EPCON G5

Rebar (FE460)

Installation in G30 Reinforced Concrete

Design Embedment Depth $L_{b,rqd}$ and Design Tensile Load Table N_{Rd}

Rebar Ø (mm)	10	12	13	16	20	25	28	32	40
Hole Ø (mm)	13-14	15-16	16-18	20-22	25-28	30-32	35-38	40-42	50-52
Design Yield, N_{Rd} (kN)	31.4	45.2	53.1	80.4	125.7	196.3	246.3	321.7	502.7
$L_{b,rqd}$ (mm)	140	165	180	220	275	340	385	515	725
n = $L_{b,rqd}$ / Rebar Ø	14	14	14	14	14	14	14	17	19
Min Edge Distance (mm)	50	55	55	60	65	75	80	85	95
Min Spacing Distance (mm)	55	65	70	85	105	130	150	170	210
L_b (mm)	N_{Rd} (kN)								
100	23.1								
110	25.4								
120	27.7	33.2							
125	28.9	34.6							
130	30.0	36.0	39.0						
140	32.3	38.8	42.9						
145		40.2	43.5						
160		44.3	48.0	59.1					
165		45.7	49.5	61.0					
180			54.0	66.5					
190				70.2					
200				73.9	92.4				
205				75.7	94.7				
220				81.3	101.6				
250					115.4	144.3			
255					117.8	147.2			
275					127.0	158.7			
280						161.6	181.0		
315						181.8	203.6		
320						184.7	206.9	200.6	
340						196.3	219.8	213.2	
360							232.7	225.7	
385							248.9	241.4	
395								247.6	
400								250.8	278.8
440								275.9	306.7
485								304.1	338.1
515								322.9	359.0
570									397.4
595									414.8
650									453.1
725									505.4

Safety Factor for bond $\gamma_B = 1.8$
Safety Factor for Concrete $\gamma_{Mc,N} = 1.5$
Safety Factor for Steel $\gamma_{Ms,N} = 1.15$
Tensile development length L_b using Epcon G5:
where the $F_{Rd} \leq N_{Rd,s}$:

$$L_b = \left(\frac{L_{b,rqd}}{f_B}\right) \cdot \left(\frac{F_{Rd}}{N_{Rd,s}}\right)$$

f_B INFLUENCE OF CONCRETE

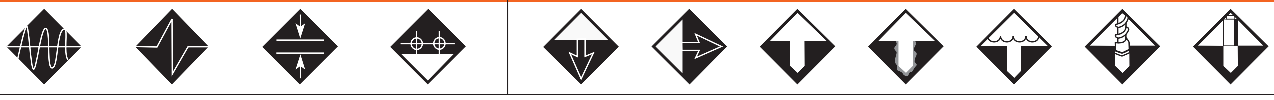
Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

Note: For splitting and splice calculation, please refer to ITW Technical Engineers.

EPCON G5
Rebar (FE460)

Epoxy Resin - High Performance

Performance	Installation

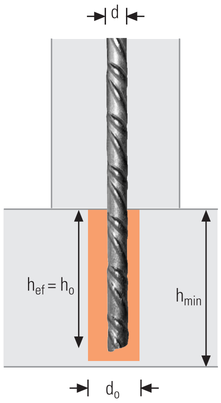


ICC-ES EVALUATION REPORT

Technical Data

EPCON G5		T8	T10	T12	T13	T16	T20	T25	T28	T32	T40
Dowel depth (mm)	$h_{ef,min}$	80	90	110	110	125	170	210	270	300	400
Ø bar (mm)	d	8	10	12	13	16	20	25	28	32	40
Ø drill bit (mm)	d_o	12	13	15	16	20	25	30	35	40	50
Drill depth (mm)	h_o	80	90	110	110	125	170	210	270	300	400
Min thick of base material (mm)	h_{min}	100	113	138	138	156	213	263	338	375	500
Ramset power tool code		DD543	DD543	DD543	DD543	DD565	DD565	DD565	DD565	DD576	DD576
Drill bit type-size		R3 PLUS-12	R3 PLUS-13	R3 PLUS-16	R3 PLUS-16	R3 MAX-20	R3 MAX-25	R3 MAX-30	R3 MAX-35	R3 MAX-40	R3 MAX-50

EPCON G5 Two part cartridge, 100% epoxy resin - vol. 650ml



Anchor Mechanical Properties

Rebar FE460	T8	T10	T12	T13	T16	T20	T25	T28	T32	T40
f_{yk} (N/mm2) Yield strength	460	460	460	460	460	460	460	460	460	460
A_s (mm2) Stressed cross-section	50.3	78.6	113.1	132.7	201.1	314.2	490.9	615.8	804.4	1,256.8
$N_{Rk,s}$ (kN) Charactiestic Yield	23.1	36.1	52.0	61.1	92.5	144.5	225.8	283.3	370.0	578.1
$N_{Rd,s}$ (kN) Design Yield	20.1	31.4	45.2	53.1	80.4	125.7	196.4	246.3	321.7	502.7

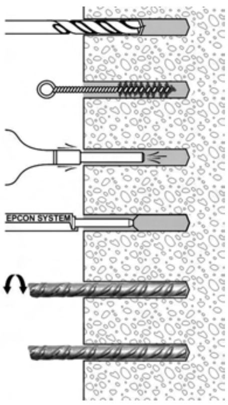
Setting Time before applying load

Ambient temperature (°C)	Max time for installation (min)	Waiting time before applying load (hr)
32°C	8.5	2
27°C	12	2
20°C	15	2
16°C	18	3
10°C	21	6

MATERIAL

Grade 460 steel

INSTALLATION



Chemical Resistance of EPCON G5 Anchor

Chemical substances	Resistance	Chemical substances	Resistance
Xylene	1	Toluene	2
Gasoline	1	10% Nitric Acid	2
20% Caustic NaOH (Sodium Hydroxide)	1	8.5% Ammonium Hydroxide	2
Fresh water	1	5% Bleach	3
Salt Water	1	Acetone	3
10% Sulfuric Acid (H2 SO4)	2	Glacial Acetic Acid	3
3.5% Hydrochloric Acid (HCL)	2	Methanol	3
9% Phosphoric Acid	2	Methylene Chloride	3

1 = High resistance (Anchors could be submerged in these materials)

2 = Medium resistance (Anchors could be temporary submerged due to splash or spill)

3 = Low resistance (Anchors should be limited to splash and spill followed by immediate cleanup)

EPCON G5

Rebar (FE460)

Number of Anchors per cartridge

Rebar diameter	**10**	**12**	**13**	**16**	**20**	**25**	**28**	**32**	**40**
Drilling Ø (mm)	13	15	16	20	25	30	35	40	50
Drilling depth (mm)	90	110	110	125	170	210	270	300	400
No. of anchors per cartridge									
EPCON G5 (650ml)	108.8	66.9	58.8	33.1	15.6	8.8	5.0	3.4	1.7

Ultimate Loads ($N_{Ru,m}$, $V_{Ru,m}$) / Characteristic Loads (N_{Rk}, V_{Rk}) in kN

TENSILE @ Concrete strength 30 N/mm²

Rebar size	**T8**	**T10**	**T12**	**T13**	**T16**
h_{ef} (mm)	80	90	110	110	125
$N_{Ru,m}$ (kN)	25.0	39.0	56.2	65.9	99.9
N_{Rk} (kN)	23.1	36.1	52.0	61.1	92.5

Rebar size	**T20**	**T25**	**T28**	**T32**	**T40**
h_{ef} (mm)	170	210	270	300	400
$N_{Ru,m}$ (kN)	156.1	243.9	305.9	399.6	624.4
N_{Rk} (kN)	144.5	225.8	283.3	370.0	578.1

SHEAR @ Concrete strength 30 N/mm²

Rebar size	**T8**	**T12**	**T13**	**T16**	**T20**
$V_{Ru,m}$ (kN)	15.0	23.4	33.7	39.6	59.9
V_{Rk} (kN)	13.9	21.7	31.2	36.6	55.5

Rebar size	**T20**	**T25**	**T28**	**T32**	**T40**
$V_{Ru,m}$ (kN)	93.7	146.3	183.6	239.8	374.6
V_{Rk} (kN)	86.7	135.5	170.0	222.0	346.9

Design Loads (N_{Rd}, V_{Rd}) for one anchor without edge or spacing influence in kN

$$N_{Rd} = \frac{N_{Rk}}{\gamma_{Mc,N}}$$

$$V_{Rd} = \frac{V_{Rk}}{\gamma_{Ms,V}}$$

TENSILE @ Concrete strength 30 N/mm²

Rebar size	**T8**	**T10**	**T12**	**T13**	**T16**
h_{ef} (mm)	80	110	110	110	125
N_{Rd} (kN)	15.4	24.1	34.7	40.7	61.7

Rebar size	**T20**	**T25**	**T28**	**T32**	**T40**
h_{ef} (mm)	170	210	270	300	400
N_{Rd} (kN)	96.4	150.6	188.9	246.7	385.4

$\gamma_{Mc,N}$ = 1.5 *(steel failure)*

SHEAR @ Concrete strength 30 N/mm²

Rebar size	**T8**	**T10**	**T12**	**T13**	**T16**
V_{Rd} (kN)	11.1	17.3	25.0	29.3	44.4

Rebar size	**T25**	**T25**	**T28**	**T32**	**T40**
V_{Rd} (kN)	69.4	108.4	136.0	177.6	277.5

$\gamma_{Ms,V}$ = 1.25

Recommended Loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

$$N_{rec} = \frac{N_{Rk}}{\gamma_{Mc,N} \cdot \gamma_F}$$

$$V_{rec} = \frac{V_{Rk}}{\gamma_{Ms,V} \cdot \gamma_F}$$

TENSILE @ Concrete strength 30 N/mm²

Rebar size	**T8**	**T10**	**T12**	**T13**	**T16**
h_{ef} (mm)	80	90	110	110	125
N_{rec} (kN)	11.0	17.2	24.8	29.1	44.0

Rebar size	**T20**	**T25**	**T28**	**T32**	**T40**
h_{ef} (mm)	170	210	270	300	400
N_{rec} (kN)	68.8	107.5	134.9	176.2	275.3

γ_F = 1.4

$\gamma_{Mc,N}$ = 1.5 *(steel failure)*

SHEAR @ Concrete strength 30 N/mm²

Rebar size	**T8**	**T10**	**T12**	**T13**	**T16**
V_{rec} (kN)	7.9	12.4	17.8	20.9	31.7

Rebar size	**T20**	**T25**	**T28**	**T32**	**T40**
V_{rec} (kN)	49.6	77.4	97.1	126.9	198.2

γ_F = 1.4

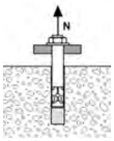
$\gamma_{Ms,V}$ = 1.25

steel failure (shaded cells)

EPCON G5
Rebar (FE460)

CC-Method

TENSILE in kN



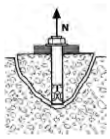
Pull-out resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$ Rebar size	T8	T10	T12	T13	T16
	Design pull-out resistance				
h_{ef} (mm)	80	90	110	110	125
$N^0_{Rd,p}$ (kN)	14.8	20.8	30.5	33.0	46.2

$N^0_{Rd,p}$ Rebar size	T20	T25	T28	T32	T40
	Design pull-out resistance				
h_{ef} (mm)	170	210	270	300	400
$N^0_{Rd,p}$ (kN)	78.5	121.2	174.5	188.1	278.8

$\gamma_{Mc,N} = 1.8$



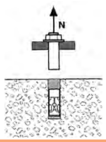
Concrete cone resistance
Concrete strength 30 N/mm²

$$N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_T \cdot \Psi_s \cdot \Psi_{c,N}$$

$N^0_{Rd,c}$ Rebar size	T8	T10	T12	T13	T16
	Design cone resistance				
h_{ef} (mm)	80	90	110	110	125
$N^0_{Rd,c}$ (kN)	26.3	31.4	42.5	42.5	51.4

$N^0_{Rd,c}$ Rebar size	T20	T25	T28	T32	T40
	Design cone resistance				
h_{ef} (mm)	170	210	270	300	400
$N^0_{Rd,c}$ (kN)	81.6	112.0	163.3	191.3	294.5

$\gamma_{Mc,N} = 1.5$



Steel resistance

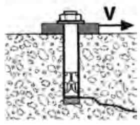
$N_{Rd,s}$ Rebar size	T8	T10	T12	T13	T16
	Steel design tensile resistance				
$N_{Rd,s}$ (kN)	15.4	24.1	34.7	40.7	61.7

$N_{Rd,s}$ Rebar size	T20	T25	T28	T32	T40
	Steel design tensile resistance				
$N_{Rd,s}$ (kN)	96.4	150.6	188.9	246.7	385.4

$\gamma_{Ms,N} = 1.5$

$$N_{Rd} = \min(N_{Rd,p}\,;\,N_{Rd,c}\,;\,N_{Rd,s})$$
$$\beta N = N_{Sd} / N_{Rd} \leq 1$$

SHEAR in kN



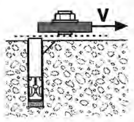
Concrete edge resistance
Concrete strength 30 N/mm²

$$V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_{\beta,V} \cdot \Psi_{s\text{-}c,V}$$

$V^0_{Rd,c}$ Rebar size	T8	T10	T12	T13	T16
	Design concrete edge resistance at a minimum edge distance (c_{min})				
h_{ef} (mm)	80	90	110	110	125
c_{min}	40	45	55	55	63
s_{min}	40	45	55	55	63
$V^0_{Rd,c}$ (kN)	2.6	3.4	5.1	5.2	6.9

$V^0_{Rd,c}$ Rebar size	T20	T25	T28	T32	T40
	Design concrete edge resistance at a minimum edge distance (c_{min})				
h_{ef} (mm)	170	210	270	300	400
c_{min}	85	105	135	150	200
s_{min}	85	105	135	150	200
$V^0_{Rd,c}$ (kN)	12.4	18.9	30.0	37.4	65.2

$\gamma_{Mc,V} = 1.5$

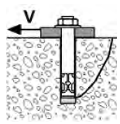


Steel resistance

$V_{Rd,s}$ Rebar size	T8	T10	T12	T13	T16
	Steel design shear resistance				
$V_{Rd,s}$ (kN)	11.1	17.3	25.0	29.3	44.4

$V_{Rd,s}$ Rebar size	T20	T25	T28	T32	T40
	Steel design shear resistance				
$V_{Rd,s}$ (kN)	69.4	108.4	136.0	177.6	277.5

$\gamma_{Ms,V} = 1.25$



Concrete pry-out failure
Concrete Strength 30 N/mm²

$$V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot \Psi_s \cdot \Psi_{c,N}$$

$V^0_{Rd,cp}$ Rebar size	T8	T10	T12	T13	T16
	Design pry-out resistance				
$V^0_{Rd,cp}$ (kN)	52.7	62.9	84.9	84.9	102.9

$V^0_{Rd,cp}$ Rebar size	T20	T25	T28	T32	T40
	Design pry-out resistance				
$V^0_{Rd,cp}$ (kN)	163.2	224.0	326.6	382.5	588.9

$\gamma_{Mc,V} = 1.5$

$$V_{Rd} = \min(V_{Rd,c}\,;\,V_{Rd,s}\,;\,V_{Rd,cp})$$
$$\beta V = V_{Sd} / V_{Rd} \leq 1$$

$$\beta N + \beta V \leq 1.2$$

f_B INFLUENCE OF CONCRETE

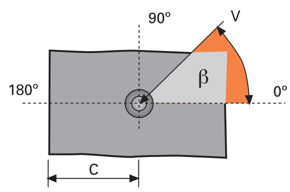
Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

f_T INFLUENCE OF EMBEDMENT DEPTH

$$f_T = \frac{h_{act}}{h_{ef}} \quad \text{where: } h_{ef} \leq h_{act} \leq 2h_{ef}$$

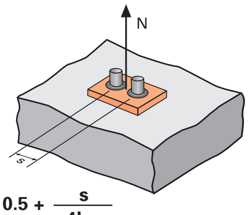
$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0~50	1.0
60	1.1
70	1.2
80	1.5
90~180	2.0



CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0.5 + \frac{s}{4h_{ef}}$$

$s_{min} < s < s_{cr,N}$

$s_{min} = 0.5h_{ef}$

$s_{cr,N} = 2h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

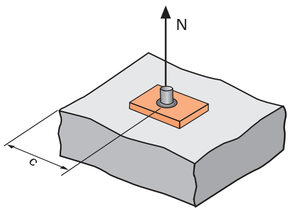
Spacing, s — Reduction Factor Ψ_s — Non-cracked concrete

Spacing, s	T8	T10	T12	T13	T16
40	0.63				
45	0.64	0.63			
55	0.67	0.65	0.63	0.63	
65	0.70	0.68	0.65	0.65	0.63
85	0.77	0.74	0.69	0.69	0.67
105	0.83	0.79	0.74	0.74	0.71
140	0.94	0.89	0.82	0.82	0.78
160	1.00	0.94	0.86	0.86	0.82
180		1.00	0.91	0.91	0.86
220			1.00	1.00	0.94
250					1.00

Spacing, s — Reduction Factor Ψ_s — Non-cracked concrete

Spacing, s	T20	T25	T28	T32	T40
85	0.63				
105	0.65	0.63			
140	0.71	0.67	0.63		
160	0.74	0.69	0.65	0.63	
210	0.81	0.75	0.69	0.68	0.63
250	0.87	0.80	0.73	0.71	0.66
300	0.94	0.86	0.78	0.75	0.69
350	1.00	0.92	0.82	0.79	0.72
420		1.00	0.89	0.85	0.76
540			1.00	0.95	0.84
600				1.00	0.88
700					0.94
800					1.00

$\Psi_{c,N}$ INFLUENCE OF EDGE FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_{c,N} = 0.27 + 0.725 \cdot \frac{c}{h_{ef}}$$

$c_{min} < c < c_{cr,N}$

$c_{min} = 0.5h_{ef}$

$c_{cr,N} = h_{ef}$

Ψ_s must be used for each distance influenced the anchors group

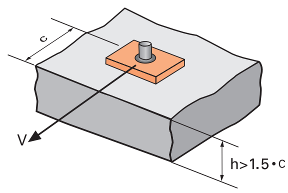
Edge, c — Reduction Factor $\Psi_{c,N}$ — Non-cracked concrete

Edge, c	T8	T10	T12	T13	T16
40	0.63				
45	0.68	0.63			
55	0.77	0.71	0.63	0.63	
63	0.84	0.78	0.69	0.69	
80	1.00	0.91	0.80	0.80	
85		0.95	0.83	0.83	0.63
90		1.00	0.86	0.86	0.65
110			1.00	1.00	0.74
125					0.80
170					1.00

Edge, c — Reduction Factor $\Psi_{c,N}$ — Non-cracked concrete

Edge, c	T20	T25	T28	T32	T40
85	0.63				
105	0.72	0.63			
135	0.85	0.74	0.63		
150	0.91	0.79	0.67	0.63	
170	1.00	0.86	0.73	0.68	
200		0.96	0.81	0.75	0.63
210		1.00	0.83	0.78	0.65
270			1.00	0.92	0.76
300				1.00	0.81
400					1.00

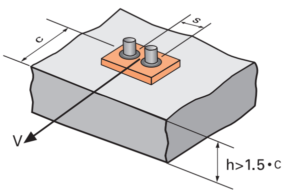
$\Psi_{s-c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



$$\Psi_{s-c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

FOR SINGLE ANCHOR FASTENING — Reduction Factor $\Psi_{s-c,V}$ — Non-cracked concrete

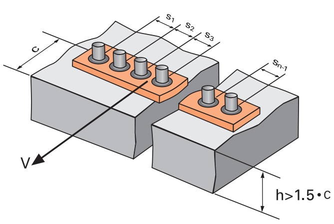
c/c_{min}	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s-c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



$$\Psi_{s-c,V} = \frac{3c + s}{6c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

FOR 2 ANCHORS FASTENING — Reduction Factor $\Psi_{s-c,V}$ — Non-cracked concrete

s/c_{min} \ 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
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
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
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
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
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65



FOR OTHER CASE OF FASTENINGS

$$\Psi_{s-c,V} = \frac{3c + s_1 + s_2 + s_3 + ... + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

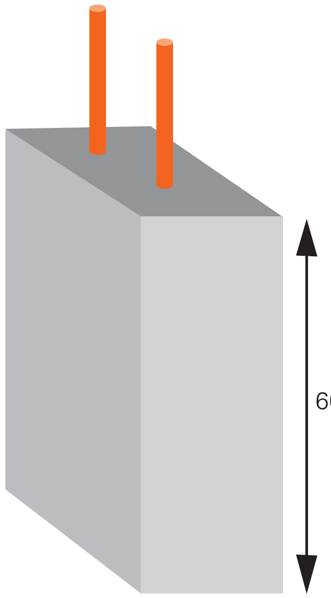
Installation in Reinforced Concrete

EXAMPLE 1:

The design action effect which causes tension in the starter bar is:

N = 650kN/m run

Strip footing details:
Concrete grade = $25N/mm^2$
Structure Thickness = 600mm
Concrete cover = 50mm



Load case induced in starter bar = 650kN/m run

Consider design of $460N/mm^2$ grade reinforcement bar

To satisfy Strength Limit State Design Criteria,

therefore,

$$N \leq A_s \cdot \frac{f_{yk}}{\gamma_{Ms}}$$

$$650{,}000(N) \leq A_s \cdot (460 \div 1.15)$$

$$A_s \geq 1{,}624mm^2$$

Using 4T25 reinforcing bar @ 300mm c/c = $1{,}963.6mm^2 > 1{,}624mm^2$

Installing T25 with Epcon G5:

$$L_b = \left(\frac{L_{b,rqd}}{f_B}\right) \cdot \left(\frac{F_{Rd}}{N_{Rd,s}}\right)$$

L_b = (340mm ÷ 0.9) x (162.5kN ÷ 196.3kN)

L_b = 312.7mm.......say 315mm

EXAMPLE 2:

where the existing structure is 380mm deep and concrete cover remains 50mm:

hole depth = 330mm
design tensile capacity for T25 @ 300mm embedment depth = 173.1kN x 0.9 = 155.7kN
650kN = n x 155.7kN
n = 650kN / 155.7kN = 4.17 ~ 5 (round to nearest number)

Use 5T25 reinforcing bar @ 225mm c/c = $2{,}454.5mm^2 > 1{,}624mm^2$

Rebar Connection Design as per EN 1992-1-1

General points

The design of rebar connections and determination of the internal section forces to be transferred in the construction joint shall be in keeping with the EN 1992-1-1.

Verfication of immediate local force transfer to the concrete has been provided.

Verification of the transfer of the loads to the anchored to the building component must be provided.

Connection joint

In case of a connection being made between new and existing concrete where the surface layer of the existing concrete is carbonated, the layer should be removed in the area of the new reinforcing bar (with a diameter d_s + 60mm) prior to the installation of the new bar. The forgoing may be neglected if building components are new and not carbonated.

To prevent damage of the concrete during drilling, the following requirements has to be met:

- Minimum concrete cover:
  $c_{min} = 30 + 0.06l_v \geq 2d_s$ (mm) for hammer drilled holes
  where l_v = actual embedment depth

- Minimum distances between 2 rebars:
  $s = 40mm \geq 4d_s$

- Minimum embedment:
  $l_{b,min} = 1.5 \cdot \max(0.3.L_{bd}\ ;\ 10Ø;\ 100mm)$

Furthermore, the minimum concrete cover according to EN 1992-1-1 SS 4.4.1.2 nust be observed.

Rebar Application Under ETA Rule - Intended Use

Overlap Joint

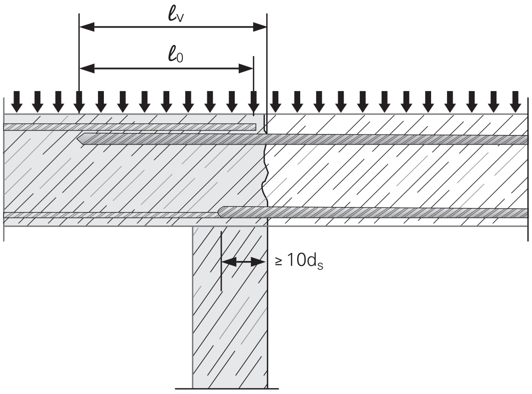


Figure 1.1: Overlap joint for rebar connections of slabs and beams.

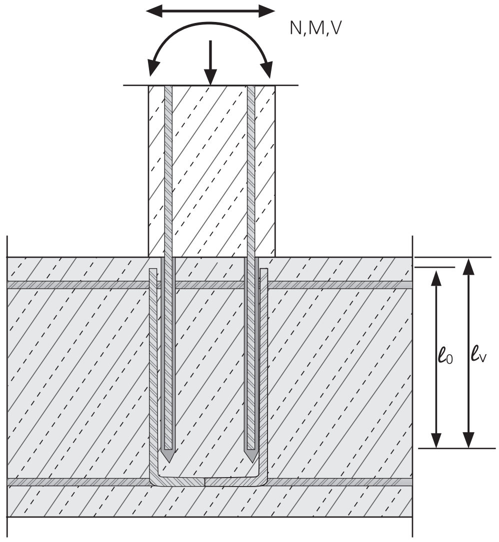


Figure 1.2: Overlap joint at a foundation of a column or wall where the rebars are stressed in tension

Anchoring Bar

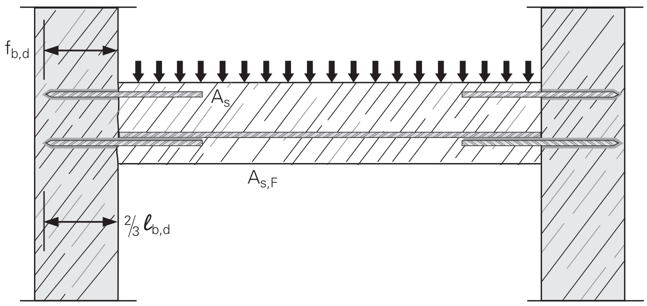


Figure 1.3: End anchoring of slabs or beams design as simply supported.

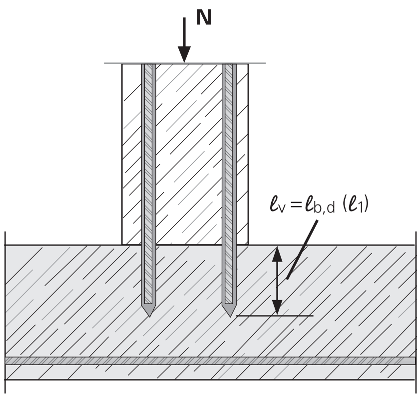


Figure 1.4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression.

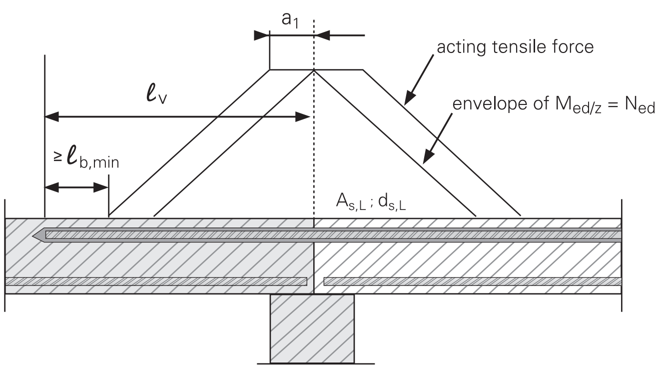


Figure 1.5: Anchoring of reinforcement to cover the line of acting tensile force.

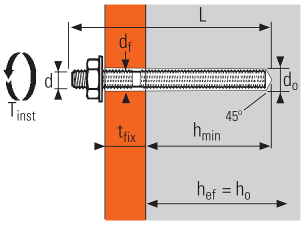
EPCON G5

Zinc Coated Anchor Stud (G5.8)

Epoxy Resin - High Performance

Performance	Material	Installation
	Zn	

ICC-ES EVALUATION REPORT



Technical Data

EPCON G5 with Chemset Stud	Anchor depth (mm)	Max thick of fixture (mm)	Drill depth (mm)	Min thick of base material (mm)	Ø Thread (mm)	Ø Drill bit (mm)	Total anchor length (mm)	Max tighten torque (Nm)	Chemset stud code	Ramset power tool code	Drill bit type-size
	$h_{ef,min}$	t_{fix}	h_o	h_{min}	d	d_o	L	T_{inst}			
M8	80	15	80	100	8	10	110	10	CS08110	DD527	R3 PLUS-10
M10	90	20	90	115	10	12	130	20	CS10130	DD527	R3 PLUS-12
M12	110	25	110	140	12	14	160	30	CS12160	DD527	R3 PLUS-14
M16	125	35	125	160	16	18	190	60	CS16190	DD543	R3 PLUS-18
M20	170	65	170	215	20	25	260	120	CS20260	DD565	R3 MAX-25
M24	210	63	210	270	24	28	300	200	CS24300	DD565	R3 MAX-28
M30	280	70	280	350	30	35	380	400	CS30380	DD565	R3 MAX-35

EPOXY G5 Two part cartridge, 100% epoxy resin - vol. 650ml

MATERIAL

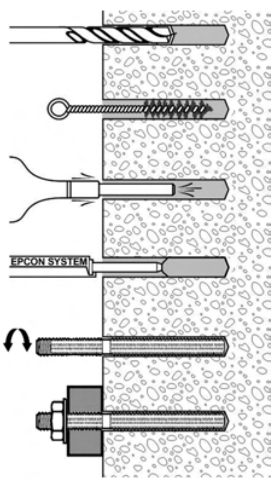
Stud:
Grade 5.8

Hexagonal Nut:
Grade 6 or 8

Washer:
Steel

Coating:
Zinc Coated 5µm

INSTALLATION



Anchor Mechanical Properties

CARBON STEEL Grade 5.8	M8	M10	M12	M16	M20	M24	M30
f_{uk} (N/mm2) Min. tensile strength	540	540	540	520	520	520	520
f_{yk} (N/mm2) Yield strength	430	430	430	420	420	420	420
A_s (mm2) Stressed cross-section	36.6	58	84.3	157	245	353	522.8
W_{el} (mm3) Elastic section modulus	31.2	62.3	109.2	277.5	540.9	935.5	1,686.0
$M^0_{Rk,s}$ (Nm) Characteristic bending moment	20.2	40.4	70.7	173.1	337.5	583.8	1,052.1
M (Nm) Recommended bending moment	16.2	32.3	56.6	138.5	270.0	467.0	841.7

Setting Time before applying load

Ambient temperature (°C)	Max time for installation (min)	Waiting time before applying load (hr)
32°C	8.5	2
27°C	12	2
20°C	15	2
16°C	18	3
10°C	21	6

Chemical Resistance of EPCON G5 Anchor

Chemical substances	Resistance	Chemical substances	Resistance
Xylene	1	Toluene	2
Gasoline	1	10% Nitric Acid	2
20% Caustic NaOH (Sodium Hydroxide)	1	8.5% Ammonium Hydroxide	2
Fresh Water	1	5% Bleach	3
Salt Water	1	Acetone	3
10% Sulfuric Acid (H2 SO4)	2	Glacial Acetic Acid	3
3.5% Hydrochloric Acid (HCL)	2	Methanol	3
9% Phosphoric Acid	2	Methylene Chloride	3

1 = High resistance (Anchors could be submerged in these materials)
2 = Medium resistance (Anchors could be temporary submerged due to splash or spill)
3 = Low resistance (Anchors should be limited to splash and spill followed by immediate cleanup)

EPCON G5

Zinc Coated Anchor Stud (G5.8)

Number of Anchors per cartridge

Stud diameter	8	10	12	16	20	24	30
Drilling Ø (mm)	10	12	14	18	25	28	35
Drilling depth (mm)	80	90	110	125	170	210	280
No. of anchors per cartridge							
EPCON G5 (650ml)	206.9	127.7	76.8	40.9	15.6	10.1	4.8

Ultimate Loads ($N_{Ru,m}$, $V_{Ru,m}$) / Characteristic Loads (N_{Rk}, V_{Rk}) in kN

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef} (mm)	80	90	110	125	170	210	280
$N_{Ru,m}$ (kN)	21.3	33.8	49.2	88.2	137.6	198.2	293.6
N_{Rk} (kN)	19.8	31.3	45.5	81.6	127.4	183.6	271.9

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
$V_{Ru,m}$ (kN)	12.8	20.3	29.5	52.9	82.6	118.9	176.2
V_{Rk} (kN)	11.9	18.8	27.3	49.0	76.4	110.1	163.1

Design Loads (N_{Rd}, V_{Rd}) for one anchor without edge or spacing influence in kN

$$N_{Rd} = \frac{N_{Rk}}{\gamma_{Mc,N}}$$

$$V_{Rd} = \frac{V_{Rk}}{\gamma_{Ms,V}}$$

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef} (mm)	80	90	110	125	170	210	280
N_{Rd} (kN)	13.2	20.9	30.3	54.4	84.9	122.4	181.2

$\gamma_{Mc,N}$ = 1.5 *(steel failure)*

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
V_{Rd} (kN)	9.5	15.0	21.9	39.2	61.2	88.1	130.5

$\gamma_{Ms,V}$ = 1.25

Recommended Loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

$$N_{rec} = \frac{N_{Rk}}{\gamma_{Mc,N} \cdot \gamma_F}$$

$$V_{rec} = \frac{V_{Rk}}{\gamma_{Ms,V} \cdot \gamma_F}$$

TENSILE @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef} (mm)	80	90	110	125	170	210	280
N_{rec} (kN)	9.4	14.9	21.7	38.9	60.7	87.4	129.5

γ_F = 1.4

$\gamma_{Mc,N}$ = 1.5 *(steel failure)*

SHEAR @ Concrete strength 30 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M30
V_{rec} (kN)	6.8	10.7	15.6	28.0	43.7	62.9	93.2

γ_F = 1.4

$\gamma_{Ms,V}$ = 1.25

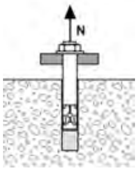
steel failure (shaded cells)

EPCON G5

Zinc Coated Anchor Stud (G5.8)

CC-Method

TENSILE in kN

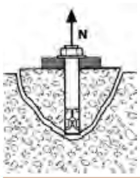


Pull-out resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$	Design pull-out resistance						
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef}	80	90	110	125	170	210	280
$N^0_{Rd,p}$ (kN)	15.3	26.7	33.8	45.5	59.1	90.1	150.1

$\gamma_{Mc,N} = 1.8$

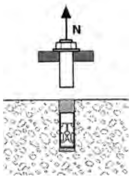


Concrete cone resistance
Concrete strength 30 N/mm²

$N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_T \cdot \Psi_s \cdot \Psi_{c,N}$

$N^0_{Rd,c}$	Design cone resistance						
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
$N^0_{Rd,c}$ (kN)	26.3	31.4	42.5	51.4	81.6	112.0	172.5

$\gamma_{Mc,N} = 1.5$

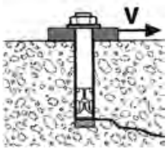


Steel resistance

$N_{Rd,s}$	Steel design tensile resistance						
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$N_{Rd,s}$ (kN)	13.2	20.9	30.3	54.4	84.9	122.4	181.2

$\gamma_{Ms,N} = 1.5$

SHEAR in kN

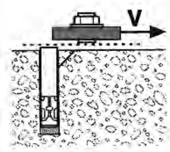


Concrete edge resistance
Concrete strength 30 N/mm²

$V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_{\beta,V} \cdot \Psi_{s\text{-}c,V}$

$V^0_{Rd,c}$	Design concrete edge resistance at a minimum edge distance (c_{min})						
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
c_{min}	40	45	55	65	85	105	140
s_{min}	40	45	55	65	85	105	140
$V^0_{Rd,c}$ (kN)	2.6	3.4	5.1	7.3	12.4	18.7	32.6

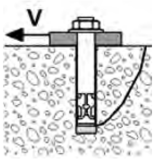
$\gamma_{Mc,V} = 1.5$



Steel resistance

$V_{Rd,s}$	Steel design shear resistance						
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$V_{Rd,s}$ (kN)	9.5	15.0	21.9	39.2	61.2	88.1	130.5

$\gamma_{Ms,V} = 1.25$



Concrete pry-out failure
Concrete Strength 30 N/mm²

$V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot \Psi_s \cdot \Psi_{c,N}$

$V^0_{Rd,cp}$	Design pry-out resistance						
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$V^0_{Rd,cp}$ (kN)	52.7	62.9	84.9	102.9	163.2	224.0	344.9

$\gamma_{Mc,V} = 1.5$

$N_{Rd} = \min(N_{Rd,p} ; N_{Rd,c} ; N_{Rd,s})$

$\beta N = N_{Sd} / N_{Rd} \leq 1$

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

$\beta V = V_{Sd} / V_{Rd} \leq 1$

$\beta N + \beta V \leq 1.2$

f_B INFLUENCE OF CONCRETE

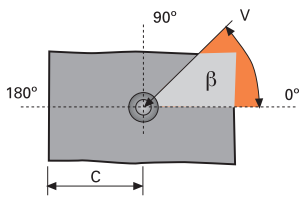
Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

f_T INFLUENCE OF EMBEDMENT DEPTH

$f_T = \frac{h_{act}}{h_{ef}}$ where: $h_{ef} \leq h_{act} \leq 2h_{ef}$

$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0~50	1.0
60	1.1
70	1.2
80	1.5
90~180	2.0

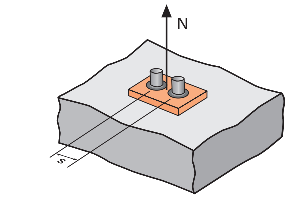


EPCON G5

Zinc Coated Anchor Stud (G5.8)

CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$\Psi_s = 0.5 + \frac{s}{4h_{ef}}$

$s_{min} < s < s_{cr,N}$

$s_{min} = 0.5h_{ef}$

$s_{cr,N} = 2h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

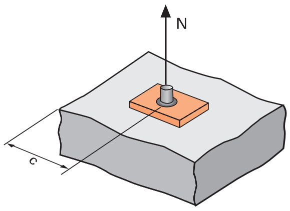
Reduction Factor Ψ_s – Non-cracked concrete

Spacing, s	M8	M10	M12	M16
40	0.63			
45	0.64	0.63		
55	0.67	0.65	0.63	
65	0.70	0.68	0.65	0.63
85	0.77	0.74	0.69	0.67
105	0.83	0.79	0.74	0.71
140	0.94	0.89	0.82	0.78
160	1.00	0.94	0.86	0.82
180		1.00	0.91	0.86
220			1.00	0.94
250				1.00

Reduction Factor Ψ_s – Non-cracked concrete

Spacing, s	M20	M24	M30
85	0.63		
105	0.65	0.63	
140	0.71	0.67	0.63
160	0.74	0.69	0.64
180	0.76	0.71	0.66
220	0.82	0.76	0.70
250	0.87	0.80	0.72
300	0.94	0.86	0.77
340	1.00	0.90	0.80
370		0.94	0.83
420		1.00	0.88
560			1.00

$\Psi_{c,N}$ INFLUENCE OF EDGE FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$\Psi_{c,N} = 0.27 + 0.725 \cdot \frac{c}{h_{ef}}$

$c_{min} < c < c_{cr,N}$

$c_{min} = 0.5h_{ef}$

$c_{cr,N} = h_{ef}$

Ψ_s must be used for each distance influenced the anchors group

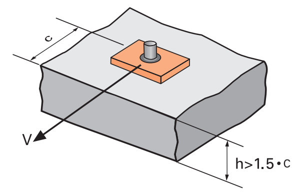
Reduction Factor $\Psi_{c,N}$ – Non-cracked concrete

Edge, c	M8	M10	M12	M16
40	0.63			
45	0.68	0.63		
55	0.77	0.71	0.63	
65	0.86	0.79	0.70	0.65
80	1.00	0.91	0.80	0.73
90		1.00	0.86	0.79
110			1.00	0.91
125				1.00

Reduction Factor $\Psi_{c,N}$ – Non-cracked concrete

Edge, c	M20	M24	M30
85	0.63		
105	0.72	0.63	
120	0.78	0.68	
140	0.87	0.75	0.63
170	1.00	0.86	0.71
210		1.00	0.81
250			0.92
280			1.00

$\Psi_{s\text{-}c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD

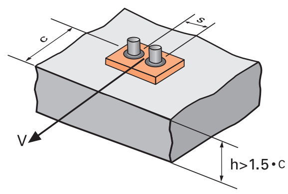


$\Psi_{s\text{-}c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$

FOR SINGLE ANCHOR FASTENING

Reduction Factor $\Psi_{s\text{-}c,V}$ – Non-cracked concrete

$\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s\text{-}c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72

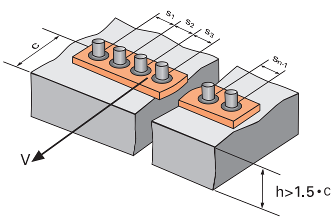


$\Psi_{s\text{-}c,V} = \frac{3c + s}{6c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$

FOR 2 ANCHORS FASTENING

Reduction Factor $\Psi_{s\text{-}c,V}$ – Non-cracked concrete

$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
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
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
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
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
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65



FOR OTHER CASE OF FASTENINGS

$$\Psi_{s\text{-}c,V} = \frac{3c + s_1 + s_2 + s_3 + ... + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

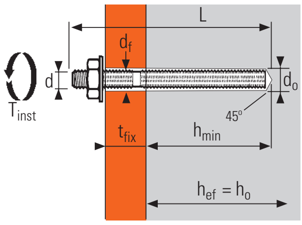
EPCON G5

Zinc Coated Anchor Stud (G8.8)

Epoxy Resin - High Performance

Performance	Material	Installation

ICC-ES EVALUATION REPORT



Technical Data

EPCON G5	Anchor depth (mm)	Max thick of fixture (mm)	Drill depth (mm)	Min thick of base material (mm)	Ø Thread (mm)	Ø Drill bit (mm)	Total anchor length (mm)	Max tighten torque (Nm)	Ramset power tool code	Drill bit type-size
	$h_{ef,min}$	t_{fix}	h_o	h_{min}	d	d_o	L	T_{inst}		
M8	80	15	80	100	8	10	110	10	DD527	R3 PLUS-10
M10	90	20	90	115	10	12	130	20	DD527	R3 PLUS-12
M12	110	25	110	140	12	14	160	30	DD527	R3 PLUS-14
M16	125	35	125	160	16	18	190	60	DD543	R3 PLUS-18
M20	170	65	170	215	20	25	260	120	DD565	R3 MAX-25
M24	210	63	210	270	24	28	300	200	DD565	R3 MAX-28
M27	240	60	240	300	27	30	340	300	DD565	R3 MAX-30
M30	280	70	280	350	30	35	380	400	DD565	R3 MAX-35
M33	300	80	300	375	33	38	420	1200	DD565	R3 MAX-38
M36	330	90	330	413	36	40	460	1500	DD565	R3 MAX-40
M39	360	100	360	450	39	45	510	1800	DD565	R3 MAX-45

MATERIAL

Stud:
Grade 8.8

Hexagonal Nut:
Grade 8 or 10

Washer:
Steel

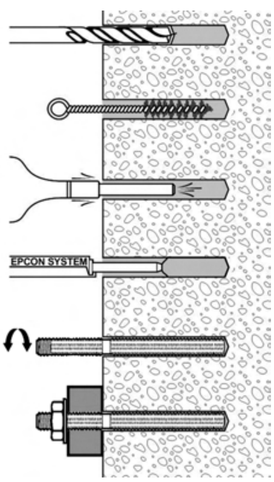
Coating:
Zinc Coated 5µm

Anchor Mechanical Properties

CARBON STEEL Grade 8.8	M8	M10	M12	M16	M20	M24
f_{uk} (N/mm2) Min. tensile strength	800	800	800	800	800	800
f_{yk} (N/mm2) Yield strength	640	640	640	640	640	640
A_s (mm2) Stressed cross-section	36.6	58	84.3	157	245	353
W_{el} (mm3) Elastic section modulus	31.2	62.3	109.2	277.5	540.9	935.5
$M^0_{Rk,s}$ (Nm) Characteristic bending moment	30.0	59.8	104.8	266.4	519.3	898.1
M (Nm) Recommended bending moment	24.0	47.8	83.9	213.1	415.4	718.5

CARBON STEEL Grade 8.8	M27	M30	M33	M36	M39
f_{uk} (N/mm2) Min. tensile strength	800	800	800	800	800
f_{yk} (N/mm2) Yield strength	640	640	640	640	640
A_s (mm2) Stressed cross-section	427	522.8	647	759	913
W_{el} (mm3) Elastic section modulus	1,245.0	1,668.0	2,322.0	2,951.0	3,860.0
$M^0_{Rk,s}$ (Nm) Characteristic bending moment	1,195.2	1,601.3	2,229.1	2,833.0	3,705.6
M (Nm) Recommended bending moment	956.2	1,281.0	1,783.3	2,266.4	2,964.5

INSTALLATION



Setting Time before applying load

Ambient temperature (°C)	Max time for installation (min)	Waiting time before applying load (hr)
32°C	8.5	2
27°C	12	2
20°C	15	2
16°C	18	3
10°C	21	6

Chemical Resistance of EPCON G5 Anchor

Chemical substances	Resistance	Chemical substances	Resistance
Xylene	1	Toluene	2
Gasoline	1	10% Nitric Acid	2
20% Caustic NaOH (Sodium Hydroxide)	1	8.5% Ammonium Hydroxide	2
Fresh Water	1	5% Bleach	3
Salt Water	1	Acetone	3
10% Sulfuric Acid (H2 SO4)	2	Glacial Acetic Acid	3
3.5% Hydrochloric Acid (HCL)	2	Methanol	3
9% Phosphoric Acid	2	Methylene Chloride	3

1 = High resistance (Anchors could be submerged in these materials)
2 = Medium resistance (Anchors could be temporary submerged due to splash or spill)
3 = Low resistance (Anchors should be limited to splash and spill followed by immediate cleanup)

EPCON G5

Zinc Coated Anchor Stud (G8.8)

Number of Anchors per cartridge

Stud diameter	8	10	12	16	20	24	27	30	33	36	39
Drilling Ø (mm)	10	12	14	18	25	28	30	35	38	35	45
Drilling depth (mm)	80	90	110	125	170	210	240	280	300	330	360
No. of anchors per cartridge											
EPCON G5 (650ml)	206.9	127.7	76.8	40.9	15.6	10.1	7.7	4.8	3.8	3.1	2.3

Ultimate Loads ($N_{Ru,m}$, $V_{Ru,m}$) / Characteristic Loads (N_{Rk}, V_{Rk}) in kN

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M8	M10	M12	M16	M20	M24
h_{ef} (mm)	80	90	110	125	170	210
$N_{Ru,m}$ (kN)	31.6	50.1	72.8	109.1	141.8	216.2
N_{Rk} (kN)	29.3	46.4	67.4	81.8	106.3	162.1

Anchor size	M27	M30	M33	M36	M39
h_{ef} (mm)	240	280	125	170	170
$N_{Ru,m}$ (kN)	264.7	360.3	419.1	485.3	595.6
N_{Rk} (kN)	198.5	270.2	314.3	364.0	446.7

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M8	M10	M12	M16	M20	M24
$V_{Ru,m}$ (kN)	19.0	30.1	43.7	81.4	127.0	183.0
V_{Rk} (kN)	17.6	27.8	40.5	75.4	117.6	169.4

Anchor size	M27	M30	M33	M36	M39
$V_{Ru,m}$ (kN)	221.4	271.0	335.4	393.5	473.3
V_{Rk} (kN)	205.0	250.9	310.6	364.3	438.2

Design Loads (N_{Rd}, V_{Rd}) for one anchor without edge or spacing influence in kN

$$N_{Rd} = \frac{N_{Rk}}{\gamma_{Mc,N}}$$

$$V_{Rd} = \frac{V_{Rk}}{\gamma_{Ms,V}}$$

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M8	M10	M12	M16	M20	M24
h_{ef} (mm)	80	90	110	125	170	210
N_{Rd} (kN)	19.5	30.9	45.0	45.5	59.1	90.1

Anchor size	M27	M30	M33	M36	M39
h_{ef} (mm)	240	280	300	330	360
N_{Rd} (kN)	110.3	150.1	174.6	202.2	248.2

$\gamma_{Mc,N}$ = 1.8

$\gamma_{Mc,N}$ = 1.5 *(steel failure)*

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M8	M10	M12	M16	M20	M24
V_{Rd} (kN)	14.1	22.3	32.4	60.3	94.1	135.6

Anchor size	M27	M30	M33	M36	M39
V_{Rd} (kN)	164.0	200.8	248.4	291.5	350.6

$\gamma_{Ms,V}$ = 1.25

Recommended Loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

$$N_{rec} = \frac{N_{Rk}}{\gamma_{Mc,N} \cdot \gamma_F}$$

$$V_{rec} = \frac{V_{Rk}}{\gamma_{Ms,V} \cdot \gamma_F}$$

TENSILE @ Concrete strength 30 N/mm2

Anchor size	M8	M10	M12	M16	M20	M24
h_{ef} (mm)	80	90	110	125	170	210
N_{rec} (kN)	13.9	22.1	32.1	32.5	42.2	64.3

Anchor size	M27	M30	M33	M36	M39
h_{ef} (mm)	240	280	300	330	360
N_{rec} (kN)	78.8	107.2	124.7	144.4	177.3

γ_F = 1.4

$\gamma_{Mc,N}$ = 1.8

$\gamma_{Mc,N}$ = 1.5 *(steel failure)*

SHEAR @ Concrete strength 30 N/mm2

Anchor size	M8	M10	M12	M16	M20	M24
V_{rec} (kN)	10.0	15.9	23.1	43.1	67.2	96.8

Anchor size	M27	M30	M33	M36	M39
V_{rec} (kN)	117.1	143.4	177.5	208.2	250.4

γ_F = 1.4

$\gamma_{Ms,V}$ = 1.25

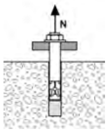
steel failure

EPCON G5

Zinc Coated Anchor Stud (G8.8)

CC-Method

TENSILE in kN



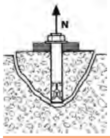
Pull-out resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$	Design pull-out resistance					
Anchor size	M8	M10	M12	M16	M20	M24
h_{ef}	80	90	110	125	170	210
$N^0_{Rd,p}$ (kN)	15.3	26.7	33.8	45.5	59.1	90.1

$N^0_{Rd,p}$	Design pull-out resistance				
Anchor size	M27	M30	M33	M36	M39
h_{ef}	240	280	300	330	360
$N^0_{Rd,p}$ (kN)	110.3	150.1	174.6	202.2	248.2

$\gamma_{Mc,N} = 1.8$



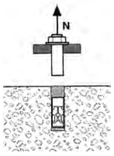
Concrete cone resistance
Concrete strength 30 N/mm²

$$N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_T \cdot \Psi_s \cdot \Psi_{c,N}$$

$N^0_{Rd,c}$	Design cone resistance					
Anchor size	M8	M10	M12	M16	M20	M24
h_{ef} (mm)	80	90	110	125	170	210
$N^0_{Rd,c}$ (kN)	26.3	31.4	42.5	51.4	81.6	112.0

$N^0_{Rd,c}$	Design cone resistance				
Anchor size	M27	M30	M33	M36	M39
h_{ef} (mm)	240	280	300	330	360
$N^0_{Rd,c}$ (kN)	136.9	172.5	191.3	220.6	251.4

$\gamma_{Mc,N} = 1.5$



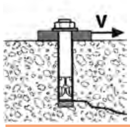
Steel resistance

$N_{Rd,s}$	Steel design tensile resistance					
Anchor size	M8	M10	M12	M16	M20	M24
$N_{Rd,s}$ (kN)	19.5	30.9	45.0	83.7	130.7	188.3

$N_{Rd,s}$	Steel design tensile resistance				
Anchor size	M27	M30	M33	M36	M39
$N_{Rd,s}$ (kN)	227.7	278.8	345.1	404.8	486.9

$\gamma_{Ms,N} = 1.5$

SHEAR in kN



Concrete edge resistance
Concrete strength 30 N/mm²

$$V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_{\beta,V} \cdot \Psi_{s\text{-}c,V}$$

$V^0_{Rd,c}$	Design concrete edge resistance at a minimum edge distance (c_{min})					
Anchor size	M8	M10	M12	M16	M20	M24
h_{ef} (mm)	80	90	110	125	170	210
c_{min}	40	45	55	65	85	105
s_{min}	40	45	55	65	85	105
$V^0_{Rd,c}$ (kN)	2.6	3.4	5.1	7.3	12.4	18.7

$V^0_{Rd,c}$	Design concrete edge resistance at a minimum edge distance (c_{min})				
Anchor size	M27	M30	M33	M36	M39
h_{ef} (mm)	240	280	300	330	360
c_{min}	120	140	150	165	180
s_{min}	120	140	150	165	180
$V^0_{Rd,c}$ (kN)	24.3	32.6	45.3	54.7	64.9

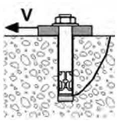
$\gamma_{Mc,V} = 1.5$

Steel resistance

$V_{Rd,s}$	Steel design shear resistance					
Anchor size	M8	M10	M12	M16	M20	M24
$V_{Rd,s}$ (kN)	14.1	22.3	32.4	60.3	94.1	135.6

$V_{Rd,s}$	Steel design shear resistance				
Anchor size	M27	M30	M33	M36	M39
$V_{Rd,s}$ (kN)	164.0	200.8	248.4	291.5	350.6

$\gamma_{Ms,V} = 1.25$



Concrete pry-out failure
Concrete Strength 30 N/mm²

$$V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot \Psi_s \cdot \Psi_{c,N}$$

$V^0_{Rd,cp}$	Design pry-out resistance					
Anchor size	M8	M10	M12	M16	M20	M24
$V^0_{Rd,cp}$ (kN)	37.6	44.9	60.7	73.5	116.5	160.0

$V^0_{Rd,cp}$	Design pry-out resistance				
Anchor size	M27	M30	M33	M36	M39
$V^0_{Rd,cp}$ (kN)	195.5	246.4	273.2	315.2	359.2

$\gamma_{Mc,V} = 1.5$

$$N_{Rd} = \min(N_{Rd,p} ; N_{Rd,c} ; N_{Rd,s})$$
$$\beta N = N_{Sd} / N_{Rd} \leq 1$$

$$V_{Rd} = \min(V_{Rd,c} ; V_{Rd,s} ; V_{Rd,cp})$$
$$\beta V = V_{Sd} / V_{Rd} \leq 1$$

$$\beta N + \beta V \leq 1.2$$

f_B INFLUENCE OF CONCRETE

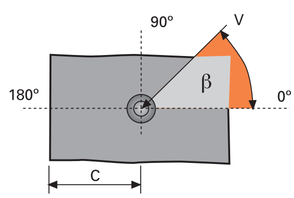
Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

f_T INFLUENCE OF EMBEDMENT DEPTH

$$f_T = \frac{h_{act}}{h_{ef}} \quad \text{where: } h_{ef} \leq h_{act} \leq 2h_{ef}$$

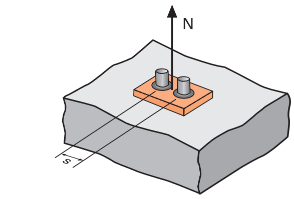
$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0~50	1.0
60	1.1
70	1.2
80	1.5
90~180	2.0



CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0.5 + \frac{s}{4h_{ef}}$$

$s_{min} < s < s_{cr,N}$

$s_{min} = 0.5h_{ef}$

$s_{cr,N} = 2h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

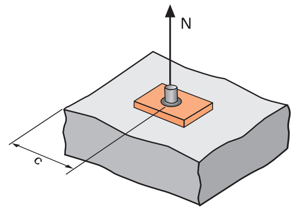
Spacing, s — Reduction Factor Ψ_s — Non-cracked concrete

	M8	M10	M12	M16	M20	M24
40	0.63					
45	0.64	0.63				
55	0.67	0.65	0.63			
65	0.70	0.68	0.65	0.63		
85	0.77	0.74	0.69	0.67	0.63	
105	0.83	0.79	0.74	0.71	0.65	0.63
140	0.94	0.89	0.82	0.78	0.71	0.67
160	1.00	0.94	0.86	0.82	0.74	0.69
180		1.00	0.91	0.86	0.76	0.71
220			1.00	0.94	0.82	0.76
250				1.00	0.87	0.80
340					1.00	0.90
420						1.00

Spacing, s — Reduction Factor Ψ_s — Non-cracked concrete

	M27	M30	M33	M36	M39
120	0.63				
140	0.65	0.63			
155	0.66	0.64	0.63		
165	0.67	0.65	0.64	0.63	
180	0.69	0.66	0.65	0.64	0.63
300	0.81	0.77	0.75	0.73	0.71
400	0.92	0.86	0.83	0.80	0.78
480	1.00	0.93	0.90	0.86	0.83
560		1.00	0.97	0.92	0.89
600			1.00	0.95	0.92
660				1.00	0.96
720					1.00

$\Psi_{c,N}$ INFLUENCE OF EDGE FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_{c,N} = 0.27 + 0.725 \cdot \frac{c}{h_{ef}}$$

$c_{min} < c < c_{cr,N}$

$c_{min} = 0.5h_{ef}$

$c_{cr,N} = h_{ef}$

Ψ_s must be used for each distance influenced the anchors group

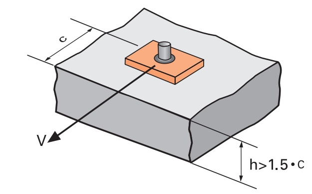
Edge, c — Reduction Factor $\Psi_{c,N}$ — Non-cracked concrete

	M8	M10	M12	M16	M20	M24
40	0.63					
45	0.68	0.63				
55	0.77	0.71	0.63			
63	0.84	0.78	0.69	0.64		
80	1.00	0.91	0.80	0.73		
85		0.95	0.83	0.76	0.63	
90		1.00	0.86	0.79	0.65	
105			0.96	0.88	0.72	0.63
110			1.00	0.91	0.74	0.65
125				1.00	0.80	0.70
150					0.91	0.79
170					1.00	0.86
210						1.00

Edge, c — Reduction Factor $\Psi_{c,N}$ — Non-cracked concrete

	M27	M30	M33	M36	M39
120	0.63				
140	0.69	0.63			
150	0.72	0.66	0.63		
165	0.77	0.70	0.67	0.63	
180	0.81	0.74	0.71	0.67	0.63
240	1.00	0.89	0.85	0.80	0.75
250		0.92	0.87	0.82	0.77
280		1.00	0.95	0.89	0.83
300			1.00	0.93	0.87
330				1.00	0.93
360					1.00

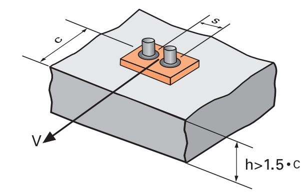
$\Psi_{s\text{-}c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



$$\Psi_{s\text{-}c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

FOR SINGLE ANCHOR FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$ — Non-cracked concrete

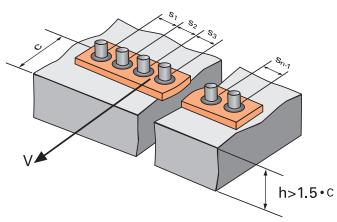
$\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s\text{-}c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



$$\Psi_{s\text{-}c,V} = \frac{3c + s}{6c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

FOR 2 ANCHORS FASTENING — Reduction Factor $\Psi_{s\text{-}c,V}$ — Non-cracked concrete

$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
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
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
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
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
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65



FOR OTHER CASE OF FASTENINGS

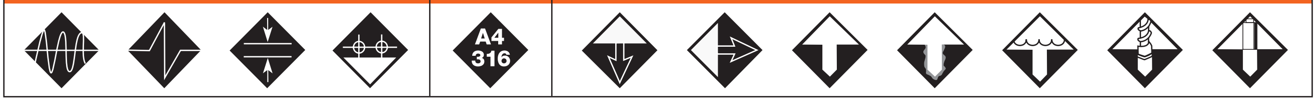
$$\Psi_{s\text{-}c,V} = \frac{3c + s_1 + s_2 + s_3 + ... + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

EPCON G5

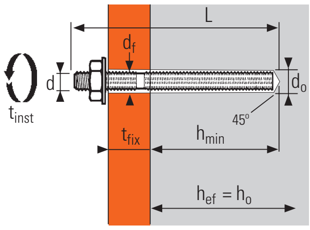
Stainless Steel Anchor Stud (SUS316)

Epoxy Resin - High Performance

Performance	Material	Installation



ICC-ES EVALUATION REPORT



Technical Data

EPCON G5 with Chemset Stud SS	Anchor depth (mm)	Max thick of fixture (mm)	Drill depth (mm)	Min thick of base material (mm)	Ø Thread (mm)	Ø Drill bit (mm)	Total anchor length (mm)	Max tighten torque (Nm)	Chemset stud code	Ramset power tool code	Drill bit type-size
	h_{ef}	t_{fix}	h_o	h_{min}	d	d_o	L	T_{inst}			
M8	80	15	80	100	8	10	110	10	CS08110SS	DD527	R3 PLUS-10
M10	90	20	90	115	10	12	130	20	CS10130SS	DD527	R3 PLUS-12
M12	110	25	110	140	12	14	160	30	CS12160SS	DD527	R3 PLUS-14
M16	125	35	125	160	16	18	190	60	CS16190SS	DD543	R3 PLUS-18
M20	170	65	170	215	20	25	260	120	CS20260SS	DD565	R3 MAX-25
M24	210	63	210	270	24	28	300	200	CS24300SS	DD565	R3 MAX-28
M30	280	70	280	350	30	35	380	400	CS30380SS	DD565	R3 MAX-35

EPOXY G5 Two part cartridge, 100% epoxy resin - vol. 650ml

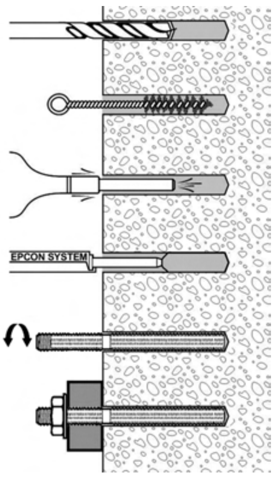
MATERIAL

Stud:
SUS316

Hexagonal Nut:
SUS316

Washer:
SUS316

INSTALLATION



Anchor Mechanical Properties

STAINLESS STEEL SUS316	M8	M10	M12	M16	M20	M24	M30
$\mathbf{f_{uk}}$ (N/mm2) Min. tensile strength	650	650	650	650	650	650	500
$\mathbf{f_{yk}}$ (N/mm2) Yield strength	450	450	450	450	450	450	250
$\mathbf{A_s}$ (mm2) Stressed cross-section	36.6	58	84.3	157	245	353	522.8
$\mathbf{W_{el}}$ (mm3) Elastic section modulus	31.2	62.3	109.2	277.5	540.9	935.5	1,686.0
$\mathbf{M^0_{Rk,s}}$ (Nm) Characteristic bending moment	24.4	48.6	85.2	216.4	421.9	729.7	1,011.6
M (Nm) Recommended bending moment	15.7	31.4	54.9	139.6	272.2	470.8	652.6

Setting Time before applying load

Ambient temperature (ºC)	Max time for installation (min)	Waiting time before applying load (hr)
32ºC	8.5	2
27ºC	12	2
20ºC	15	2
16ºC	18	3
10ºC	21	6

Chemical Resistance of EPCON G5 Anchor

Chemical substances	Resistance	Chemical substances	Resistance
Xylene	1	Toluene	2
Gasoline	1	10% Nitric Acid	2
20% Caustic NaOH (Sodium Hydroxide)	1	8.5% Ammonium Hydroxide	2
Fresh Water	1	5% Bleach	3
Salt Water	1	Acetone	3
10% Sulfuric Acid (H2 SO4)	2	Glacial Acetic Acid	3
3.5% Hydrochloric Acid (HCL)	2	Methanol	3
9% Phosphoric Acid	2	Methylene Chloride	3

1 = High resistance (Anchors could be submerged in these materials)

2 = Medium resistance (Anchors could be temporary submerged due to splash or spill)

3 = Low resistance (Anchors should be limited to splash and spill followed by immediate cleanup)

EPCON G5

Stainless Steel Anchor Stud (SUS316)

Number of Sealings per cartridge

Stud diameter	**8**	**10**	**12**	**16**	**20**	**24**	**30**
Drilling Ø (mm)	10	12	14	18	25	28	35
Drilling depth (mm)	80	90	110	125	170	210	280
No. of anchors per cartridge							
EPCON G5 (650ml)	206.9	127.7	76.8	40.9	15.6	10.1	4.8

Ultimate Loads ($N_{Ru,m}$, $V_{Ru,m}$) / Characteristic Loads (N_{Rk}, V_{Rk}) in kN

TENSILE @ Concrete strength 30 N/mm²

Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
$N_{Ru,m}$ (kN)	25.7	40.7	59.2	110.2	141.8	216.2	360.3
N_{Rk} (kN)	23.8	37.7	54.8	102.1	106.3	162.1	270.2

SHEAR @ Concrete strength 30 N/mm²

Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$V_{Ru,m}$ (kN)	15.4	24.4	35.5	66.1	103.2	148.7	169.4
V_{Rk} (kN)	14.3	22.6	32.9	61.2	95.6	137.7	156.8

Design Loads (N_{Rd}, V_{Rd}) for one anchor without edge or spacing influence in kN

$$N_{Rd} = \frac{N_{Rk}}{\gamma_{Mc,N}}$$

$$V_{Rd} = \frac{V_{Rk}}{\gamma_{Ms,V}}$$

TENSILE @ Concrete strength 30 N/mm²

Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
N_{Rd} (kN)	15.3	24.3	35.4	65.8	59.1	90.1	150.1

$\gamma_{Mc,N}$ = 1.8
$\gamma_{Mc,N}$ = 1.55 *(steel failure)*
$\gamma_{Mc,N}$ = 2.00 *(steel failure ≥ M30)*

SHEAR @ Concrete strength 30 N/mm²

Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
V_{Rd} (kN)	9.2	14.6	21.2	39.5	61.6	88.8	78.4

$\gamma_{Ms,V}$ = 1.55 for M8 to M24
$\gamma_{Ms,V}$ = 2.00 for M30

Recommended Loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

$$N_{rec} = \frac{N_{Rk}}{\gamma_{Mc,N} \cdot \gamma_F}$$

$$V_{rec} = \frac{V_{Rk}}{\gamma_{Ms,V} \cdot \gamma_F}$$

TENSILE @ Concrete strength 30 N/mm²

Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
N_{rec} (kN)	11.0	17.4	25.3	47.0	42.2	64.3	107.2

γ_F = 1.4
$\gamma_{Mc,N}$ = 1.8
$\gamma_{Mc,N}$ = 1.55 *(steel failure M8 - M24)*
$\gamma_{Mc,N}$ = 2.00 *(steel failure ≥ M30)*

SHEAR @ Concrete strength 30 N/mm²

Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
V_{rec} (kN)	6.6	10.4	15.2	28.2	44.0	63.4	56.0

γ_F = 1.4
$\gamma_{Ms,V}$ = 1.55 for M8 to M24
$\gamma_{Ms,V}$ = 2.00 for M30

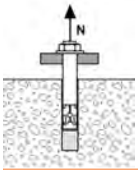
steel failure

EPCON G5

Stainless Steel Anchor Stud (SUS316)

CC-Method

TENSILE in kN

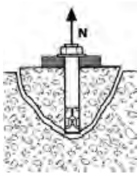


Pull-out resistance
Concrete strength 30 N/mm²

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

$N^0_{Rd,p}$ Design pull-out resistance							
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
$N^0_{Rd,p}$ (kN)	15.3	26.7	33.8	45.5	59.1	90.1	150.1

$\gamma_{Mc,N} = 1.8$

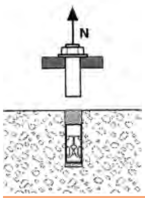


Concrete cone resistance
Concrete strength 30 N/mm²

$N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_T \cdot \Psi_s \cdot \Psi_{c,N}$

$N^0_{Rd,p}$ Design cone resistance							
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
$N^0_{Rd,c}$ (kN)	26.3	31.4	42.5	51.4	81.6	112.0	172.5

$\gamma_{Mc,N} = 1.5$

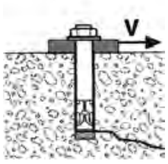


Steel resistance

$N_{Rd,s}$ Steel design tensile resistance							
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$N_{Rd,s}$ (kN)	15.3	24.3	35.4	65.8	102.7	148.0	130.7

$\gamma_{Ms,N} = 1.55$ for M8 to M24
$\gamma_{Ms,N} = 2.00$ for M30

SHEAR in kN

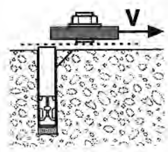


Concrete edge resistance
Concrete strength 30 N/mm²

$V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_{\beta,V} \cdot \Psi_{s\text{-}c,V}$

$V^0_{Rd,c}$ Design concrete edge resistance at a minimum edge distance (c_{min})							
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
h_{ef} (mm)	80	90	110	125	170	210	280
c_{min}	40	45	55	65	85	105	140
s_{min}	40	45	55	65	85	105	140
$V^0_{Rd,c}$ (kN)	2.6	3.4	5.1	7.3	12.4	18.7	32.6

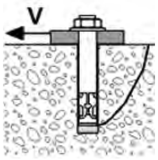
$\gamma_{Mc,V} = 1.5$



Steel resistance

$V_{Rd,s}$ Steel design shear resistance							
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$V_{Rd,s}$ (kN)	9.2	14.6	21.2	39.5	61.6	88.8	78.4

$\gamma_{Ms,V} = 1.55$ for M8 to M24
$\gamma_{Ms,V} = 2.00$ for M30



Concrete pry-out failure
Concrete Strength 30 N/mm²

$V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot \Psi_s \cdot \Psi_{c,N}$

$V^0_{Rd,cp}$ Design pry-out resistance							
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
$V^0_{Rd,cp}$ (kN)	52.7	62.9	84.9	102.9	163.2	224.0	344.9

$\gamma_{Ms,V} = 1.5$

$N_{Rd} = \min(N_{Rd,p}\,;\,N_{Rd,c}\,;\,N_{Rd,s})$
$\beta N = N_{Sd} / N_{Rd} \le 1$

$V_{Rd} = \min(V_{Rd,c}\,;\,V_{Rd,s};\,V_{Rd,cp})$
$\beta V = V_{Sd} / V_{Rd} \le 1$

$\beta N + \beta V \le 1.2$

f_B INFLUENCE OF CONCRETE

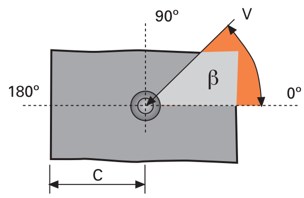
Concrete Grade	f_B	Concrete Grade	f_B
C16/20	0.81	C35/45	1.21
C20/25	0.90	C40/50	1.28
C25/30	1.00	C45/55	1.34
C30/37	1.10	C50/60	1.40

f_T INFLUENCE OF EMBEDMENT DEPTH

$f_T = \dfrac{h_{act}}{h_{ef}}$ where: $h_{ef} \le h_{act} \le 2h_{ef}$

$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0~50	1.0
60	1.1
70	1.2
80	1.5
90~180	2.0

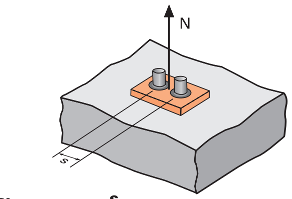


EPCON G5

Stainless Steel Anchor Stud (SUS316)

CC-Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0.5 + \frac{s}{4h_{ef}}$$

$s_{min} < s < s_{cr,N}$

$s_{min} = 0.5h_{ef}$

$s_{cr,N} = 2h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

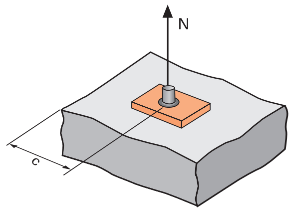
Spacing, s — Reduction Factor Ψ_s — Non-cracked concrete

	M8	M10	M12	M16
40	0.63			
45	0.64	0.63		
55	0.67	0.65	0.63	
65	0.70	0.68	0.65	0.63
85	0.77	0.74	0.69	0.67
105	0.83	0.79	0.74	0.71
140	0.94	0.89	0.82	0.78
160	1.00	0.94	0.86	0.82
180		1.00	0.91	0.86
220			1.00	0.94
250				1.00

Spacing, s — Reduction Factor Ψ_s — Non-cracked concrete

	M20	M24	M30
85	0.63		
105	0.65	0.63	
140	0.71	0.67	0.63
160	0.74	0.69	0.64
180	0.76	0.71	0.66
220	0.82	0.76	0.70
250	0.87	0.80	0.72
300	0.94	0.86	0.77
340	1.00	0.90	0.80
370		0.94	0.83
420		1.00	0.88
560			1.00

$\Psi_{c,N}$ INFLUENCE OF EDGE FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_{c,N} = 0.27 + 0.725 \cdot \frac{c}{h_{ef}}$$

$c_{min} < c < c_{cr,N}$

$c_{min} = 0.5h_{ef}$

$c_{cr,N} = h_{ef}$

Ψ_s must be used for each distance influenced the anchors group

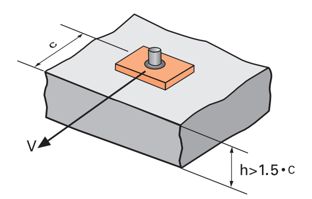
Edge, c — Reduction Factor $\Psi_{c,N}$ — Non-cracked concrete

	M8	M10	M12	M16
40	0.63			
45	0.68	0.63		
55	0.77	0.71	0.63	
65	0.86	0.79	0.70	0.65
80	1.00	0.91	0.80	0.73
90		1.00	0.86	0.79
110			1.00	0.91
125				1.00

Edge, c — Reduction Factor $\Psi_{c,N}$ — Non-cracked concrete

	M20	M24	M30
85	0.63		
105	0.72	0.63	
120	0.78	0.68	
140	0.87	0.75	0.63
170	1.00	0.86	0.71
210		1.00	0.81
250			0.92
280			1.00

$\Psi_{s\text{-}c,V}$ INFLUENCED OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD

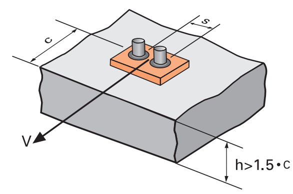


$$\Psi_{s\text{-}c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

FOR SINGLE ANCHOR FASTENING

Reduction Factor $\Psi_{s\text{-}c,V}$ — Non-cracked concrete

$\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$\Psi_{s\text{-}c,V}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72

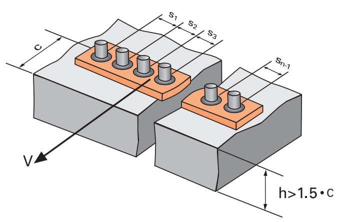


$$\Psi_{s\text{-}c,V} = \frac{3c + s}{6c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

FOR 2 ANCHORS FASTENING

Reduction Factor $\Psi_{s\text{-}c,V}$ — Non-cracked concrete

$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
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
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
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
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
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65



FOR OTHER CASE OF FASTENINGS

$$\Psi_{s\text{-}c,V} = \frac{3c + s_1 + s_2 + s_3 + \ldots + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$