blow the hole clean again with hand pump minimum 2 times.

(4b) Blow the hole clean again with compressed air (min. 6 bar).

(5) Attached static nozzle and load the cartridge into dispensing tool.

(6) Mark embedment depth on the rebar. The bar should be free of dirt.

(7) Discard non-uniformly mixed until mortar shows consistent grey colour.

(8) Fill the hole up to approximately 2/3 with adhesive.

(9) Use piston plug for overhead installation.

(10) Push the rebar into the hole while slightly turning action.

(11) Be sure the rebar is fully embedded and excess mortar is visible.

(12) Allow the adhesive to cure prior to applying any load or torque.

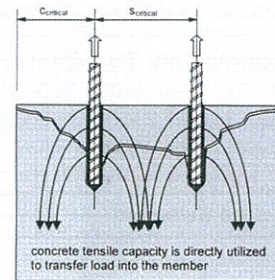
SETTING PARAMETERS

Rebar Size			Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
Rebar diameter	d	(mm)	8	10	13	16	20	25	28	32	40
Drill bit diameter	d ₀	(mm)	12	14	16	20	25	32	35	40	50
Effective Anchorage Depth	h _{ef}	(mm)	80	90	115	125	170	210	250	300	350
Min. Base Material Thickness	h _{min}	(mm)	h _{ef} + 30mm ≥ 100mm			h _{ef} + 2d ₀					
Minimum edge distance	c _{min}	(mm)	40	50	70	80	100	125	140	160	200
Critical edge distance	c _{cr}	(mm)	97	121	170	180	219	274	298	330	413
Minimum spacing distance	s _{min}	(mm)	40	50	70	80	100	125	140	160	200
Critical spacing distance	s _{cr}	(mm)	194	242	339	360	438	548	596	661	826
Consumption per hole	Vol.	(ml)	7.3	11.1	18.6	31.6	67.1	135.8	193.4	303.1	552.5

CRE-585 with Rebar

Basic Loading Data For Single Rebar

- Concrete C20/25, $f_{ck,cube} = 25 \text{ N/mm}^2$
- Correct setting as setting procedures and parameters
- No spacing and edge distance influence
- Steel failure
- Base material temperature range I: -40°C to $+40^\circ\text{C}$
(max. long term temperature $+24^\circ\text{C}$ & max. short term temperature $+40^\circ\text{C}$)



Tensile Resistance

Rebar Grade 500		Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
Non Cracked Concrete										
Ultimate Strength	$N_{Ru,m}$ (kN)	30.2	42.5	79.0	96.0	146.8	216.4	281.8	347.8	450.9
Characteristic Strength	N_{Rk} (kN)	28.7	40.4	67.1	81.6	117.4	173.1	219.8	271.3	351.7
Design Strength	N_{Rd} (kN)	16.0	22.5	37.3	38.9	55.9	82.4	104.7	129.2	167.5
Recommended Strength	N_{Rec} (kN)	11.4	16.0	26.6	27.8	39.9	58.9	74.8	92.3	119.6
Cracked Concrete										
Ultimate Strength	$N_{Ru,m}$ (kN)	23.0	32.3	53.6	62.8	103.7	153.1	204.1	258.4	302.2
Characteristic Strength	N_{Rk} (kN)	16.1	22.6	37.6	44.0	72.6	107.2	142.9	180.9	241.8
Design Strength	N_{Rd} (kN)	8.9	12.6	20.9	20.9	34.6	51.0	68.0	86.1	115.1
Recommended Strength	N_{Rec} (kN)	6.4	9.0	14.9	15.0	24.7	36.4	48.6	61.5	82.2

$$N_{Rd} = N_{Rk} / \gamma_{Mc,N} \quad [\text{Safety Factor for concrete, } \gamma_{Mc,N} = 1.8 \text{ for T8 ~ T13}] \quad [\gamma_{Mc,N} = 2.1 \text{ for T16 ~ T40}]$$

$$N_{Rec} = N_{Rd} / \gamma_F \quad [\text{Safety Factor for load action, } \gamma_F = 1.4]$$

Shear Resistance

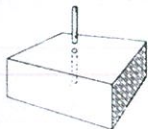
Rebar Grade 500		Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
Non Cracked Concrete and Cracked Concrete										
Ultimate Strength	$V_{Ru,m}$ (kN)	14.5	22.7	38.3	58.1	90.7	141.7	177.8	232.3	362.9
Characteristic Strength	V_{Rk} (kN)	13.8	21.6	36.5	55.3	86.4	135.0	169.3	221.2	345.7
Design Strength	V_{Rd} (kN)	9.2	14.4	24.3	36.9	57.6	90.0	112.9	147.4	230.5
Recommended Strength	V_{Rec} (kN)	6.6	10.3	17.4	26.3	41.1	64.3	80.6	105.3	164.6

$$V_{Rd} = V_{Rk} / \gamma_{Ms,V} \quad [\text{Safety Factor for steel, } \gamma_{Ms,V} = 1.5]$$

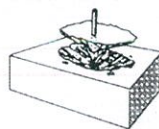
$$V_{Rec} = V_{Rd} / \gamma_F \quad [\text{Safety Factor for load action, } \gamma_F = 1.4]$$

TENSILE - Concrete Capacity CC Design Method

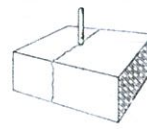
$$\text{Design tensile resistance } N_{Rd} = \min(N_{Rd,p}; N_{Rd,c}; N_{Rd,sp}; N_{Rd,s})$$



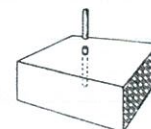
$$N_{Rd,p} = N_{Rd,p}^0 \cdot f_B$$



$$N_{Rd,c} = N_{Rd,c}^0 \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_B \cdot f_{hef}$$



$$N_{Rd,sp} = N_{Rd,c}^0 \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_B \cdot f_{hef}$$



$$N_{Rd,s}$$

Design Pull-out Resistance, $N_{Rd,p}$

Rebar Size		Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
$N_{Rd,p}^0$ Non Cracked Concrete	(kN)	15.6	22.0	33.9	42.7	71.6	108.9	138.6	190.0	268.3
$N_{Rd,p}^0$ Cracked Concrete	(kN)	8.9	12.6	20.9	20.9	34.6	51.0	68.0	86.1	115.1

CRE-585 with Rebar

Design Concrete Cone Resistance, $N_{Rd,c}$

Design Splitting Resistance, $N_{Rd,sp}$

Rebar Size		Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
$N_{Rd,c}$ Non Cracked Concrete	(kN)	17.2	22.0	33.9	35.6	55.1	77.8	106.6	126.7	167.7
$N_{Rd,c}$ Cracked Concrete	(kN)	12.2	15.7	24.2	25.4	39.3	55.6	76.1	90.5	119.8

Design Steel Resistance, $N_{Rd,s}$

Rebar Size		Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
$N_{Rd,s}$ (FE460 87%)	(kN)	20.1	31.4	53.1	80.5	125.7	196.4	246.5	321.9	502.9
$N_{Rd,s}$ (Grade 500)	(kN)	20.0	30.7	52.2	79.3	123.6	192.9	242.1	315.7	493.6

INFLUENCING FACTORS

Influence of Concrete Strength

Concrete Strength Designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = \sqrt{f_{ck,cube} / 25N/mm^2}$	1.00	1.10	1.22	1.34	1.41	1.48	1.55

$f_{ck,cube}$ = 150mm concrete cube compressive strength

Influence of edge distance¹⁾

c/c_{cr}	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
$f_{1,N} = 0.7 + 0.3 \cdot c/c_{cr} = 1$	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00
$f_{1,sp} = 0.7 + 0.3 \cdot c/c_{cr} = 1$										
$f_{2,N} = 0.5 \cdot (1 + c/c_{cr}) = 1$	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
$f_{2,sp} = 0.5 \cdot (1 + c/c_{cr}) = 1$										

1) The above influencing factors must apply for every edge distance smaller than critical edge distance c_{cr} . Actual edge distance shall not be smaller than minimum edge distance c_{min} .

Influence of anchor spacing²⁾

s/s_{cr}	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
$f_{3,N} = 0.5 \cdot (1 + s/s_{cr,N}) = 1$	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
$f_{3,sp} = 0.5 \cdot (1 + s/s_{cr,sp}) = 1$										

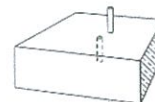
2) The above influencing factors must apply for every anchor spacing smaller than critical spacing distance s_{cr} . Actual anchor spacing distance shall not be smaller than minimum spacing distance s_{min} .

Influence of anchorage depth

f_{hef}	$f_{hef} = (h_{act} / h_{ef})^{1.5}$
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SHEAR - Concrete Capacity CC Design Method

Design shear resistance $V_{Rd} = \min (V_{Rd,c} ; V_{Rd,cp} ; V_{Rd,s})$



$$V_{Rd,c} = V_{Rd,c}^0 \cdot f_{\beta} \cdot f_{sc} \cdot f_B \cdot f_{hef}$$

$$V_{Rd,cp} = \text{lower value of } k \cdot N_{Rd,p} \text{ and } k \cdot N_{Rd,c}$$

$$V_{Rd,s}$$

CRE-585 with Rebar

Design Concrete Edge Resistance, $V_{Rd,c}$

Rebar Size		Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
$V_{Rd,c}$ Non Cracked Concrete	(kN)	5.9	8.6	11.6	18.7	27.0	39.2	47.3	59.0	85.5
$V_{Rd,c}$ Cracked Concrete	(kN)	4.2	6.1	8.2	13.2	19.2	27.7	33.5	41.8	61.1

Design Concrete Pryout Resistance, $V_{Rd,cp}$

$V_{Rd,cp}$ = lower value of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$	$k = 1$ for $h_{ef} < 60\text{mm}$ $k = 2$ for $h_{ef} \geq 60\text{mm}$
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Design Steel Resistance, $V_{Rd,s}$

Rebar Size		Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
$V_{Rd,s}$ (FE460 87%)	(kN)	11.1	17.3	29.3	44.4	69.4	108.4	135.2	177.6	277.5
$V_{Rd,s}$ (Grade 500)	(kN)	9.3	14.7	24.3	36.7	57.3	90.0	112.7	147.3	230.4

INFLUENCING FACTORS

Influence of Concrete Strength

Concrete Strength Designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = \sqrt{f_{ck,cube} / 25\text{N/mm}^2}$	1.00	1.10	1.22	1.34	1.41	1.48	1.55

$f_{ck,cube}$ = 150mm concrete cube compressive strength

Influence of anchorage depth

f_{hef}	$f_{hef} = (h_{act} / h_{ef})^{1.5}$
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Influence of shear loading angle

Angle β	0°	10°	20°	30°	40°	50°	60°	70°	80°	=90°
f_β	1.00	1.01	1.05	1.13	1.24	1.40	1.64	1.97	2.32	2.50



Influence of anchoring spacing and edge distance for concrete edge resistance

Formula for single-anchor fastening influenced only by edge

$$f_{sc} = \frac{c}{c_{min}} \sqrt{\frac{c}{c_{min}}}$$

For Single Anchor

C/C_{min}	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
f_{sc}	1.0	1.3	1.7	2.0	2.4	2.8	3.3	3.7	4.2	4.7	5.2	5.7	6.3	6.8	7.4	8.0

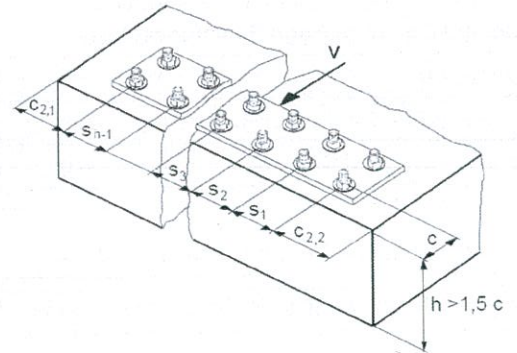
CRE-585 with Rebar

Formula for two-anchor fastening valid for $S < 3c$

$$f_{sc} = \frac{3c+s}{6c_{min}} \sqrt{\frac{c}{c_{min}}}$$

General formula for n-anchor fastening (edge plus n-1 spacing)
only valid where s_1 to s_{n-1} are all $< 3c$ and $c_2 > 1.5c$

$$f_{sc} = \frac{3c + s_1 + s_2 + \dots + s_{n-1}}{3nc_{min}} \sqrt{\frac{c}{c_{min}}}$$



Note: It is assumed that only the row of anchors closed to the free concrete edge carries the centric shear load.

For 2 anchors

FOR LABORATORY																		
C/C _{min}		1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	
S/C _{min}	1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16	3.44	3.73	4.03	4.33	
	1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31	3.60	3.89	4.19	4.50	
	2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.13	2.38	2.63	2.90	3.18	3.46	3.75	4.05	4.35	4.67	
	2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61	3.90	4.21	4.52	4.83	
	3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76	4.06	4.36	4.68	5.00	
	3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91	4.21	4.52	4.84	5.17	
	4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05	4.36	4.68	5.00	5.33	
	4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20	4.52	4.84	5.17	5.50	
	5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35	4.67	5.00	5.33	5.67	
	5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50	4.82	5.15	5.49	5.83	
	6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65	4.98	5.31	5.65	6.00	
	6.5							3.24	3.54	3.84	4.16	4.47	4.80	5.13	5.47	5.82	6.17	
	7.0								3.67	3.98	4.29	4.62	4.95	5.29	5.63	5.98	6.33	
	7.5									4.11	4.43	4.76	5.10	5.44	5.79	6.14	6.50	
	8.0										4.57	4.91	5.25	5.59	5.95	6.30	6.67	
	8.5											5.05	5.40	5.75	6.10	6.47	6.83	
	9.0											5.20	5.55	5.90	6.26	6.63	7.00	
	9.5												5.69	6.05	6.42	6.79	7.17	
	10.0														6.21	6.58	6.95	7.33
	10.5															6.74	7.12	7.50
11.0																7.28	7.67	
11.5																	7.83	
12.0																	8.00	

COMBINED LOAD - Tension and Shear

$$\beta_N = N_{sd} / N_{Rd} \leq 1 \quad (N_{sd} = \text{Tensile design action})$$

$$\beta_V = V_{sd} / V_{Rd} \leq 1 \quad (V_{sd} = \text{Shear design action})$$

Design check: $\beta_N + \beta_V \leq 1.2$ or $\beta_N^\alpha + \beta_V^\alpha \leq 1$ ($\alpha = 1.5$ for all failure mode)

CRE-585 with Rebar

Basic Loading Data With Variable Embedment Depth For Single Rebar

- Non cracked concrete G40, $f_{ck,cube} = 40 \text{ N/mm}^2$
- Rebar Grade 500, Tensile Strength $f_{uk,s} = 550 \text{ N/mm}^2$, Yield Strength $f_{yk,s} = 500 \text{ N/mm}^2$
- Correct setting as setting procedures
- No spacing and edge distance influence
- Steel failure
- Base material temperature range I: -40°C to $+40^\circ \text{C}$
- Influence of concrete strength = 1.22
- Min. Edge distance = 5ϕ
- Min. Spacing distance = 5ϕ
- Partial safety factor for steel = 1.4
- Partial safety factor for bond = 1.8

Rebar Size	ϕ	mm	$\phi 8$	$\phi 10$	$\phi 13$	$\phi 16$	$\phi 20$	$\phi 25$	$\phi 28$	$\phi 32$	$\phi 40$
Drill bit/ hole diameter	d_0	mm	12	14	16	20	25	30	35	40	50
Bar Cross-Section Area	A_s	mm ²	50.3	78.5	132.7	201.1	314.2	490.9	615.8	804.2	1257
Char. Rebar Strength	$N_{Rk,s}$	kN	28.0	43.0	73.0	111.0	173.0	270.0	339.0	442.0	691.0
Design Rebar Strength	$N_{Rd,s}$	kN	20.0	30.7	52.1	79.3	123.6	192.9	242.1	315.7	493.6
Edge Distance / Cover	c	mm	40	50	70	80	100	125	140	160	200
Spacing Distance	s	mm	40	50	70	80	100	125	140	160	200
Design Tensile Loads (kN)	Effective Embedment Depth, h_{ef}	60	mm	14.5							
		70	mm	17.0							
		80	mm	19.4	24.2						
		83	mm	20.1	25.1						
		90	mm	21.8	27.3	35.4					
		100	mm	24.2	30.3	39.4	44.2				
		115	mm	27.9	34.8	45.3	50.8				
		120	mm		36.3	47.2	53.0	56.1			
		125	mm		37.3	49.2	55.2	58.5	69.5		
		132	mm		39.4	52.0	58.3	61.7	73.4		
		145	mm		43.2	57.1	64.0	67.8	80.6	87.2	
		150	mm			59.1	66.2	70.1	83.4	90.2	92.0
		170	mm			66.9	75.1	79.5	94.5	102.2	104.3
		180	mm			70.9	79.5	84.2	100.0	108.2	110.4
		185	mm			72.8	81.7	86.5	117.0	111.2	113.5
		200	mm				88.3	93.5	126.5	120.2	122.7
		210	mm				92.7	98.2	116.7	126.2	128.8
		252	mm				111.3	117.8	140.1	151.5	154.6
		265	mm					123.9	147.3	159.3	162.5
		270	mm					126.3	150.1	162.3	165.6
		300	mm					140.3	166.7	180.3	184.0
		350	mm					163.7	194.5	210.4	214.7
		370	mm					173.0	205.7	222.4	226.9
		400	mm						222.3	240.4	245.3
		403	mm						224.0	242.2	247.2
		450	mm						250.1	270.5	276.0
		486	mm						270.1	292.1	298.1
		500	mm							300.5	306.7
		515	mm							309.5	315.9
		550	mm							330.6	337.3
		565	mm							339.6	346.5
		600	mm								368.0
		700	mm								429.3
		720	mm								441.6
		730	mm								492.5
		800	mm								539.7
		900	mm								607.2*
		1000	mm								674.7*
		1025	mm								691.5*

*Test Load Cell limits at 600kN

CRE-585 with Rebar

Basic Loading Data With Variable Embedment Depth For Single Rebar

- Non cracked concrete G45, $f_{ck,cube} = 45 \text{ N/mm}^2$
- Rebar 500, Tensile Strength $f_{uk,s} = 550 \text{ N/mm}^2$, Yield Strength $f_{yk,s} = 500 \text{ N/mm}^2$
- Correct setting as setting procedures
- No spacing and edge distance influence
- **Steel failure**
- Base material temperature range I: -40°C to $+40^\circ\text{C}$

- Influence of concrete strength = 1.34
- Min. Edge distance = 5ϕ
- Min. Spacing distance = 5ϕ
- Partial safety factor for steel = 1.4
- Partial safety factor for bond = 1.8

Rebar Size	ϕ	mm	$\phi 8$	$\phi 10$	$\phi 13$	$\phi 16$	$\phi 20$	$\phi 25$	$\phi 28$	$\phi 32$	$\phi 40$
Drill bit/ hole diameter	d_0	mm	12	14	16	20	25	30	35	40	50
Bar Cross-Section Area	A_s	mm ²	50.3	78.5	132.7	201.1	314.2	490.9	615.8	804.2	1257
Char. Rebar Strength	$N_{Rk,s}$	kN	28.0	43.0	73.0	111.0	173.0	270.0	339.0	442.0	691.0
Design Rebar Strength	$N_{Rd,s}$	kN	20.0	30.7	52.1	79.3	123.6	192.9	242.1	315.7	493.6
Edge Distance / Cover	c	mm	40	50	70	80	100	125	140	160	200
Spacing Distance	s	mm	40	50	70	80	100	125	140	160	200
Design Tensile Loads (kN)	Effective Embedment Depth, h_{ef}	60	mm	16.0							
		70	mm	18.6							
		75	mm	20.0							
		80	mm	21.3	26.6						
		90	mm	23.9	29.9	38.9					
		93	mm	24.7	30.9	40.2					
		100	mm	26.6	33.3	43.2	48.5				
		105	mm	27.9	34.9	45.4	50.9				
		115	mm		38.3	49.7	55.8				
		121	mm		40.2	52.3	58.7	62.2			
		125	mm		40.9	54.0	60.6	64.2	76.3		
		130	mm		42.6	56.2	63.1	66.8	79.4		
		150	mm			64.9	72.8	77.0	91.6	99.0	
		165	mm			71.3	80.0	84.8	100.7	108.9	
		170	mm			73.5	82.5	87.3	118.1	112.2	114.5
		200	mm				97.0	102.7	122.1	132.0	134.7
		210	mm				101.9	107.9	128.2	138.6	141.5
		230	mm				111.6	118.1	140.4	151.8	154.9
		240	mm					123.3	146.5	158.4	161.7
		250	mm					128.4	152.6	165.0	168.4
		300	mm					154.1	183.1	198.1	202.1
		315	mm					161.8	192.3	208.0	212.2
		340	mm					174.6	207.6	224.5	229.0
		350	mm						213.7	231.1	235.8
		370	mm						225.9	244.3	249.2
		400	mm						244.2	264.1	269.5
		445	mm						271.7	293.8	299.8
		450	mm							297.1	303.1
		470	mm							310.3	316.6
		500	mm							330.1	336.8
		515	mm							340.0	346.9
		600	mm								404.2
		660	mm								444.6
		670	mm								496.5
		800	mm								592.8
		933	mm								691.4*

*Test Load Cell limits at 600kN

CRE-585 with Rebar

Basic Loading Data With Variable Embedment Depth For Single Rebar

- Non cracked concrete G50, $f_{ck,cube} = 50 \text{ N/mm}^2$
- Rebar 500 Tensile Strength $f_{uk,s} = 550 \text{ N/mm}^2$, Yield Strength $f_{yk,s} = 500 \text{ N/mm}^2$
- Correct setting as setting procedures
- No spacing and edge distance influence
- **Steel failure**
- Base material temperature range I: -40°C to $+40^\circ\text{C}$

- Influence of concrete strength = 1.41
- Min. Edge distance = 5ϕ
- Min. Spacing distance = 5ϕ
- Partial safety factor for steel = 1.4
- Partial safety factor for bond = 1.8

Rebar Size	ϕ	mm	$\phi 8$	$\phi 10$	$\phi 13$	$\phi 16$	$\phi 20$	$\phi 25$	$\phi 28$	$\phi 32$	$\phi 40$
Drill bit/ hole diameter	d_0	mm	12	14	16	20	25	30	35	40	50
Bar Cross-Section Area	A_s	mm ²	50.3	78.5	132.7	201.1	314.2	490.9	615.8	804.2	1257
Char. Rebar Strength	$N_{Rk,s}$	kN	28.0	43.0	73.0	111.0	173.0	270.0	339.0	442.0	691.0
Design Rebar Strength	$N_{Rd,s}$	kN	20.0	30.7	52.1	79.3	123.6	192.9	242.1	315.7	493.6
Edge Distance	c	mm	40	50	70	80	100	125	140	160	200
Spacing Distance	s	mm	40	50	70	80	100	125	140	160	200
Design Tensile Loads (kN)	Effective Embedment Depth, h_{ef}	60	mm	16.8							
		70	mm	19.6							
		80	mm	22.4	28.0						
		88	mm	24.6	30.8						
		90	mm	25.2	31.5	40.9					
		100	mm	28.0	35.0	45.5					
		115	mm		40.2	52.3	58.7				
		125	mm		43.1	56.9	63.8	67.6			
		130	mm			59.1	66.3	70.3	83.5		
		140	mm			63.7	71.5	75.7	89.9	97.3	
		155	mm			70.5	79.1	83.8	99.6	107.7	109.9
		160	mm			72.8	81.7	86.5	102.8	111.1	113.4
		170	mm				86.8	91.9	124.3	118.1	120.5
		180	mm				91.9	97.3	131.6	125.0	127.6
		200	mm				102.1	108.1	128.5	138.9	141.8
		210	mm				107.2	113.5	134.9	145.9	148.9
		218	mm				111.3	117.8	140.0	151.4	154.5
		220	mm					118.9	141.3	152.8	155.9
		229	mm					123.8	147.1	159.1	162.3
		250	mm					135.1	160.6	173.7	177.2
		280	mm					151.3	179.9	194.5	198.5
		300	mm					162.1	192.7	208.4	212.7
		320	mm					173.0	205.6	222.3	226.8
		350	mm						224.8	243.1	248.1
		400	mm						257.0	277.9	283.5
		420	mm						269.8	291.8	297.7
		450	mm							312.6	319.0
		490	mm							340.4	347.3
		500	mm								354.4
		550	mm								389.9
		600	mm								425.3
		625	mm								443.0
		633	mm								493.6
		700	mm								545.8
		800	mm								623.8*
		887	mm								691.6*

*Test Load Cell limits at 600kN

CRE-585 with Post Installed Rebars

Eurocode EC2 EN 1992-1-1 Design

The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing. The design of post-installed rebar connections and determination of the internal section forces to be transferred in the construction joint shall be verified in accordance with EC2 EN 1992-1-1. When ascertaining the tensile force in the rebar, allowance shall be made for the statically effective height of the bonded-in reinforcement.

Determination of the basic anchorage length

The required basic anchor length $\ell_{b,reqd}$ shall be determined in accordance with EC2 EN 1992-1-1, equation (8.3)

$$\ell_{b,reqd} = (d_s / 4) \times (a_{sd} / f_{bd})$$

with: d_s = diameter of the rebar

a_{sd} = calculated design stress of the rebar

f_{bd} = design value of bond strength according to corresponding ETA, in consideration of the coefficient related to the quality of bond conditions and of the coefficient related to the bar diameter and of the drilling technique.

Determination of the minimum anchorage depth

Anchoring rebar

In the case of anchoring rebar, the minimum anchorage length, $\ell_{b,min}$ must be determined as follows:

$$\ell_{b,min} = \max(0.3) \ell_{b,reqd}; 10d_s; 100\text{mm}) \text{ under tension}$$

$$\ell_{b,min} = \max(0.6) \ell_{b,reqd}; 10d_s; 100\text{mm}) \text{ under compression}$$

Overlap joint

In the case of overlap joint, the minimum anchorage length, $\ell_{b,min}$ must be determined as follows:

$$\ell_{b,min} = \max(0.3 \cdot \alpha_6 \cdot \ell_{b,reqd}; 15d_s; 200\text{mm}) \text{ EC2 EN 1992-1-1, section 8.7.3}$$

where α_6 = Basically, always 100% of the reinforcement in the joint between existing and new component are lapped. The factor is therefore always 1.5.

Determination of the design anchorage length

Anchoring rebar

In the case of anchoring rebar, the design anchorage length, ℓ_{bd} must be determined as follows:

$$\ell_{bd} = \alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_4 \cdot \alpha_5 \ell_{b,reqd} \geq \ell_{b,min}$$

$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$ determined according to EC2 EN 1992-1-1, Table 8.2

Overlap joint

In the case of overlap joint, the design anchorage length, ℓ_{bd} must be determined as follows:

$$\ell_{bd} = \alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_4 \cdot \alpha_5 \cdot \alpha_6 \ell_{b,reqd} \geq \ell_{b,min}$$

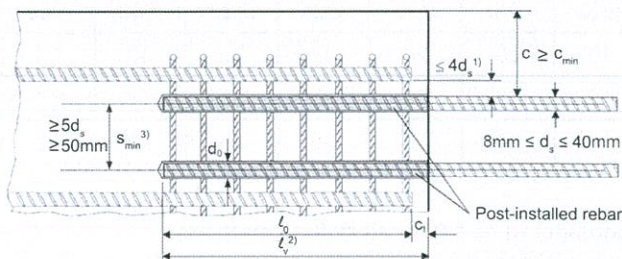
$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6$ determined according to EC2 EN 1992-1-1, Table 8.2 and 8.3

Values of $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$ and α_6 coefficients

α_1	Influence of the shape of the rebar	$\alpha_1 = 1$ for straight rebar
α_2	Influence of the concrete cover	$0.7 \leq \alpha_2 \leq 1.0$ calculated according EC2 EN 1992-1-1:2004 Table 8.2
α_3	Influence of the confinement by transverse reinforcement not welded to main reinforcement	$\alpha_3 = 1$ assumed no transverse reinforcement
α_4	Influence of the confinement by welded transverse reinforcement	$\alpha_4 = 1$ assumed no welded transverse reinforcement
α_5	Influence of the confinement by transverse pressure	$0.7 \leq \alpha_5 \leq 1.0$
α_6	Influence of the overlapping length	$1.0 \leq \alpha_6 \leq 1.5$

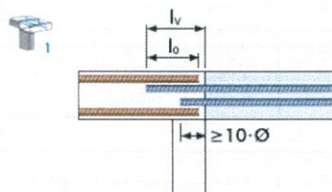
CRE-585 with Post-Installed Rebars

General design rule of construction of post-installed rebars

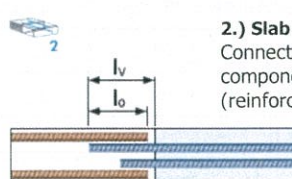


- d_s = diameter of post-installed rebar
 d_o = drill bit diameter
 l_o = lap length
 c = concrete cover at end-face of post-installed rebar
 c_{min} = minimum concrete cover
 s_{min} = minimum spacing for post-installed rebars
- 1) If the clear distance between overlapped bars exceeds $4d_s$, then the lap length, l_o , shall be increased by the difference between the actual clear distance and $4d_s$.
 2) For calculation of the effective embedment depth of overlap joints the concrete cover at end-face of the post-installed rebar c , shall be considered.
 3) The spacing between post-installed rebars shall be greater than the minimum of $5d_s$ and 50mm

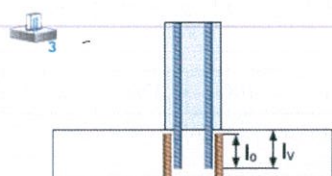
A) Application **with** connecting reinforcement



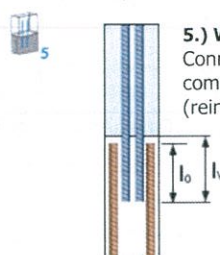
1.) Slab to slab on support / Beam to beam on support:
 Connection of a slab or a beam to an existing supported component by overlapping the reinforcement (reinforcement lap).



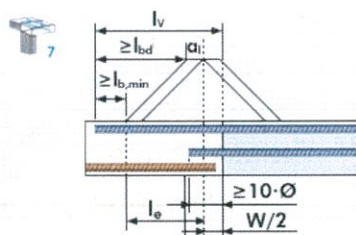
2.) Slab to slab / Beam to beam:
 Connection of a slab or a beam to an existing component by overlapping the reinforcement (reinforcement lap).



3.) Wall to foundation / Column to foundation (lap):
 Connection of a wall / column to an existing foundation by overlapping the reinforcement (reinforcement lap).

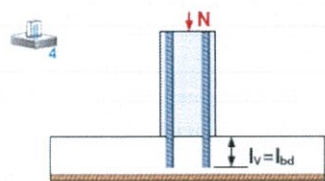


5.) Wall extension / column extension:
 Connection of a wall / column to an existing component by overlapping the reinforcement (reinforcement lap).

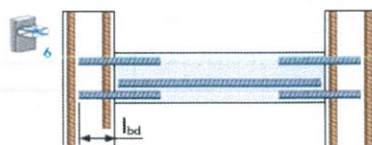


7.) Envelop of tensile force (bottom reinforcement layer):
 Anchoring of reinforcement to cover the envelop of the tensile force in a component (slab or beam) subjected to bending.

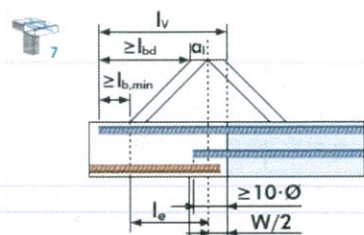
B) Application **without** connecting reinforcement



4.) Wall to foundation / Column to foundation (compression):
 Connection of a wall or column under compression to an existing foundation (only compression force N permitted).



6.) End anchoring of slab or beam (simply supported):
 End anchoring of a simply supported slab or beam (only shear force V permitted).



7.) Envelop of tensile force (upper reinforcement layer):
 Anchoring of reinforcement to cover the envelop of the tensile force in a component (slab or beam) subjected to bending.

CRE-585 with Post-Installed Rebars

Drill bit diameters, d_0

Rebar Size			Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
Hammer drilling	HD	mm	12	14	16	20	25	32	35	40	50
Compressed air drilling	CD	mm	12	14	16	20	26	32	35	40	57
Diamond core drilling	DD	mm	12	14	16	20	25	32	35	40	52

The multiplication factor for minimum anchorage length shall be considered as 1.0 for all drilling methods

Minimum anchorage and lap lengths for C20/25 and maximum hole lengths, l_{max}

Rebar, $f_{y,k}$ 500 N/mm ²			Ø8	Ø10	Ø13	Ø16	Ø20	Ø25	Ø28	Ø32	Ø40
Hammer drilling and compressed air drilling											
Min. anchorage length	$l_{b,min}$	mm	113	142	184	227	284	354	397	454	616
Min. lap length	$l_{o,min}$	mm	200	200	200	240	300	375	420	480	621
Diamond core drilling											
Min. anchorage length	$l_{b,min}$	mm	170	213	275	340	425	532	595	681	925
Min. lap length	$l_{o,min}$	mm	300	300	315	360	450	563	630	720	932
All drilling method											
Max. hole length	l_{max}	mm	1000	1000	1300	1600	2000	2500	2800	3200	3200

According to EC2 EN 1992-1-1, $l_{b,min}$ (8.6) and $l_{o,min}$ (8.11) are calculated for good bond conditions and $a_6 = 1.0$ with maximum rebar yield strength $f_{y,k}$ 500 N/mm²

Minimum concrete cover c_{min} of post-installed rebar depending of drilling method

Drilling method	Rebar diameter	Without drilling aid	With drilling aid
Hammer drilling	< 25mm	$30mm + 0.06 l_v \geq 2d_s$	$30mm + 0.02 l_v \geq 2d_s$
	$\geq 25mm$	$40mm + 0.06 l_v \geq 2d_s$	$40mm + 0.02 l_v \geq 2d_s$
Compressed air drilling	< 25mm	$50mm + 0.08 l_v$	$50mm + 0.02 l_v$
	$\geq 25mm$	$60mm + 0.08 l_v$	$60mm + 0.02 l_v$
Diamond core drilling	< 25mm	Drill stand is used as drilling aid	$30mm + 0.02 l_v \geq 2d_s$
	$\geq 25mm$		$40mm + 0.02 l_v \geq 2d_s$

Furthermore the minimum concrete cover must be observed according EC2: EN 1992-1-1, Section 4.4.1.2

Design values of the ultimate bond resistance f_{bd} in N/mm² for hammer drilling, compressed air drilling methods for good conditions

Rebar (mm)	Concrete Class								
d_s	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Ø8 - Ø32	1.6	2.0	2.3	2.7	3.0	3.4	3.7	4.0	4.3
Ø40	1.5	1.8	2.1	2.5	2.8	3.1	3.4	3.7	4.0

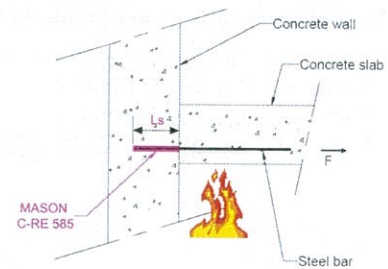
Design values of the ultimate bond resistance f_{bd} in N/mm² for diamond core drilling method for good conditions

Rebar (mm)	Concrete Class								
d_s	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Ø8 - Ø25	1.6	2.0	2.3	2.7	3.0	3.4	3.7	4.0	4.3
Ø28 - Ø32	1.6	2.0	2.3	2.7	2.7	2.7	2.7	2.7	2.7
Ø40	1.5	1.8	2.1	2.5	2.5	2.5	2.5	2.5	2.5

CRE-585 with Post-Installed Rebars

Fire Resistance Data according to CSTB, Report 26050230

- Wall to slab connection
- Non cracked concrete C20/25, $f_{ck, cylinder} = 20 \text{ N/mm}^2$
- Rebar 500, $f_{yk, s} = 500 \text{ N/mm}^2$
- Fire resistance classes F30 to F240 according to EC2 fire situation anchorage

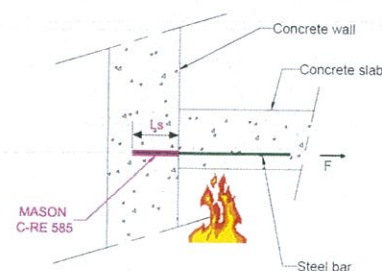


Rebar Diameter $\varnothing$ (mm)	Drill Hole Diameter D (mm)	Rebar Maximum Load F (kN)	Rebar Anchorage Depth Ls (mm)	Max. Fire Resistance Force of Rebar (kN)					
				R30	R60	R90	R120	R180	R240
8	12	16.2	80	3.4	1.1	0.6	0.4	0.3	0.3
			95	6.4	2.0	1.0	0.7	0.6	0.5
			110	10.2	3.5	1.7	1.2	0.8	0.8
			125	14.5	6.0	2.8	1.9	1.3	1.1
			135	16.2	8.1	3.9	2.6	1.6	1.3
			170		16.2	10.5	7.1	3.9	2.7
			195			16.2	12.4	7.0	4.5
			210				16.2	9.6	6.0
			240					16.2	10.5
			270						16.2
10	14	25.3	100	8.5	2.7	1.4	1.1	0.8	0.7
			115	13.2	4.6	2.3	1.7	1.2	1.0
			130	18.5	7.8	3.7	2.6	1.7	1.4
			145	24.1	11.8	6.0	4.0	2.4	2.0
			150	25.3	13.4	7.0	4.6	2.8	2.2
			185		25.3	16.4	11.6	6.3	4.5
			215			25.3	20.6	12.1	8.1
			230				25.3	16.0	10.7
			265					25.3	19.4
			285						25.3
12	16	36.4	120	16.8	5.8	3.0	2.2	1.6	1.5
			135	23.0	9.5	4.7	3.3	2.2	2.0
			150	29.7	14.2	7.4	4.8	3.2	2.7
			165	36.4	19.8	11.2	7.1	4.6	3.7
			205		36.4	25.3	17.3	11.1	8.1
			235			36.4	28.3	19.7	14.1
			255				36.4	26.8	19.7
			280					36.4	28.1
			305						36.4
14	18	49.6	140	29.0	11.7	6.0	4.4	2.8	2.6
			150	34.2	15.3	8.1	5.7	3.5	3.2
			160	39.4	19.3	10.7	7.4	4.4	3.8
			170	44.9	23.7	13.8	9.5	5.5	4.7
			180	49.6	28.3	17.5	12.2	6.8	5.6
			225		49.6	37.8	29.4	17.6	13.1
			250			49.6	41.4	27.0	20.4
			270				49.6	35.6	27.7
			300					49.6	40.3
			320						49.6

CRE-585 with Post-Installed Rebars

Fire Resistance Data according to CSTB, Report 26050230

- Wall to slab connection
- Non cracked concrete C20/25, $f_{ck, cylinder} = 20 \text{ N/mm}^2$
- Rebar 500, $f_{yk, s} = 500 \text{ N/mm}^2$
- Fire resistance classes F30 to F240 according to EC2 fire situation anchorage

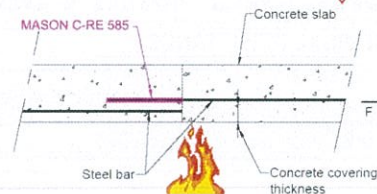


Rebar Diameter Ø (mm)	Drill Hole Diameter D (mm)	Rebar Maximum Load F (kN)	Rebar Anchorage Depth Ls (mm)	Max. Fire Resistance Force of Rebar (kN)					
				R30	R60	R90	R120	R180	R240
16	20	64.8	160	44.9	20.2	10.9	7.9	5.1	4.3
			170	51.0	24.9	14.2	10.1	6.3	5.1
			180	57.3	30.0	18.0	12.8	7.8	6.2
			190	63.6	35.4	22.3	16.1	9.7	7.4
			195	64.8	38.2	24.6	18.0	10.7	8.2
			240		64.8	48.4	39.0	25.7	18.4
			270			64.8	55.7	39.8	29.6
			290				64.8	50.4	38.8
			320					64.8	54.0
			340						64.8
20	25	101.2	200	87.2	45.3	29.0	21.3	13.1	10.5
			215	99.1	55.7	37.7	28.6	17.5	13.6
			220	101.2	59.3	40.7	31.3	19.2	14.8
			275		101.2	79.0	66.2	47.0	35.9
			305			101.2	88.1	66.3	52.7
			325				101.2	80.5	65.4
			355					101.2	86.0
			380						101.2
25	30	158.1	250	158.1	100.4	67.0	54.5	36.1	27.8
			310		158.1	121.0	105.3	78.9	63.6
			350			158.1	143.0	113.6	95.1
			370				158.1	132.2	112.3
			400					158.1	139.4
			420						158.1
32	40	259.0	320	259.0	223.5	160.7	129.0	98.8	82.0
			350		259.0	197.3	163.8	130.3	110.8
			400			259.0	224.7	188.1	165.1
			430				259.0	224.7	200.3
			460					259.0	236.5
			480						259.0

CRE-585 with Post-Installed Rebars

Bond strength depending on concrete cover in the case of fire exposure

- Fire situation in slab to slab or wall to wall parallel (overlapping joint) connection
- C-RE 585 maximum bonding stress in relation to fire resistance classes and required minimum concrete coverage.



Concrete Cover (mm)	Max. Bond Stress (N/mm ²)					
	R30	R60	R90	R120	R180	R240
10	0.0	0.0	0.0	0.0	0.0	0.0
20						
30						
40						
50	1.6	0.3	0.4	0.3	0.3	0.3
60	3.2	0.5				
70	6.0	0.9				
80	10.8	1.6				
90	14.0	2.6	0.9	0.5	0.4	0.4
100	16.5	4.1	1.3	0.7		
110	17.9	6.5	2.0	1.0		
120	19.0	9.5	3.0	1.4	0.6	0.3
130	19.7	12.5	4.4	2.1	0.8	0.4
140	20.0	14.7	6.2	2.9	1.0	0.5
150	20.4	16.1	8.4	4.1	1.4	0.7
160	20.7	17.5	11.1	5.6	1.9	0.9
170	20.7	18.2	13.3	7.5	2.5	1.2
180	20.7	19.0	14.7	10.0	3.3	1.5
190	21.1	19.7	16.1	12.2	4.2	1.9
200		20.0	17.2	13.6	5.4	2.5
210		20.0	17.9	15.0	6.9	3.1
220		20.4	18.6	16.1	8.8	4.0
230		20.7	19.0	17.2	10.8	4.9
240		20.7	19.7	17.9	12.5	6.2
250		20.7	19.7	18.6	13.6	7.8
260		20.7	20.0	19.0	15.0	9.5
270		21.1	20.4	19.7	15.7	11.1
280			20.4	19.7	16.8	12.5
290			20.7	20.0	17.5	13.6
300			20.7	20.4	17.9	14.7
310			20.7	20.4	18.6	15.7
320			20.7	20.7	19.0	16.5
330			20.7	20.7	19.3	17.2
340			21.1	21.1	19.7	17.5
350				21.1	20.0	18.2
360				21.1	20.0	18.6
370					20.4	19.0
380					20.4	19.3
390					20.7	19.7
400					20.7	20.0
410					20.7	20.4
420					21.1	20.4
430						20.7
440						20.7
450						20.7
460						21.1
470						21.1

CRE-585 with Post-Installed Rebars

CHEMICAL REISISTANCE

Chemical Agent	Concentration %	Resistant	Non resistant
Boric acid, aqueous solution		<>	
Citric acid	All	<>	
Formic acid (Methanoic acid)	10	<>	
Oleic acid	100	<>	
Phosphoric acid	85	<>	
Tartaric acid	All	<>	
Sulfuric acid	30		x
Acetic acid (Vinegar)	40		x
Hydrochloric acid (Muriatic acid)	Conc.		x
Lactic acid	All		x
Nitric acid	10		x
Phenol, aqueous solution (Carbonic acid)	8		x
Ammonia, aqueous solution	5	<>	
Beer	100	<>	
Benzene (kp 100-140°F)	100	<>	
Calcium carbonate, suspended in water	All	<>	
Calcium chloride, suspended in water		<>	
Calcium hydroxide, suspended in water		<>	
Carbon tetrachloride	100	<>	
Caustic soda (Sodium hydroxide)	40	<>	
Formaldehyde, aqueous solution	30	<>	
Freon		<>	
Glycol (Ethylene glycol)		<>	
Laitance		<>	
Magnesium chloride, aqueous solution	All	<>	
Perchloroethylene	100	<>	
Potash lye (Potassium hydroxide, 10% and 40% solutions)		<>	
Potassium carbonate, aqueous solution	All	<>	
Potassium chloride, aqueous solution	All	<>	
Potassium nitrate, aqueous solution	All	<>	
Sodium carbonate, aqueous solution	All	<>	
Sodium chloride, aqueous solution	All	<>	
Sodium phosphate, aqueous solution	All	<>	
Sodium silicate	All	<>	
Tetrachloroethylene	100	<>	
Turpentine	100		x
Trichloroethylene	100		x
Methanol	100		x
Hydrogen peroxide	30		x
Isopropyl alcohol	100		x
Ethyl alcohol, aqueous solution	50		x
Benzole	100	<>	
Petroleum	100	<>	
Chlorine	All	<>	
Motor oil (SAE 20 W-50)	100	<>	
Diesel oil	100	<>	
Fuel oil		<>	
Gasoline (premium grade)	100	<>	
Linseed oil	100	<>	
Lubricating oil	100	<>	

ELECTRICAL INSULATION

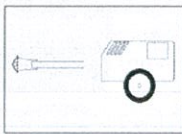
C-RE 585 have good electrically insulating characteristics hence it is not conductive electrically in the hardened state. Its electric resistivity is $1.2 \times 10^{12} \Omega \cdot m$. C-RE 585 is suitable for railway track anchoring applications and rail constructions where require electric insulation anchoring systems.

MASON C-RE 585 Installation Guide



SETTING INSTRUCTION

Dry, wet/damp and water-saturated concrete, hammer drilling method

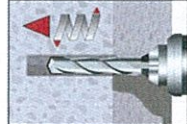


C-RE 585 (585 ml)
C-RE 585 (385 ml)
Resealable
Hard Plastic Cartridge

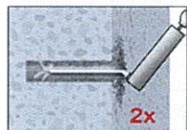
Static Mixing Nozzle

Rebar FE460
Rebar BS1 500 S

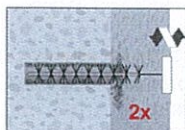
Property Class 5.8
Property Class 8.8
Stainless Steel A4 - 70



(1) Drill hole with hammerdrill to the required rebar size and depth.



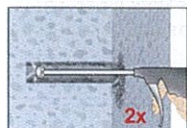
(2a) Manual Cleaning
(i) Blow the hole clean with hand pump up to hole diameter 20mm.



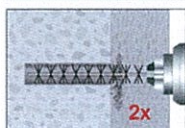
(ii) Brush the hole with appropriate size wire brush.



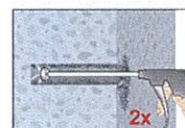
(iii) Blow the hole clean again with hand pump minimum 2 times.



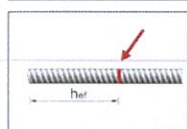
(2b) Compressed air cleaning
(i) Use compressed air (min. 6 bar) hole diameter >20mm or depth >240mm.



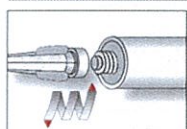
(ii) Attached the appropriate size wire brush to a drilling machine or battery screwdriver



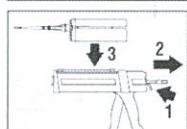
(iii) Blow the hole clean again with compressed air (min. 6 bar).



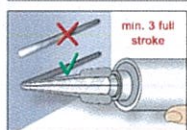
(3) Mark embedment depth on the rebar. The bar should be free of dirt.



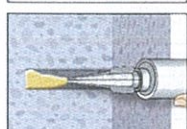
(4) Attached static nozzle to the cartridge.



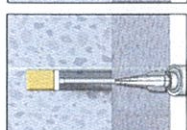
(5) Load the cartridge into dispensing tool.



(6) Discard non-uniformly mixed until mortar shows consistent grey colour.



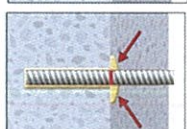
(7) Starting from bottom and back of the cleaned hole fill the hole up to approximately 2/3 with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets.



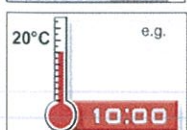
(8) Use piston plug for overhead installation.



(9) Push the rebar into the hole while slightly turning action.



(10) Be sure the rebar is fully embedded and excess mortar is visible.



(11) Allow the adhesive to cure prior to applying any load or torque.

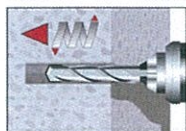
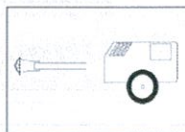
Temperature of base material	Gelling- and working time	Full curing time in dry base material	Full curing time in wet base material
+5 °C	120 Min.	50 h	100 h
+10 °C	90 Min.	30 h	60 h
+20 °C	30 Min.	10 h	20 h
+30 °C	20 Min.	6 h	12 h
+40 °C	12 Min.	4 h	8 h

MASON C-RE 585 Installation Guide

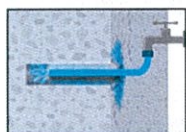


SETTING INSTRUCTION

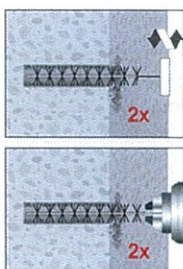
Water flooded bore hole or submerged concrete, hammer drilling method



(1) Drill hole with hammerdrill to the required rebar size and depth.

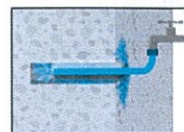


(2a) Rinsing with water until clear water comes out.

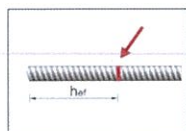


2b(i) Brush the hole with appropriate size wire brush.

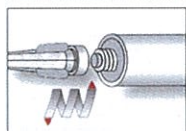
2b(ii) Attached the appropriate size wire brush to a drilling machine or battery screwdriver



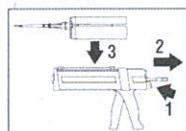
(2c) Rinsing again with water until clear water comes out.



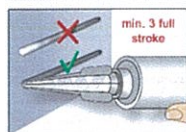
(3) Mark embedment depth on the rebar. The bar should be free of dirt.



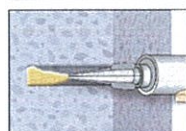
(4) Attached static nozzle to the cartridge.



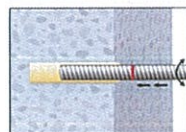
(5) Load the cartridge into dispensing tool.



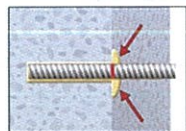
(6) Discard non-uniformly mixed until mortar shows consistent grey colour.



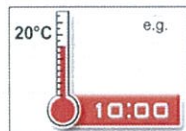
(7) Starting from bottom and back of the cleaned hole fill the hole up to approximately 2/3 with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets.



(8) Push the rebar into the hole while slightly turning action.



(9) Be sure the rebar is fully embedded and excess mortar is visible.



(11) Allow the adhesive to cure prior to applying any load or torque.

Temperature of base material	Gelling- and working time	Full curing time in dry base material	Full curing time in wet base material
+5 °C	120 Min.	50 h	100 h
+10 °C	90 Min.	30 h	60 h
+20 °C	30 Min.	10 h	20 h
+30 °C	20 Min.	6 h	12 h
+40 °C	12 Min.	4 h	8 h

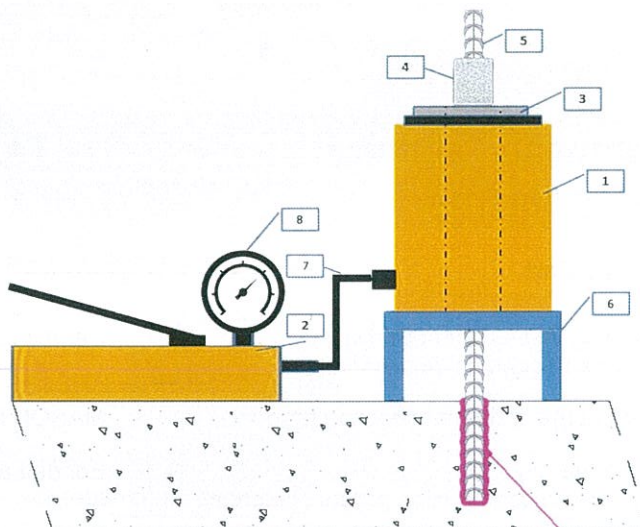
Note: Unknown temperature range for flooded hole or submerged concrete, allow the adhesive to cure min. 72hrs (3days) for full load capacity.

CRE-585 Tensile Pull-Out Test Method

- 1) Place the loading frame over the rebar/ threaded rod anchor to be tested.
- 2) For threaded rod testing, connect the coupler with high tensile threaded rod to the anchor to be tested.
- 3) Place the suitable hollow plunger cylinder on the frame and through the rebar/ anchor.
- 4) For rebar testing, assemble the rebar wedge c/w wedge blocks on the set up. Apply a firm tap on the wedge to have full engagement of the rebar.
- 5) Connect the hydraulic hand pump, pressure gauge and hose assembly and then check for the leakages.
- 6) Apply the load gradually to the required proof load (design load for non-destructive testing) or ultimate load (for destructive testing).
- 7) Observe the mode of failure.
- 8) Record the achieved load and mode of failure.

C-RE 585 with Rebar Testing

Equipment List	Description
1	Center pull hollow plunger cylinder
2	Hydraulic hand pump
3	Metal washer plate
4	Rebar wedges
5	Rebar to be tested
6	Loading frame
7	Hydraulic hose
8	Pressure gauge



Common Rebar Failure Modes



Concrete Failure



Steel Failure



Steel Elongation

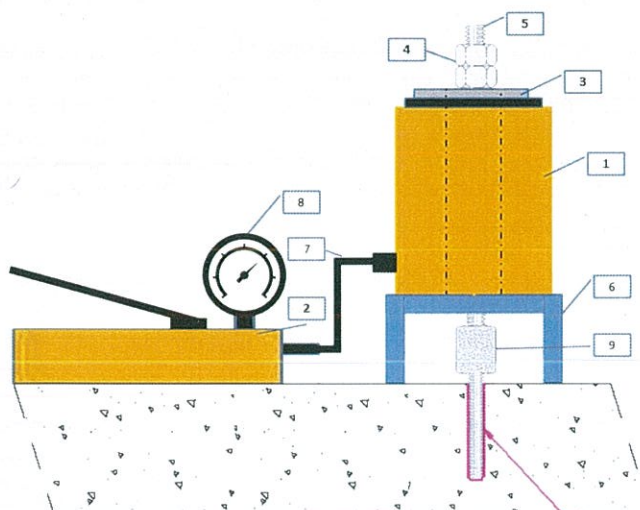


Bond Failure*

MASON Chemical Anchor with Rebar

C-RE 585 with Threaded Rod Testing

Equipment List	Description
1	Center pull hollow plunger cylinder
2	Hydraulic hand pump
3	Metal washer plate
4	Nuts
5	High tensile threaded rod
6	Loading frame
7	Hydraulic hose
8	Pressure gauge
9	Threaded rod coupler



MASON Chemical Anchor with Threaded Rod

Common Anchor Failure Modes



Concrete Failure



Steel Failure



Bond Failure*

- *General possible causes:
- Improper hole cleaning method
 - Improper mixing of resin & hardener
 - Insufficient chemical amount
 - Insufficient curing time
 - Insufficient embedment depth

Approval body for construction products
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and
Laender Governments



European Technical Assessment

ETA-14/0206
of 4 July 2014

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	MASON Injection system C-RE 585 for concrete
Product family to which the construction product belongs	Bonded anchor with anchor rod for use in concrete
Manufacturer	Fasten Enterprises Pte Ltd. 171 Kallang Way #01-04 SINGAPORE 349250 SINGAPUR
Manufacturing plant	Fasten Enterprises Pte Ltd. Plant 1
This European Technical Assessment contains	27 pages including 3 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	Guideline for European technical approval of "Metal anchors for use in concrete", ETAG 001 Part 5: "Bonded anchors", April 2013, used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011.

Approval body for construction products
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Bautechnisches Prüfamt

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European Technical Assessment

ETA-14/0201
of 7 April 2017

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the
European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

MASON injection system C-RE 585
for rebar connection

Product family
to which the construction product belongs

System for post installed rebar
connection with mortar

Manufacturer

Fasten Enterprises Pte Ltd.
No. 3 Ang Mo Kio Street 62
#01-50/51 LINK@AMK
SINGAPORE 569139
SINGAPUR

Manufacturing plant

Fasten Enterprises Pte Ltd. Plant 1

This European Technical Assessment
contains

17 pages including 3 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

European Assessment Document (EAD)
330087-00-0601

This version replaces

ETA-14/0201 issued on 26 June 2014



le futur en construction

DIRECTION SECURITE, STRUCTURES et FEU

Division Mécanique et Résistance au Feu

REPORT No 26050230

Fasten Enterprises Pte Ltd.

MASON C-RE 585

on

Fasten Enterprises Pte Ltd. – MASON C-RE 585 injection systems
in conjunction with concrete reinforcing bar (ϕ 8 to 32mm)
and subjected to fire exposure

REQUESTED BY:

Fasten Enterprises Pte Ltd.

171 Kallang Way #01-04

Singapore, Singapore 349250

The laboratories of the SAFETY, STRUCTURES, and FIRE Department of the CSTB Experimentation Division are accredited by COFRAC's Test Section, French Accreditation Committee, for the following programmes, defined in Agreement 1-0301:

- no. 3 (tests on hydraulic concrete and its components)

- no. 39, part 2 (tests of mechanical fastening elements, tests of expansion anchors)

"As a signatory to the ILAC MRA, ICBO ES recognizes the technical equivalence of COFRAC accreditation of CSTB for the tests contained in this report."

Conference of Building Officials (ICBO): 5360 Workman Mill Road Whittier, CA 90601 USA

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It comprises 38 pages numbered from 1/38 to 38/38

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Suppliers

[Suppliers](#)**Brand** MASON, C-RE 585 (M 16)[Product](#)**Model** -[Performance](#)[Requirement](#)**Listed Date** 2019-08-22**Expiry Date** 2022-08-31[Materials List](#)**Company** FASTEN ENTERPRISES (PTE) LTD[Application](#)**Telephone** 67412998
No.**Email** office@fasten.com.sg**Website** www.fasten.com.sg[Back](#)

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TEST REPORT

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SetSCO Services Pte Ltd
18 Teban Gardens Crescent
Singapore 608925
Tel : (65) 6566 7777
Fax: (65) 6566 7718
www.setsco.com
Business Reg. No. 196900269D

Page : 1 of 2
Date : 08/01/2021

Our Ref : ST-8500141318/3

Subject : Tensile Pull Out Test on H10 to H40 rebars installed with Mason C-RE 585 chemical onto concrete block (Grade 30)* at 3, Ang Mo Kio Street 62 by Fasten Enterprises Pte Ltd.

Tested For : **FASTEN ENTERPRISES PTE LTD**
No. 3 Ang Mo Kio Street 62
#01-50/51, Link @ AMK
Singapore 569139
Attn:- Thein Hike

Test Location : 3, Ang Mo Kio Street 62

Date of Test : 6th January 2021

Sample Description : One (01) nos. each of H10 to H40 rebars installed with Mason C-RE 585 chemical were selected by the client for testing.

Method of Test : Load was applied axially to the various sizes of installed rebars with Mason C-RE 585 by a centre-pull hydraulic jack system to the ultimate load as advised by the client. The maximum load applied shall then be recorded and the mode of failure noted.

Note: *Information provided by the client
Refer to the table on page 2 for test results.

ST-8500141318/3 (7-Rebars with Mason C-RE 585) Fasten Enterprises Pte Ltd / Saiyidah

Mike

Terms & Conditions:

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Results :
Tensile Pull Out Test on H10-H40 Rebars Installed Using MASON C-RE 585

Sample Ref.	Test Member	Fixing Type	Nominal Dia. of Hole (mm)	Embedded Length (mm)	Required Tensile Load (kN) ***	Applied Tensile Proof Load (kN)	Observation After Test
T1	Mock-up Concrete Block (Grade 30) **	H10	10	90	30.9	55.3	Rebar fracture
T2		H13	13	120	52.1	86.5	
T3		H16	16	130	79.0	132.6	
T4		H20	20	170	123.4	204.6	
T5		H25	25	210	192.8	321.1	
T6		H32	32	300	316.0	471.1	No chemical bond failure **
T7		H40	40	350	493.7	506.1	

Note: ** No further increase in load was able to be applied as the maximum capacity of jack has reached.

*** Required tensile load based on design steel resistance grade 500 rebar

Witness :

(1) Thein Hike (Fasten)

Test Conducted By : Michael Gurusamy

HOW YONG MENG

Assistant Manager

Structural & Integrity Testing Dept.

Construction Technology Division

ANNEX 1

ST-8500141318/3

Photo 1 / 2



Test Ref : T1



Test Ref : T2



Test Ref : T3

Mike



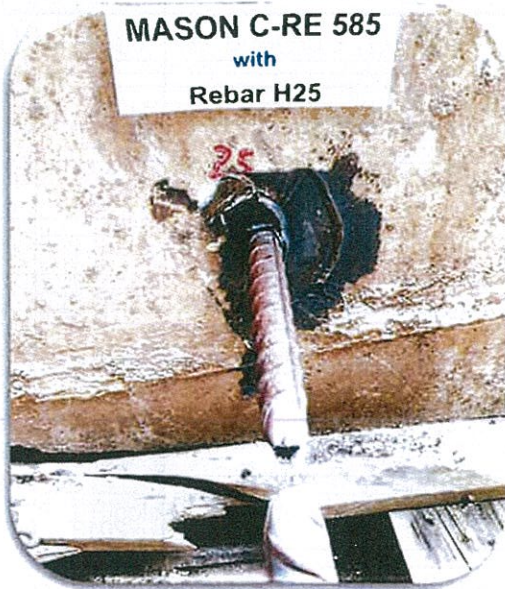
Test Ref : T4



ANNEX 1

ST-8500141318/3

Photo 2 / 2



Test Ref : T5



Test Ref : T6



Test Ref : T7

Mike



Project Reference for MASON C-RE 585 Chemical Anchor

No.	Project	C&S Consultant	Year
1	2 Sty Detached House @ Jalan Harum	-	2012
2	C937B Tai Seng Facility Building	Meinhardt Infrastructure Pte Ltd	2012
3	Warehouse A&A @ Changi South St 2	-	2012
4	No.1 Changi Biz Park Ave	-	2013
5	CRAMOIL - Automatic Chemical Handling System Project @ Tuas View Lane	Jurong Consultants Pte Ltd	2013
6	C932 DTL3 Mattar Station	LTA	2013
7	No.10 Ang Mo Kio TECHPOINT	-	2013
8	HDB Lift Upgrading @ Serangoon Central	Surbana International Consultants Pte Ltd	2013
9	A&A @ 7 Tuas Ave 16	-	2013
10	Aviation Centre at Seletar Airport @ West Camp Rd	T H Chuah & Partners LLP	2013
11	Gain City 10 Sty Warehouse @ 71 Sungei Kadut Drive	LSW Consulting Engineers	2013
12	Seletar Aerospace Park	Mott MacDonald Singapore Pte Ltd	2013
13	Bedok Bus Interchange	-	2014
14	Yeo Warehouse @ 3 Senoko Way	Longrove & Associates	2014
15	Blk 5 Loyang Crescent	-	2014
16	Office Development @ 268 Orchard Road	Chong & Lee Consultants Pte Ltd	2014
17	GEMS World Academy @ Yishun	-	2014
18	Devonshire 12 Condominium	EPM Engineering Consultants	2014
19	TECHQUEST @ No.7 International Business Park	-	2014
20	Yishun Ave 1 & 6 L/P 199	-	2014

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No.	Project	C&S Consultant	Year
21	No.31 Kaki Bukit Rd 3 TECHLINK	-	2014
22	The South Beach (Mixed-use Development)	Arup Singapore Pte Ltd	2014
23	Terrace House No.81 Lucky Gardens	-	2014
24	Paya Lebar iPark @ 12 Tai Seng Link	CGM Engineering Consultants	2014
25	LOYANG ENTERPRISE 6 Sty Factory	Engineers Partnership	2014
26	ACE@BUROH 9 Story Factory	CGM Engineering Consultants	2014
27	Factory @ Tuas South Street 6	Prompt Consortium P/L Inter-Project Consortium	2014
28	Ripple Bay Condo @ Pasir Ris Drive 4	KTP Consultants Pte Ltd	2014
29	Oversea Family School @ Pasir Ris Drive 3	-	2015
30	Bedok South	-	2015
31	Bedok Bus Interchange	-	2015
32	ARC @Tampines Ave 8	-	2015
33	Jurong Island	-	2015
34	Aviation Centre @ Seletar Airport	T H Chuah & Partners LLP	2015
35	Woodlands Drive 62/64 HDB N6C22	LSW Consulting Engineers	2016
36	Upgrading: Telok Ayer Hong Lim Green Community Centre	NG 3 Consultants Pte Ltd	2016
37	Changi New Water Plants A&A	Beca Carter Hollings & Ferner (S.E. Asia) P/L	2016
38	Factory - 22 Gul Avenue	KCL Consultants Pte Ltd	2016
39	Factory – Tuas South Street 7	CSTech Consultants And Engineering P/L (aka KCL Consultants)	2016
40	Factory – Tuas South Street 9	CSTech Consultants And Engineering P/L (aka KCL Consultants)	2016
41	HDB Buangkok crescent N9C18	KTP Consultants Pte Ltd	2016

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No.	Project	C&S Consultant	Year
42	Tanglin Trust School – new 5 storey	Rankine and Hill (S) Pte Ltd	2016
43	SER-Changi Airport T4	-	2016
44	M5 @ Jalan Mutiara	WTS Consulting Engineers	2016
45	Shine @ Tuas South Industrial Factory	Engineers Partnership LLP	2016
46	HDB @ Sumang Walk/ Punggol Way	Surbana Jurong Consultants Pte Ltd	2016
47	Yishun Northpoint Mall Upgrading	DE Consultants (S) P/L	2016
48	TRIO @ Sam Leong Road	KCL Consultants Pte Ltd	2016
49	T222 Outram Station	KTP Consultants Pte Ltd	2016
50	T228 Garden By The Bay Station	Tritech Consultant Pte Ltd	2016
51	HDB Bukit Batok Neighbourhood 4 Contract 18-21	Surbana Jurong Consultants Pte Ltd	2017
52	Apartments 9 Buildings @ Choa Chu Kang Ave 5	EPM Engineering Consultants	2017
53	HDB Tampines Contract 2A	Surbana Jurong Consultants Pte Ltd	2017
54	The VISIONAIRE Condominium @ Sembawang Road / Canberra Link	CSTech Consultants And Engineering P/L (aka KCL Consultants)	2017
55	HDB AMK St 22 N2C31 AMK Court	Surbana Jurong Consultants Pte Ltd	2017
56	HDB Bedok North Rd N4C9	KTP Consultants Pte Ltd	2017
57	Wellington Primary School-Upgrade	Calibre Consulting (S) Pte Ltd	2017
58	HDB Jalan Teck Whye N1C15	KTP Consultants Pte Ltd	2017
59	HDB Sengkang West Road N4C30	P & T Consultants P/L	2017
60	HDB Dawson Contract 3 @ Margaret Drive/ Commonwealth Ave	Surbana Jurong Consultants Pte Ltd	2017

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No.	Project	C&S Consultant	Year
61	Kingsmen Creative Centre HQ @ Changi Business Park	-	2017
62	Pasir Ris Street 51	-	2017
63	Mosque: Upgrade 503 Tampines Ave 5	GNG Consulting Engineers	2017
64	Punggol East	KTP Consultants Pte Ltd	2017
65	Factory @ Tuas Ave 2	-	2017
66	New Factory @ 16 Senoko Way	GeoAlliance Consultants Pte Ltd	2017
67	Wet Science Building (NUS)	CPG Consultants Pte Ltd	2017
68	New HDB @ Tampines Ave 6/9/12	Surbana Jurong Pte Ltd	2017
69	Punggol Northshore Contract 1 & 2	Housing Development Board	2017
70	New HDB @ Buangkok Drive Extension/ Buangkok Link	P & T Consultants P/L	2017
71	New HDB @ Punggol Northshore Drive	KTP Consultants Pte Ltd	2017
72	New HDB @ Bedok Town Centre Contract 8	KTP Consultants Pte Ltd	2017
73	New HDB @ Punggol West C39 MATILDA SUNDECK, Sumang Lane	P & T Consultants P/L	2018
74	New HDB @ Bedok North Ave1 C19 BEDOK NORTH VALE	KTP Consultants Pte Ltd	2018
75	164 Kallang Way Industrial Factory	T C Sin & Associates	2018
76	Gem Residences @ Lor 6 Toa Payoh	P & T Consultants P/L	2018
77	New Factory @ 57 Quality Road	Prompt Consortium Pte Ltd (aka Inter-Project Consortium)	2018
78	New Factory @ 11 Tuas South Link 2	KCL Consultants Pte Ltd	2018
79	Woodleigh Lane Condo	Tham & Wong LLP (aka TW-Asia Consultants Pte Ltd)	2018

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No.	Project	C&S Consultant	Year
80	Martin Modern Condo	KCL Consultants Pte Ltd	2018
81	New HDB @ Dawson/ Kay Siang Rd	DE Consultants (S) Pte Ltd	2018
82	New HDB @ Canberra Walk	KTP Consultants Pte Ltd	2018
83	New HDB @ Sembawang/ Canberra Street	Surbana Jurong Consultants Pte Ltd	2018
84	Yishun Ave 8 (Part 2) & Vehicular Bridge across Simpang Sungei Kiri	Surbana Jurong Consultants Pte Ltd	2018
85	Industrial Building @ 25 Harper Road	KCL Consultants Pte Ltd	2018
86	Parc Botannia Condo @ Fernvale St	P & T Consultants P/L	2018
87	Project-Spring Winter Nursing Home @ Dover Ave	RSP Architects Planners & Engineers Pte Ltd	2018
88	Margaret Ville at Margaret Drive	KCL Consultants Pte Ltd	2019
89	HDB Punggol North C8, Northshore Trio	KTP Consultants Pte Ltd	2019
90	HDB N4C31 Fernvale Glades, Sengkang West Rd	P & T Consultants P/L	2019
91	HDB Guillemard C1A, Pine Vista, Cassia Crescent	DE Consultants (S) Pte Ltd	2019
92	Covered Linkway @ Tuas Industrial Estate, Changi Business Park & One-North (Package A – Tuas)	KTP Consultants Pte Ltd	2019
93	HDB Tampines GREENFOLIAGE N6C20 Tampines North Drive 2	Rankine and Hill (S) Pte Ltd	2019
94	Road Works - Upper Changi Road East	RJ Crocker Consultants Pte Ltd (aka JCVL Pte Ltd)	2019
95	Woodlands Dive 60 HDB N7C33	DE Consultants (S) Pte Ltd	2019
96	TIMMAC@Kranji Factory	Mott MacDonald Singapore Pte Ltd	2019
97	T306 Tanjong Katong Station	Mott MacDonald Singapore Pte Ltd	2019
98	C158 Canberra Station	Surbana Jurong Consultants Pte Ltd	2019
99	HDB (SK N3 C29 & NC) @ Anchorvale Road/ St	LSW Consulting Engineers Pte Ltd	2019

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No.	Project	C&S Consultant	Year
100	TANJONG KATONG PRIMARY SCHOOL: UPGRADE, 10 Seraya Road	LSW Consulting Engineers Pte Ltd	2019
101	Goldhill Memorial Centre, Tampines Road	ERSS Consultants Pte Ltd	2019
102	PASIR RIS DRIVE NURSING HOME, Pasir Ris Dr 3	Beca Carter Hollings & Ferner (S.E.Asia) Pte Ltd	2019/2020
103	NUS: School of Computing & COM2 Building, Research Link	Ronnie & Koh Consultants Pte Ltd	2019/2020
104	JUNIPER HILL Condo, 39 & 41 Ewe Boon Rd	Aurecon Singapore Pte Ltd	2019/2020
105	LOGOS ECOMMERCE HUB, 4 Pandan Crescent	Tham & Wong LLP (aka TW-Asia Consultants Pte Ltd)	2019/2020
106	New HDB, Yishun N3C26, Yishun Ring Rd	Surbana Jurong Consultants Pte Ltd	2019/2020
107	Tampines MRT Station Tampines	SIAC Pte Ltd	2019/2020
108	WATERFRONT I and II @ Northshore	Housing and Development Board	2020
109	HDB, Woodleigh Hillside (Bidadari C10-C12)	Surbana Jurong Consultants Pte Ltd	2020
110	Potong Pasir Nursing Home	P & T Consultants P/L	2020
111	Pasir Ris Nursing Home	Beca Carter Hollings & Ferner (S.E.Asia) Pte Ltd	2020
112	Tanglin Trust School A&A	WSP Consultancy Pte Ltd (formerly Parsons Brinckerhoff Pte Ltd)	2020/2021
113	PLANT NURSERY @ 435A Clementi Road	Engineers Alliance Pte. Ltd	2020/2021
114	TAMPINES GREENVERGE, Tampines N6 C8/ 9 & 10	Surbana Jurong Consultants Pte Ltd	2020/2021
115	TAMPINES GREENFOLIAGE Tampines N6 C20	Rankine & Hill (S) Pte Ltd	2020/2021
116	New HDB, Geylang C43A	Surbana Jurong Pte Ltd KTP Consultants Pte Ltd	2020/2021
117	NUS: School of Computing & COM3 Building @ Research Link	Ronnie & Koh Consultants Pte Ltd	2020/2021
118	SOLARIS @ TAI SENG, Tai Seng Avenue	T C Sin & Associates	2020/2021
119	CR1069 Road Diversion and Canal Works	Arup Singapore Pte Ltd	2020/2021
120	Contract RC118 Viaduct Upper Changi Road East	T.Y Lin International Pte Ltd	2020/2021
121	KEMPAS RESIDENCES, Kallang Whampoa C58	Beca Carter Hollings & Ferner (S.E.Asia) Pte Ltd	2020/2021
122	Leedon Green Condominiums	KCL Consultants Pte Ltd	2020/2021
123	MIDTOWN DEVELOPMENT: HOTEL AT CLUB STREET	RSP Architects Planners & Engineers Pte Ltd	2020/2021
124	DAIRY FARM RESIDENCES	KCL Consultants Pte Ltd	2020/2021
125	MAYFAIR GARDENS	DP Engineers Pte Ltd	2020/2021
126	PUNGGOL POINT COVE, Punggol North C14	Surbana Jurong Consultants Pte Ltd	2020/2021
127	T303 TANJONG RHU STATION	Mott MacDonald Singapore Pte Ltd	2020/2021

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