HP HAMMER GLASS CAPSULES WITH VA RODS

PRODUCT FEATURES
- Speedy installation without any drilling accessories.
- Guarantee fill up hole without any wastage.
- Highly recommended for floor and wall fixings.
- High efficiency in series installation.
- Suitable for high dynamic loading in solid substrate.
- Suitable for close edges and tight spacings application.

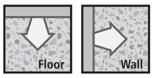
RESIN SPECIFICATIONS
- Epoxy Acrylate Resin
- Specific weight: 1.6 g/cm³.
- Compressive Strength (BS 6319): 70 N/mm².

SHELF LIFE
- Shelf life is 12 months with the capsules kept in cool dry conditions (+5°C to + 25°C) out of direct sunlight.

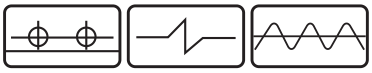
SUBSTRATES
- RC concrete, solid stone, concrete block & other solid masonry.

CONC | STONE

HOLE ORIENTATION



LOADING ZONES



APPROVALS / CERTIFICATIONS
- TNO Certification for Rebar Installation from Netherlands.

TNO innovation for life

VA RODS AVAILABILITY

Z ZINC | G | A2 INOX | A4 INOX

BASIC LOADING DATA

- For static and quasi-static loadings.
- Only a single anchor is considered.
- No anchor spacing and edge distance influences.
- Loading applicable to dry and wet concrete.
- For non-cracked concrete only.
- Concrete compressive strength C20/25 ($f_{ck,cube}$ = 25 N/mm²).

STEEL CLASS 5.8

CHARACTERISTIC RESISTANCE [F_{Rk}]								
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Tensile Load, N_{Rk}	[kN]	16.7	25.2	35.3	60.5	104.9	141.1	220.5
Shear Load, V_{Rk}	[kN]	9.0	14.0	21.0	39.0	61.0	88.0	140.0

DESIGN RESISTANCE [F_{Rd}]								
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Tensile Load, N_{Rd}	[kN]	9.3	14.0	19.6	33.6	58.3	78.4	122.5
Shear Load, V_{Rd}	[kN]	7.2	11.2	16.8	31.2	48.8	70.4	112.0

RECOMMENDED LOAD [F_{Rec}]								
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Tensile Load, N_{Rec}	[kN]	6.6	10.0	14.0	24.0	41.6	56.0	87.5
Shear Load, V_{Rec}	[kN]	5.1	8.0	12.0	22.3	34.9	50.3	80.0

** Bold Italic numbers represent steel failure.*

HIGH TENSILE STEEL CLASS 8.8

CHARACTERISTIC RESISTANCE [F_{Rk}]								
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Tensile Load, N_{Rk}	[kN]	16.7	25.2	35.3	60.5	104.9	141.1	220.5
Shear Load, V_{Rk}	[kN]	15.0	23.0	33.0	63.0	98.0	141.0	224.0

DESIGN RESISTANCE [F_{Rd}]								
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Tensile Load, N_{Rd}	[kN]	9.3	14.0	19.6	33.6	58.3	78.4	122.5
Shear Load, V_{Rd}	[kN]	12.0	18.4	26.4	50.4	78.4	112.8	179.2

RECOMMENDED LOAD [F_{Rec}]								
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Tensile Load, N_{Rec}	[kN]	6.6	10.0	14.0	24.0	41.6	56.0	87.5
Shear Load, V_{Rec}	[kN]	8.6	13.1	18.9	36.0	56.0	80.6	128.0

** Bold Italic numbers represent steel failure.*

HP HAMMER GLASS CAPSULES WITH VA RODS

CHARACTERISTIC RESISTANCE [F_{Rk}]						STAINLESS STEEL CLASS A2/A4		
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Tensile Load, N_{Rk}	[kN]	16.7	25.2	35.3	60.5	104.9	141.1	220.5
Shear Load, V_{Rk}	[kN]	13.0	20.0	29.0	55.0	86.0	124.0	196.0

DESIGN RESISTANCE [F_{Rd}]								
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Tensile Load, N_{Rd}	[kN]	9.3	14.0	19.6	33.6	58.3	78.4	122.5
Shear Load, V_{Rd}	[kN]	8.3	12.8	18.6	35.3	55.1	79.5	125.6

RECOMMENDED LOAD [F_{Rec}]								
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Tensile Load, N_{Rec}	[kN]	6.6	10.0	14.0	24.0	41.6	56.0	87.5
Shear Load, V_{Rec}	[kN]	6.0	9.2	13.3	25.2	39.4	56.8	89.7

** Bold Italic numbers represent steel failure.*

SERVICE TEMPERATURE RANGE

The Statheros HP Epoxy Acrylate Resin Glass Capsule performance based on the tabulated temperature range as given below. A gradual temperature increase in base material may lead to a reduction of design bond stress.

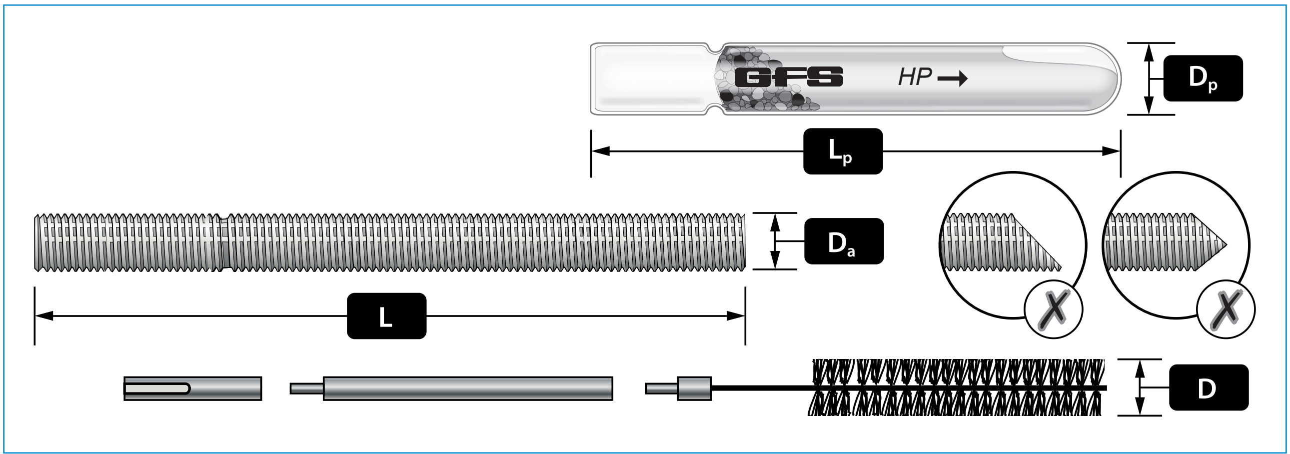
TEMPERATURE RANGE	BASE MATERIAL TEMPERATURE	MAXIMUM LONG TERM BASE MATERIAL TEMPERATURE	MAXIMUM SHORT TERM BASE MATERIAL TEMPERATURE
Temperature Range	-40 °C to + 80 °C	+ 50 °C	+80 °C

Maximum Short Term Base Material Temperature
Short term temperature refers to those elevated base material temperature occurred over brief moment such as diurnal cycling intervals.

Maximum Long Term Base Material Temperature
Long term temperature refers to those elevated base material temperature occurred over a significant long period of time.

HP HAMMER GLASS CAPSULES DIMENSION

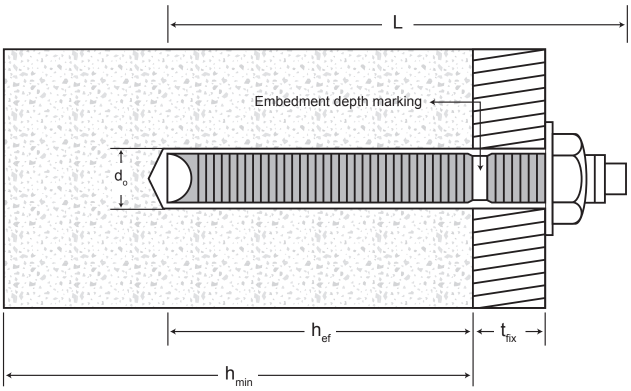
ANCHOR (CAPSULE) SIZE		M8	M10	M12	M16	M20	M24	M30
Capsule Diameter, D_p	[mm]	9	11	13	17	22	24	33
Capsule Length, L_p	[mm]	80	90	110	125	175	210	265
Capsule Volume, V_p	[ml]	4.0	6.4	11.3	23.1	53.0	76.0	191.0
Required Volume per cm, V_s	[cc/cm]	0.44	0.59	0.75	1.09	2.64	2.87	4.37
Recommended Stud Rods Length, L	[mm]	110	130	160	190	260	300	380
Minimum Brush Diameter, D	[mm]	10.5	11.5	14.5	18.5	25.5	28.5	35.5



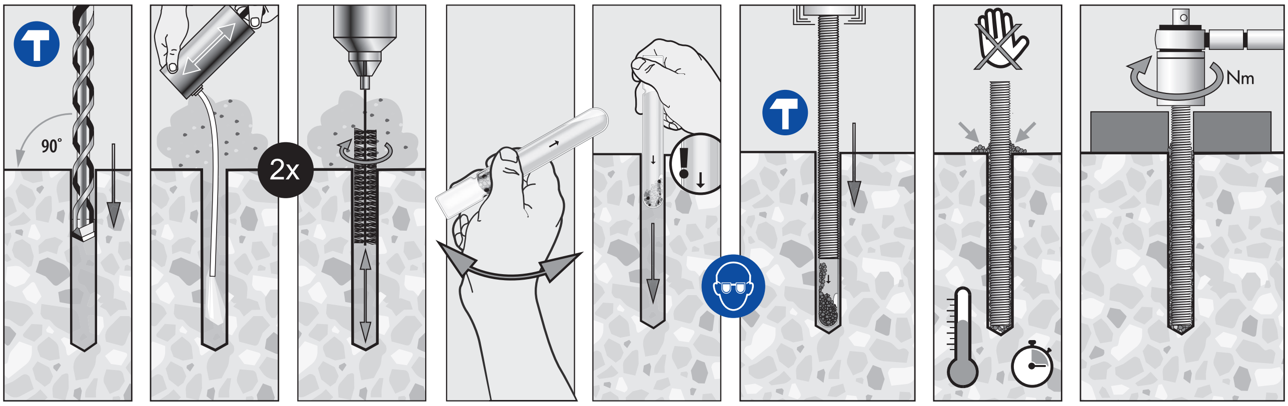
SETTING DETAILS

ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M30
Nominal Drill Hole Diameter, d_0	[mm]	10	12	14	18	25	28	35
Fixture Hole Diameter, d_{fix}	[mm]	9	12	14	18	22	26	33
Maximum Fixture Thickness, t_{fix}	[mm]	15	20	30	40	50	55	70
Recommended Torque, T_{inst}	[Nm]	10	20	40	80	120	180	300
Standard Anchorage Depth: $h_{ef,std}$								
Standard Anchorage Depth, $h_{ef,std}$	[mm]	80	90	110	125	175	210	270
Minimum Spacing, s_{min}	[mm]	40	45	55	65	85	105	135
Minimum Edge Distance, c_{min}	[mm]	40	45	55	65	85	105	135
Minimum Concrete Thickness, h_{min}	[mm]	110	120	140	160	220	265	350
Maximum Anchorage Depth, $h_{ef,max}$								
Maximum Anchorage Depth, $h_{ef,max}$	[mm]	160	180	220	250	350	420	540
Minimum Spacing, s_{min}	[mm]	50	60	70	95	120	145	175
Minimum Edge Distance, c_{min}	[mm]	50	60	70	95	120	145	175
Minimum Concrete Thickness, h_{min}	[mm]	$h_{ef,max}$ + 30mm				$h_{ef,max} + 2d_o$		

SETTING DIAGRAM



INSTALLATION PROCEDURES



1. Drill hole either with an electric rotary hammer or a diamond drilling machine. *(Refer to setting table for diameter and depth)*
2. In reinforced concrete, the use of diamond drilling machine is recommended.
3. Clean anchor hole at least twice thoroughly using a brush and compressed air or with clean water when the substrate is in wet condition.
4. Before inserting the HP Hammer Glass Capsules into the hole, check the viscosity of the resin. At lukewarm temperature, it should run easily inside the glass capsule.
5. Always take note of the arrow direction on the capsule before inserting into the drilled hole. To ensure that the capsule is inserted correctly, always have the arrow pointing into the hole when you insert the capsule.
6. Clean the rebar or anchor rod before inserting into the hole. The rebar or anchor rod should be free of any grease, corrosion or oil.
7. Make sure the rebar or anchor rod match with the correct embedment depth. Installation of the rebar or anchor rod may be executed manually by using a handheld hammer or mechanically by using an electric or pneumatic percussion tool. *(Always wear safety goggles when installing the anchor).*
8. Observe the curing time. The installed rebar or anchor rod cannot be disturbed or loaded before the specified curing time has lapsed.

GEL AND CURING TIME

BASE MATERIAL TEMPERATURE $T_{base\ material}$ (°C)	CURE TIME (WORKING TIME) IN DRY CONCRETE $t_{cure,dry}$ (hrs.)	CURE TIME FOR WET CONCRETE $t_{cure,wet}$ (hrs)
$-5 \leq T_{base\ material} < 0$	10	10
$0 \leq T_{base\ material} < +10$	5	10
$+10 \leq T_{base\ material} < +20$	2	4
$+20 \leq T_{base\ material} < +30$	1	2

MATERIAL SPECIFICATIONS

DESIGNATION	MATERIAL
VA Rods - Class 5.8 & 8.8 M8 - M30	Strength class 5.8, 8.8 to EN ISO 898-1 Steel, zinc plated ≥ 5µm to EN ISO 4042 Steel, hot dipped galvanised ≥ 40µm to EN ISO 10684
Washer ISO 7089	Steel, zinc plated to EN ISO 4042 Steel, hot dipped galvanised to EN ISO 10684
Hexagon Nut EN ISO 4032	Strength class 5.8, 8.8 to EN ISO 898-2 Steel galvanised ≥ 5µm to EN ISO 4042 Hot dipped galvanised ≥ 40µm to EN ISO 10684
VAS Rods - Class A2 & A4 M8 - M30	Strength class A2-70 & A4-70 to EN ISO 3506-1 Stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 to EN 10088
Washer ISO 7089	Stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088
Hexagon Nut EN ISO 4032	Strength class A2-70 & A4-70 to EN ISO 3506-2 Stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 to EN 10088

MECHANICAL PROPERTIES

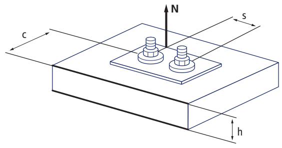
ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M27	M30
Cross Sectional Area, A_s	[mm²]	36.6	58.0	84.3	157.0	245.0	353.0	459.0	519.0
Nominal Tensile Strength, f_{uk}	[N/mm²]								
~ Carbon Steel: Class 5.8		500	500	500	500	500	500	500	500
~ High Tensile Steel: Class 8.8		800	800	800	800	800	800	800	800
~ Stainless Steel: Class A2/A4		700	700	700	700	700	700	700	700
Nominal Yield Strength, f_{yk}	[N/mm²]								
~ Carbon Steel: Class 5.8		400	400	400	400	400	400	400	400
~ High Tensile Steel: Class 8.8		640	640	640	640	640	640	640	640
~ Stainless Steel: Class A2/A4		450	450	450	450	450	450	450	450
Elastic Moment Of Resistance, W_{el}	[mm³]	31.2	62.3	109.2	277.5	540.9	935.5	1,245.0	1,668.0
Design Bending Moment, $M_{Rd,s}$	[Nm]								
~ Carbon Steel: Class 5.8		15.2	29.6	52.8	132.8	260.0	448.8	665.6	900.0
~ High Tensile Steel: Class 8.8		24.0	48.0	84.0	212.8	415.2	718.4	1,065.6	1,439.2
~ Stainless Steel: Class A2/A4		16.7	33.3	59.0	149.4	291.0	503.8	746.8	1,009.0

The design bending moment is derived from $M_{Rd,s} = M_{Rk,s} / \gamma_{Ms,N}$ where the partial safety factor is 1.25 for carbon steel 5.8 and high tensile steel 8.8; 1.56 for stainless steel A2/A4. The recommended bending moment is derived from $M_{Rec,s} = M_{Rd,s} / \gamma_F$ where the partial safety factor is 1.4.

HP HAMMER GLASS CAPSULES WITH VA RODS

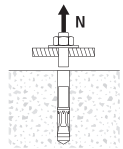
TENSION LOAD [N_{Rd}]

Design Tensile Resistance, N_{Rd}:	lower value of [$N_{Rd,s}$; $N_{Rd,p}$; $N_{Rd,c}$]
Design Steel Tensile Resistance:	$N_{Rd,s}$
Design Pull-Out Resistance:	$N_{Rd,p} = N^0_{Rd,p} \cdot \Psi_{h,N} \cdot \Psi_{\beta,N}$
Design Concrete Cone Resistance:	$N_{Rd,c} = N^0_{Rd,c} \cdot \Psi_{h,N} \cdot \Psi_{\beta,N} \cdot \Psi_{s,N} \cdot \Psi_{c,N}$



STEEL TENSILE RESISTANCE [$N_{Rd,s}$]

- For static and quasi-static loadings.
- Only a single anchor is considered.
- For non-cracked concrete only.
- Data valid only for specified steel grade.

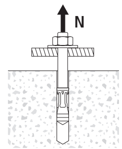


ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M30
Carbon Steel: Class 5.8								
$N_{Rd,s}$	[kN]	12.0	19.3	28.0	52.0	82.0	118.0	187.3
High Tensile Steel: Class 8.8								
$N_{Rd,s}$	[kN]	19.3	30.7	44.7	84.0	130.7	188.0	299.3
Stainless Steel: Class A2/A4								
$N_{Rd,s}$	[kN]	13.9	21.4	31.6	58.8	92.0	132.1	210.2

The design steel tensile resistance is derived from $N_{Rd,s} = N_{Rk,s} / \gamma_{Ms,N}$ where the partial safety factor is 1.5 for carbon steel 5.8 and high tensile steel 8.8; 1.87 for stainless steel A2/A4. The recommended load is derived from $N_{Rec,s} = N_{Rd,s} / \gamma_F$ where the partial safety factor is 1.4.

PULL-OUT RESISTANCE [$N_{Rd,p}$]

- For static and quasi-static loadings.
- Only a single anchor is considered.
- No anchor spacing and edge distance influences.
- Loading applicable to dry and wet concrete.
- For non-cracked concrete only.
- Concrete compressive strength C20/25 ($f_{ck,cube}$ = 25 N/mm²).
- Applicable to carbon steel and stainless steel.

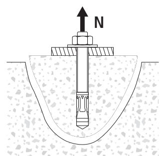


ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M30
$h_{ef,std}$	[mm]	80	90	110	125	175	210	270
$N^0_{Rd,p}$	[kN]	9.3	14.0	19.6	33.6	58.3	78.4	122.5

The design pull-out resistance is derived from $N^0_{Rd,p} = N^0_{Rk,p} / \gamma_{Mc,N}$ where the partial safety factor is 1.8. The recommended load is derived from $N^0_{Rec,p} = N^0_{Rd,p} / \gamma_F$ where the partial safety factor is 1.4.

CONCRETE CONE RESISTANCE [$N_{Rd,c}$]

- For static and quasi-static loadings.
- Only a single anchor is considered.
- No anchor spacing and edge distance influences.
- Loading applicable to dry and wet concrete.
- For non-cracked concrete only.
- Concrete compressive strength C20/25 ($f_{ck,cube}$ = 25 N/mm²).

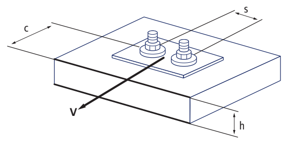


ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M30
$h_{ef,std}$	[mm]	80	90	110	125	175	210	270
$N^0_{Rd,c}$	[kN]	20.1	24.0	32.4	39.2	64.9	85.4	124.5

The design concrete cone resistance is derived from $N^0_{Rd,c} = N^0_{Rk,c} / \gamma_{Mc,N}$ where the partial safety factor is 1.8. The recommended load is derived from $N^0_{Rec,c} = N^0_{Rd,c} / \gamma_F$ where the partial safety factor is 1.4.

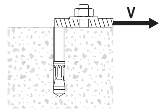
SHEAR LOAD [V_{Rd}]

Design Shear Resistance, V_{Rd}:	lower value of [$V_{Rd,s}$; $V_{Rd,c}$; $V_{Rd,cp}$]
Design Steel Shear Resistance:	$V_{Rd,s}$
Design Concrete Edge Shear Resistance:	$V_{Rd,c} = V^0_{Rd,c} \cdot \Psi_{\beta,V} \cdot \Psi_{\alpha,V} \cdot \Psi_{sc,V}$
Design Concrete Pry-Out Resistance:	$V_{Rd,cp} = V^0_{Rd,cp} \cdot \Psi_{\beta,V} \cdot \Psi_{s,N} \cdot \Psi_{c,N}$



STEEL SHEAR RESISTANCE [$V_{Rd,s}$]

- For static and quasi-static loadings.
- Only a single anchor is considered.
- For non-cracked concrete only.
- Data valid only for specified steel grade.

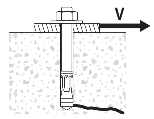


ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M30
Carbon Steel: Class 5.8								
$V_{Rd,s}$	[kN]	7.2	11.2	16.8	31.2	48.8	70.4	112.0
High Tensile Steel: Class 8.8								
$V_{Rd,s}$	[kN]	12.0	18.4	26.4	50.4	78.4	112.8	179.2
Stainless Steel: Class A2/A4								
$V_{Rd,s}$	[kN]	8.3	12.8	18.6	35.3	55.1	79.5	125.6

The design steel shear resistance is derived from $V_{Rd,s} = V_{Rk,s} / \gamma_{Ms,v}$ where the partial safety factor is 1.25 for carbon steel 5.8 and high tensile steel 8.8; 1.56 for stainless steel A2/A4. The recommended load is derived from $V_{Rec,s} = V_{Rd,s} / \gamma_F$ where the partial safety factor is 1.4.

CONCRETE EDGE SHEAR RESISTANCE [$V_{Rd,c}$]

- For static and quasi-static loadings.
- Only a single anchor is considered.
- No anchor spacing and edge distance influences.
- Loading applicable to dry and wet concrete.
- For non-cracked concrete only.
- Concrete compressive strength C20/25 ($f_{ck,cube}$ = 25 N/mm²).

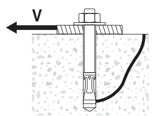


ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M30
$h_{ef,std}$	[mm]	80	90	110	125	175	210	270
c_{min}	[mm]	40	45	55	65	85	105	135
$V^0_{Rd,c}$	[kN]	3.6	4.7	6.9	10.1	17.8	25.8	42.1

The design concrete edge shear resistance is derived from $V^0_{Rd,c} = V^0_{Rk,c} / \gamma_{Mc,V}$ where the partial safety factor is 1.5. The recommended load is derived from $V^0_{Rec,c} = V^0_{Rd,c} / \gamma_F$ where the partial safety factor is 1.4.

CONCRETE PRY-OUT RESISTANCE [$V_{Rd,cp}$]

- For static and quasi-static loadings.
- Only a single anchor is considered.
- No anchor spacing and edge distance influences.
- Loading applicable to dry and wet concrete.
- For non-cracked concrete only.
- Concrete compressive strength C20/25 ($f_{ck,cube}$ = 25 N/mm²).



ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M30
$h_{ef,std}$	[mm]	80	90	110	125	175	210	270
$V^0_{Rd,cp}$	[kN]	40.1	47.9	64.7	78.4	129.9	170.8	248.9

The design concrete pry-out resistance is derived from $V^0_{Rd,cp} = V^0_{Rk,cp} / \gamma_{Mc,v}$ where the partial safety factor is 1.5. The recommended load is derived from $V^0_{Rec,cp} = V^0_{Rd,cp} / \gamma_F$ where the partial safety factor is 1.4.

COMBINED TENSION & SHEAR

Combined Tension & Shear: $\frac{N_{Sd}}{N_{Rd}} + \frac{V_{Sd}}{V_{Rd}} \leq 1.2$

The resultant force must be satisfied to the above conditions. The designer must cross check the loading conditions, types of applied loads and substrate to ensure the recommended anchor is applicable to the actual site applications. This would avoid any design faults which commonly caused by inconclusive load requirements with respective to actual site conditions.

INFLUENCING FACTORS - TENSION

INFLUENCE OF ANCHORAGE DEPTH [$\Psi_{h,N}$]

$$\Psi_{h,N} = \frac{h_{act}}{h_{ef,std}}$$

Limits: $h_{ef,std} \leq h_{act} \leq h_{ef,max}$

INFLUENCE OF CONCRETE STRENGTH ON PULL-OUT AND CONCRETE CONE RESISTANCE [$\Psi_{\beta,N}$]

$$\Psi_{\beta,N} = \left(\frac{f_{ck,cube}}{25}\right)^{0.3}$$

Limits: 25 MPa $\leq f_{ck,cube} \leq$ 60 MPa

Concrete Strength Designation (ENV 206)		C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 50/60
Concrete Cylinder Strength, $f_{ck,cyl}$	[MPa]	20	25	30	35	40	50
Concrete Cube Strength, $f_{ck,cube}$	[MPa]	25	30	37	45	50	60
Concrete Strength Factor, $\psi_{\beta,N}$		1.00	1.06	1.12	1.19	1.23	1.30

INFLUENCE OF ANCHOR SPACING [$\psi_{s,N}$]

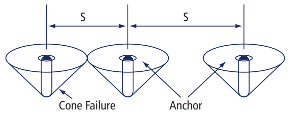
Anchor Spacing 's' [mm]	M8	M10	M12	M16	M20	M24	M30
40	0.63						
45	0.64	0.63					
55	0.67	0.65	0.63				
65	0.70	0.68	0.65	0.63			
85	0.77	0.74	0.69	0.67	0.62		
105	0.83	0.79	0.74	0.71	0.65	0.63	
135	0.92	0.88	0.81	0.77	0.69	0.66	0.63
150	0.97	0.92	0.84	0.80	0.71	0.68	0.64
160	1.00	0.94	0.86	0.82	0.73	0.69	0.65
180		1.00	0.91	0.86	0.76	0.71	0.67
220			1.00	0.94	0.81	0.76	0.70
250				1.00	0.86	0.80	0.73
350					1.00	0.92	0.82
420						1.00	0.89
540							1.00
Critical Spacing 's_{cr}' [mm]	160	180	220	250	350	420	540
Minimum Spacing 's_{min}' [mm]	40	45	55	65	85	105	135

$$\Psi_{s,N} = 0.5 + \frac{s}{4^* h_{ef,std}}$$

Limits: $s_{min} \leq s \leq s_{cr}$

$s_{min} = 0.5 * h_{ef,std}$

$s_{cr} = 2.0 * h_{ef,std}$



INFLUENCE OF EDGE DISTANCE [$\psi_{c,N}$]

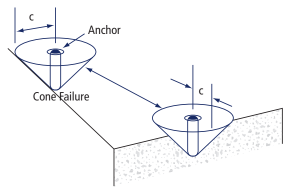
Edge Distance 'c' [mm]	M8	M10	M12	M16	M20	M24	M30
40	0.65						
45	0.69	0.65					
55	0.78	0.73	0.65				
65	0.87	0.81	0.71	0.66			
80	1.00	0.92	0.81	0.75			
85		0.96	0.84	0.78	0.64		
90		1.00	0.87	0.80	0.66		
105			0.97	0.89	0.72	0.65	
110			1.00	0.92	0.74	0.67	
125				1.00	0.80	0.72	
135					0.84	0.75	0.65
175					1.00	0.88	0.75
210						1.00	0.84
270							1.00
Critical Edge Distance 'c_{cr}' [mm]	80	90	110	125	175	210	270
Minimum Edge Distance 'c_{min}' [mm]	40	45	55	65	85	105	135

$$\Psi_{c,N} = 0.3 + 0.7 * \frac{c}{h_{ef,std}}$$

Limits: $c_{min} \leq c \leq c_{cr}$

$c_{min} = 0.5 * h_{ef,std}$

$c_{cr} = 1.0 * h_{ef,std}$



INFLUENCING FACTORS - SHEAR

INFLUENCE OF CONCRETE STRENGTH ON CONCRETE EDGE SHEAR AND CONCRETE PRY-OUT RESISTANCE [$\Psi_{\beta,V}$]

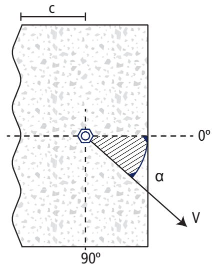
$$\Psi_{\beta,V} = \sqrt{\frac{f_{ck,cube}}{25}}$$

Limits: 25 MPa $\leq f_{ck,cube} \leq$ 60 MPa

Concrete Strength Designation (ENV 206)		C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 50/60
Concrete Cylinder Strength, $f_{ck,cyl}$	[MPa]	20	25	30	35	40	50
Concrete Cube Strength, $f_{ck,cube}$	[MPa]	25	30	37	45	50	60
Concrete Strength Factor, $\psi_{\beta,V}$		1.00	1.10	1.22	1.34	1.41	1.55

INFLUENCE OF SHEAR LOAD DIRECTION [$\Psi_{\alpha,V}$]

Load Type	Angle, α [°]	$\Psi_{\alpha,V}$
Oblique 0°	0° < α ≤ 15°	1.00
Oblique 30°	15° < α ≤ 37.5°	1.14
Oblique 45°	37.5° < α ≤ 52.5°	1.35
Oblique 60°	52.5° < α ≤ 67.5°	1.71
Oblique 90°	67.5° < α ≤ 90°	2.00



INFLUENCE OF ANCHOR SPACING AND EDGE DISTANCE ON CONCRETE EDGE SHEAR RESISTANCE [$\Psi_{sc,V}$]

$$\Psi_{sc,V} = \frac{c}{c_{min}} * \sqrt{\frac{c}{c_{min}}}$$

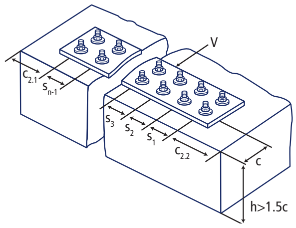
for single anchor towards a concrete edge

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

for two anchors when $s \leq 3c$

$$\Psi_{sc,V} = \frac{3c + s_1 + s_2 + s_{n-1}}{3nc_{min}} * \sqrt{\frac{c}{c_{min}}}$$

for multiple anchors when s_1 to $s_{n-1} \leq 3c$ and $c_2 \geq 1.5c$



$\Psi_{sc,V}$		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
Edge influence with single anchor		1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72	6.27	6.83	7.41	8.00
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	3.53	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

STATHEROS HP HAMMER GLASS CAPSULE FOR POST-INSTALLED REBAR APPLICATIONS

(Design Load Approach with BS8110 Bond Strength Method)

Concrete Compressive Strength: $f_{ck,cube}$ = 25 N/mm²

Rebar Size, d_s		ϕ10	ϕ12	ϕ16	ϕ20	ϕ25	ϕ32
Design Steel Resistance, $N_{Rd,s}$	[kN]	31.4	45.2	80.4	125.7	196.4	321.7
Design Bond Stress, τ_{Rd}	[N/mm²]	6.4	5.8	5.8	5.8	5.5	5.5
Drilled Hole Diameter, d_o	[mm]	13 ~ 14	15 ~ 16	20 ~ 22	25 ~ 28	30 ~ 32	40 ~ 42
Bar Spacing, s	[mm]	50	65	80	100	125	160
Edge Distance, c	[mm]	40	40	40	50	65	80
$L_{b,rqd}$ (to steel yield) / Rebar ϕ		20	20	20	20	20	20
Anchorage Length, L_b [mm]		Design Tensile Bonding Capacity, N_{Rd} [kN] (Single Capsule Application)					
100		20.2	*"Minimum depth to develop full steel shear"*				
120			26.1				
160				46.5			
200					72.6		
250						108.0	
320							177.0
Anchorage Length, L_b [mm]		Design Tensile Bonding Capacity, N_{Rd} [kN] (Double Capsule Application)					
200		**31.4**	*"Minimum depth to develop full steel shear"*				
240			**45.3**				
320				**80.5**			
400					**125.7**		
500						**196.4**	
640							**321.7**
Length to Develop Steel Yield, $L_{b,rqd}$ [mm]		200	240	320	400	500	640

1) Safety factor for design tensile steel resistance: $\gamma_{Ms,N}$ = 1.15 (based on steel yield strength of 460 N/mm²).
2) Safety factor for design tensile pull-out resistance: $\gamma_{Mc,N}$ = 1.8.
3) Safety factor for design tensile concrete cone resistance: $\gamma_{Mc,N}$ = 1.5.
4) Loading applicable to non-cracked concrete with design comply in accordance to BS8110.
5) Minimum spacing shall be $4d_s$ bar to bar or $5d_s$ centre-to-centre.
6) Minimum edge distance shall be $2d_s$ bar to bar or $2.5d_s$ centre-to-centre.

APPROVAL LISTING

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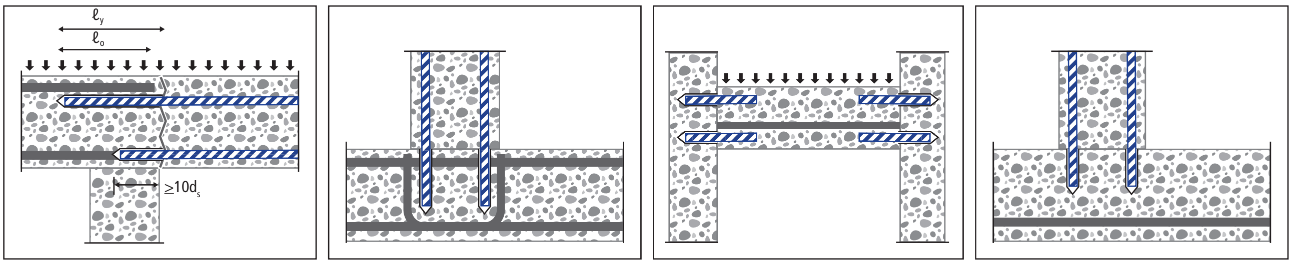

Overlap joints for slabs and beams or foundation column or wall; rebar connection for simply supported slabs or beams; shear connector or compression component joints.

Important note: Architect or design engineer must conduct final checked with the actual site condition for any variations against tabulated data.

STATHEROS HP HAMMER GLASS CAPSULE
FOR POST-INSTALLED REBAR APPLICATIONS
(Design Load Approach with BS8110 Bond Strength Method)

Concrete Compressive Strength: $f_{ck,cube}$ = 30 N/mm²

Rebar Size, d_s		φ10	φ12	φ16	φ20	φ25	φ32
Design Steel Resistance, $N_{Rd,s}$	[kN]	31.4	45.2	80.4	125.7	196.4	321.7
Design Bond Stress, τ_{Rd}	[N/mm²]	6.8	6.1	6.1	6.1	5.8	5.8
Drilled Hole Diameter, d_o	[mm]	13 ~ 14	15 ~ 16	20 ~ 22	25 ~ 28	30 ~ 32	40 ~ 42
Bar Spacing, s	[mm]	50	65	80	100	125	160
Edge Distance, c	[mm]	40	40	40	50	65	80
$L_{b,rqd}$ (to steel yield) / Rebar φ		20	20	20	20	20	20
Anchorage Length, L_b [mm]		Design Tensile Bonding Capacity, N_{Rd} [kN] (Single Capsule Application)					
100		21.5					
120			27.7		"Minimum depth to develop full steel shear"		
160				49.3			
200					77.0		
250						114.5	
320							187.6
Anchorage Length, L_b [mm]		Design Tensile Bonding Capacity, N_{Rd} [kN] (Double Capsule Application)					
200		**31.4**					
240			**45.3**		"Minimum depth to develop full steel shear"		
320				**80.5**			
400					**125.7**		
500						**196.4**	
640							**321.7**
Length to Develop Steel Yield, $L_{b,rqd}$ [mm]		200	240	320	400	500	640

1) Safety factor for design tensile steel resistance: $\gamma_{Ms,N}$ = 1.15 (based on steel yield strength of 460 N/mm²).
2) Safety factor for design tensile pull-out resistance: $\gamma_{Mc,N}$ = 1.8.
3) Safety factor for design tensile concrete cone resistance: $\gamma_{Mc,N}$ = 1.5.
4) Loading applicable to non-cracked concrete with design comply in accordance to BS8110.
5) Minimum spacing shall be $4d_s$ bar to bar or $5d_s$ centre-to-centre.
6) Minimum edge distance shall be $2d_s$ bar to bar or $2.5d_s$ centre-to-centre.

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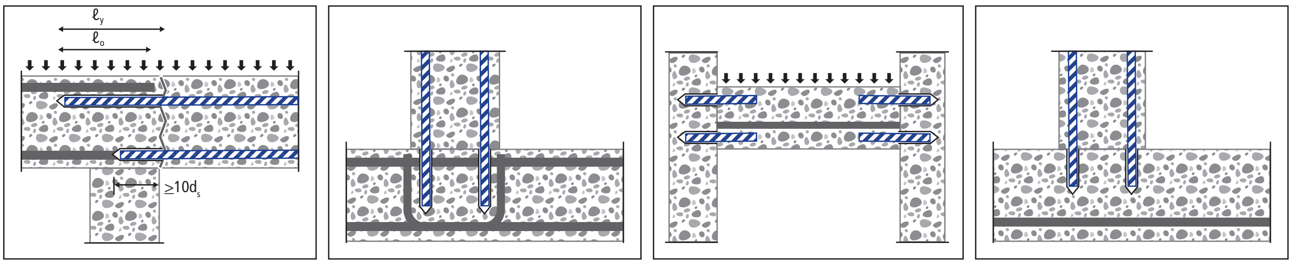

Overlap joints for slabs and beams or foundation column or wall; rebar connection for simply supported slabs or beams; shear connector or compression component joints.

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STATHEROS HP HAMMER GLASS CAPSULE FOR POST-INSTALLED REBAR APPLICATIONS

(Design Load Approach with BS8110 Bond Strength Method)

Concrete Compressive Strength: $f_{ck,cube}$ = 35 N/mm²

Rebar Size, d_s		φ10	φ12	φ16	φ20	φ25	φ32
Design Steel Resistance, $N_{Rd,s}$	[kN]	31.4	45.2	80.4	125.7	196.4	321.7
Design Bond Stress, τ_{Rd}	[N/mm²]	7.2	6.4	6.4	6.4	6.1	6.1
Drilled Hole Diameter, d_o	[mm]	13 ~ 14	15 ~ 16	20 ~ 22	25 ~ 28	30 ~ 32	40 ~ 42
Bar Spacing, s	[mm]	50	65	80	100	125	160
Edge Distance, c	[mm]	40	40	40	50	65	80
$L_{b,rqd}$ (to steel yield) / Rebar φ		20	20	20	20	20	20
Anchorage Length, L_b [mm]		Design Tensile Bonding Capacity, N_{Rd} [kN] (Single Capsule Application)					
100		22.5					
120			29.0			*"Minimum depth to develop full steel shear"*	
160				51.6			
200					80.6		
250						119.9	
320							196.4
Anchorage Length, L_b [mm]		Design Tensile Bonding Capacity, N_{Rd} [kN] (Double Capsule Application)					
200		**31.4**					
240			**45.3**			*"Minimum depth to develop full steel shear"*	
320				**80.5**			
400					**125.7**		
500						**196.4**	
640							**321.7**
Length to Develop Steel Yield, $L_{b,rqd}$ [mm]		200	240	320	400	500	640

1) Safety factor for design tensile steel resistance: $\gamma_{Ms,N}$ = 1.15 (based on steel yield strength of 460 N/mm²).
2) Safety factor for design tensile pull-out resistance: $\gamma_{Mc,N}$ = 1.8.
3) Safety factor for design tensile concrete cone resistance: $\gamma_{Mc,N}$ = 1.5.
4) Loading applicable to non-cracked concrete with design comply in accordance to BS8110.
5) Minimum spacing shall be $4d_s$ bar to bar or $5d_s$ centre-to-centre.
6) Minimum edge distance shall be $2d_s$ bar to bar or $2.5d_s$ centre-to-centre.

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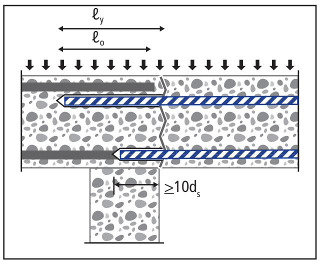

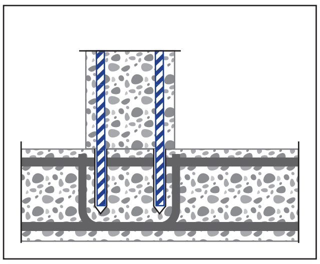
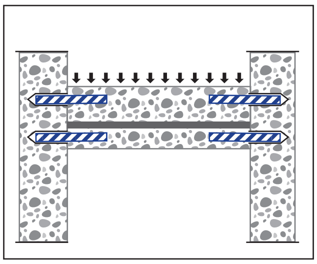
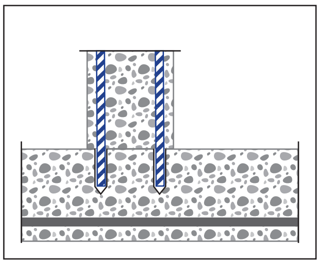

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