EPG65 HIGH STRENGTH EPOXY WITH VA RODS

PRODUCT FEATURES

- Ideal for wide range of substrates with close spacing and edge distance.
- Economical with wide range of fixings and bonding applications.
- Suitable for damp hole, cored hole and oversized holes.
- Recommended for chemical studs and rebar fixings.
- Extended working time ideally for tropical climate.
- Low shrinkage with high load applications.

RESIN SPECIFICATIONS

- 100% Solid Epoxy Resin - pinky red after mixing.
- Specific weight: 1.6 g/cm³.
- Compressive strength (ASTM D675-02a): 84 N/mm².

SHELF LIFE

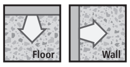
- Cartridges should be stored in their original packaging in cool conditions (5°C ~ 25°C) out of direct sunlight. When stored in this condition, the shelf life will be 24 months from the date of manufacture.

SUBSTRATES

- RC concrete C20/25 to C50/60 at maximum according to EN 206:2013+A1:2018.
- Solid stone & other solid masonry.

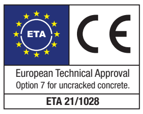
CONC STONE

HOLE ORIENTATION

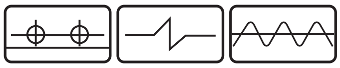


APPROVALS/ CERTICIFICATIONS

- ETA-21/1028 according to ETAG 001 Part 1 & 5 Option 7.



LOADING ZONES



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 or wet concrete.
- Concrete compressive strength C20/25 ($f_{ck,cube}$ = 25 N/mm²).
- Loading based on standard anchorage depth.
- For non-cracked concrete.

CHARACTERISTIC RESISTANCE [F_{Rk}]							STEEL CLASS 5.8		
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile Load, N_{Rk}	[kN]	***18.0***	***29.0***	***42.0***	66.0	106.8	158.3	190.9	229.0
Shear Load, V_{Rk}	[kN]	9.0	15.0	21.0	39.0	61.0	88.0	115.0	140.0

DESIGN RESISTANCE [F_{Rd}]									
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile Load, N_{Rd}	[kN]	***12.0***	***19.3***	***28.0***	44.0	71.2	105.6	127.2	152.7
Shear Load, V_{Rd}	[kN]	7.2	12.0	16.8	31.2	48.8	70.4	92.0	112.0

RECOMMENDED LOAD [F_{Rec}]									
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile Load, N_{Rec}	[kN]	***8.6***	13.8	20.0	31.4	50.9	75.4	90.9	109.1
Shear Load, V_{Rec}	[kN]	5.1	8.6	12.0	22.3	34.9	50.3	65.7	80.0

** Bold Italic numbers represent steel failure.*

EPG65 HIGH STRENGTH EPOXY WITH VA RODS

HIGH TENSILE STEEL CLASS 8.8

CHARACTERISTIC RESISTANCE [F_{Rk}]									
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile Load, N_{Rk}	[kN]	26.1	36.8	49.8	66.0	106.8	158.3	190.9	229.0
Shear Load, V_{Rk}	[kN]	15.0	23.0	34.0	63.0	98.0	141.0	184.0	224.0

DESIGN RESISTANCE [F_{Rd}]									
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile Load, N_{Rd}	[kN]	17.4	24.5	33.2	44.0	71.2	105.6	127.2	152.7
Shear Load, V_{Rd}	[kN]	12.0	18.4	27.2	50.4	78.4	112.8	147.2	179.2

RECOMMENDED LOAD [F_{Rec}]									
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile Load, N_{Rec}	[kN]	12.4	17.5	23.7	31.4	50.9	75.4	90.9	109.1
Shear Load, V_{Rec}	[kN]	8.6	13.1	19.4	36.0	56.0	80.6	105.1	128.0

** Bold Italic numbers represent steel failure.*

STAINLESS STEEL CLASS A2/A4

CHARACTERISTIC RESISTANCE [F_{Rk}]									
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile Load, N_{Rk}	[kN]	***26.0***	36.8	49.8	66.0	106.8	158.3	190.9	229.0
Shear Load, V_{Rk}	[kN]	13.0	20.0	30.0	55.0	86.0	124.0	161.0	196.0

DESIGN RESISTANCE [F_{Rd}]									
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile Load, N_{Rd}	[kN]	***13.7***	***21.6***	33.2	44.0	71.2	105.6	127.2	152.7
Shear Load, V_{Rd}	[kN]	8.3	12.8	19.2	35.3	55.1	79.5	103.2	125.6

RECOMMENDED LOAD [F_{Rec}]									
Anchor Size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile Load, N_{Rec}	[kN]	***9.8***	***15.4***	23.7	31.4	50.9	75.4	90.9	109.1
Shear Load, V_{Rec}	[kN]	6.0	9.2	13.7	25.2	39.4	56.8	73.7	89.7

** Bold Italic numbers represent steel failure.*

SERVICE TEMPERATURE RANGE

The Statheros EPG65 is 100% Solid Epoxy Resin 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	+10 °C to + 45 °C	+ 24 °C	+ 40 °C

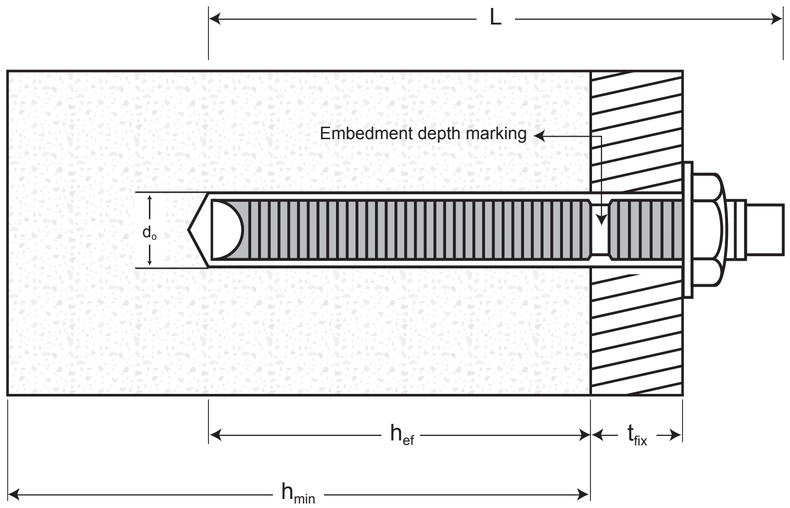
Maximum Short Term Base Material Temperature
Short term temperature refers to those elevated base material temperature occurred over brief moment such as diurnal cycling intervals.

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

SETTING DETAILS

ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M27	M30
Standard Anchor Length, L	[mm]	110	130	160	190	260	300	340	380
Nominal Drill Hole Diameter, d_0	[mm]	10	12	14	18	24	28	32	35
Fixture Hole Diameter, d_{fix}	[mm]	9	12	14	18	22	26	30	33
Maximum Fixture Thickness, t_{fix}	[mm]	15	20	30	40	50	55	60	70
Recommended Torque, T_{inst}	[Nm]	10	20	40	80	150	200	270	300
Minimum Anchorage Depth, $h_{ef,min}$									
Minimum Anchorage Depth, $h_{ef,min}$	[mm]	60	60	70	80	90	96	108	120
Minimum Spacing, s_{min}	[mm]	40	50	60	75	90	115	120	140
Minimum Edge Distance, c_{min}	[mm]	40	45	45	50	55	60	75	80
Minimum Concrete Thickness, h_{min}	[mm]	100	100	100	115	130	160	180	200
Maximum Anchorage Depth, $h_{ef,max}$									
Maximum Anchorage Depth, $h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600
Minimum Spacing, s_{min}	[mm]	40	50	60	75	90	115	120	140
Minimum Edge Distance, c_{min}	[mm]	40	45	45	50	55	60	75	80
Minimum Concrete Thickness, h_{min}	[mm]	200	224	268	336	444	532	600	670
Standard Anchorage Depth, $h_{ef,std}$									
Standard Anchorage Depth, $h_{ef,std}$	[mm]	80	90	110	125	170	210	250	270
Minimum Spacing, s_{min}	[mm]	40	45	55	65	85	105	125	135
Minimum Edge Distance, c_{min}	[mm]	40	45	55	65	85	105	125	135
Minimum Concrete Thickness, h_{min}	[mm]	$h_{ef,std} + 30mm \geq 100mm$			$h_{ef,std} + 2d_o$				

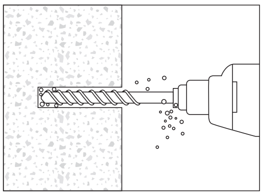
SETTING DIAGRAM



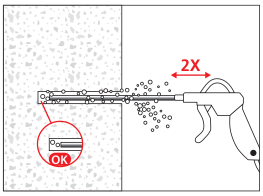
INSTALLATION PROCEDURES

Before commencing installation ensure the operative is equipped with appropriate personal protection equipment, SDS Hammer Drill, Air, Hole Cleaning Brush, good quality Dispensing Tool – either manual or power operated, chemical cartridge with mixing nozzle and extension tube, if needed.

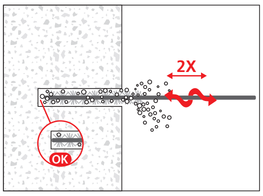
Step 1: Bore hole drilling.
Drilling of hole with an electric drill to the diameter and depth required by the selected reinforcing bar. Drill hole diameter must be in accordance with anchor size.



Step 2: Bore hole cleaning.
Start from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 30 seconds) or an air machine a minimum of two times. If the bore hole ground is not reached an extension shall be used.



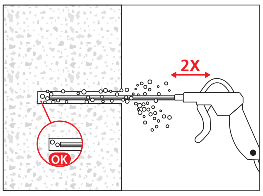
Brush the hole with an appropriately sized wide brush a minimum of two times. If the bore hole ground is not reached with the brush, a brush extension shall be used. The diameter of wire brush is equal to the hole diameter.



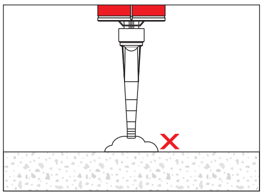
For bore holes deeper than 200 mm, or bore hole diameter bigger than 35 mm, compressed air (min. 30 seconds) must be used. Finally blow the hole clean again with compressed air (min. 30 seconds) or an air machine a minimum of two times. If the bore hole ground is not reached an extension shall be used.

When the bonded fastener is installed in wet concrete or in water-filled drill holes the cleaning procedure shall be executed twice.

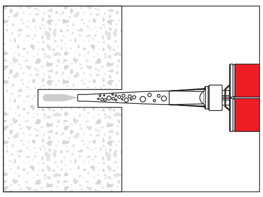
In any case, the cleaning procedure will continue until the bore hole is completely cleaned.



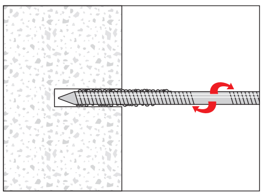
Prior to dispensing into the anchor hole, squeeze out separately the resin until it shows a consistent red color, and discard nonuniformly mixed adhesive components.



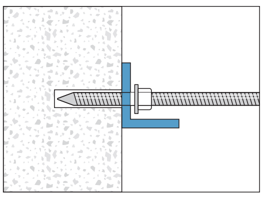
Step 3: Bore hole filling.
Start from the bottom or back of the cleaned anchor hole and fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets.



Step 4: Anchor.
Insert the anchor with a rotary motion into the filled drill hole. Some adhesive must come out of the hole. The anchor must be placed within the minimum and maximum curing time



During the resin hardening time the anchor must not be moved or loaded.



GEL AND CURING TIME

BASE MATERIAL TEMPERATURE $T_{base\ material}$ (°C)	GEL TIME (WORKING TIME) t_{gel} (mins)	CURING TIME FOR DRY HOLE t_{cure} (hrs)	CURING TIME FOR DAMP HOLE t_{cure} (hrs)
$+10 \leq T_{base\ material} < +15$	600	48	72
$+15 \leq T_{base\ material} < +20$	150	30	45
$+20 \leq T_{base\ material} < +25$	60	24	36
$+25 \leq T_{base\ material} < +30$	30	15	20
$+30 \leq T_{base\ material} < +35$	15	10	12
$+35 \leq T_{base\ material} < +40$	8	6	8

* *Cartridge should be ≥ +10°C.*

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.

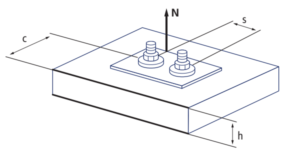
TENSION LOAD [N_{Rd}]

Design Tensile Resistance, N_{Rd}: lower value of [$N_{Rd,s}$; $N_{Rd,p}$; $N_{Rd,c}$]

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

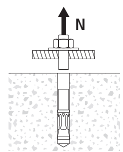
Design Pull-Out Resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot \Psi_{h,N} \cdot \Psi_{\beta,N}$

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 and cracked concrete.
- Data valid only for specified steel grade.

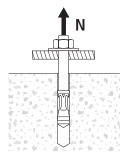


ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M27	M30
Carbon Steel: Class 5.8									
$N_{Rd,s}$	[kN]	12.0	19.3	28.0	52.7	82.0	118.0	153.3	187.3
High Tensile Steel: Class 8.8									
$N_{Rd,s}$	[kN]	19.3	30.7	44.7	84.0	130.7	188.0	244.7	299.3
Stainless Steel: Class A2/A4									
$N_{Rd,s}$	[kN]	13.7	21.6	31.1	57.9	90.5	130.0	168.9	206.8

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; 1.9 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.
- Concrete compressive strength C20/25 ($f_{ck,cube}$ = 25 N/mm²).
- For non-cracked concrete.

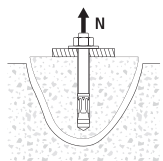


ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M27	M30
h_{nom}	[mm]	80	90	110	125	170	210	250	270
$N^0_{Rd,p}$	[kN]	17.4	24.5	33.2	44.0	71.2	105.6	127.2	152.7

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 1.5. 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 [$N_{Rd,c}$]

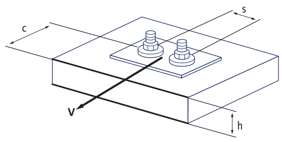
- For static and quasi-static loadings.
- Only a single anchor is considered.
- No anchor spacing and edge distance influences.
- Loading applicable to dry and wet concrete.
- Concrete compressive strength C20/25 ($f_{ck,cube}$ = 25 N/mm²).
- For non-cracked concrete.



ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M27	M30
h_{nom}	[mm]	80	90	110	125	170	210	250	270
$N^0_{Rd,c}$	[kN]	24.1	28.7	38.8	47.1	74.6	102.5	133.1	149.4

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 1.5. 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 [$V_{Rd,s}$; $V_{Rd,c}$; $V_{Rd,cp}$]

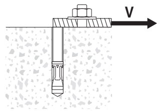
Design Steel Shear Resistance: $V_{Rd,s}$

Design Concrete Edge Shear Resistance: $V_{Rd,c} = V^0_{Rd,c} * \Psi_{\beta,V} * \Psi_{\alpha,V} * \Psi_{sc,V}$

Design Concrete Pry-Out Resistance: $V_{Rd,cp} = V^0_{Rd,cp} * \Psi_{\beta,V} * \Psi_{s,N} * \Psi_{c,N}$

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

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

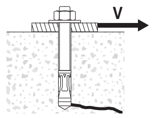


ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M27	M30
Carbon Steel: Class 5.8									
$V_{Rd,s}$	[kN]	7.2	12.0	16.8	31.2	48.8	70.4	92.0	112.0
High Tensile Steel: Class 8.8									
$V_{Rd,s}$	[kN]	12.0	18.4	27.2	50.4	78.4	112.8	147.2	179.2
Stainless Steel: Class A2/A4									
$V_{Rd,s}$	[kN]	8.3	12.8	19.2	35.3	55.1	79.5	103.2	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.
- Concrete compressive strength C20/25 ($f_{ck,cube}$ = 25 N/mm²).
- For non-cracked concrete.

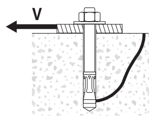


ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M27	M30
h_{nom}	[mm]	80	90	110	125	170	210	250	270
c_{min}	[mm]	40	45	55	65	85	105	125	135
$V^0_{Rd,c}$	[kN]	3.6	4.7	6.9	10.1	17.4	25.8	35.8	42.1

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.
- Concrete compressive strength C20/25 ($f_{ck,cube}$ = 25 N/mm²).
- For non-cracked concrete.



ANCHOR SIZE		M8	M10	M12	M16	M20	M24	M27	M30
h_{nom}	[mm]	80	90	110	125	170	210	250	270
$V^0_{Rd,cp}$	[kN]	48.2	57.5	77.7	94.1	149.2	204.9	266.2	298.7

The Design Concrete Pry-Out Resistance is derived from $V^0_{Rd,cp} = V^0_{Rk,cp} / \gamma_{Mp,v}$ 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: $h_{ef,min} \leq h_{act} \leq 20 * d$

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

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		1.00	1.00	1.00	1.00	1.00	1.10

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

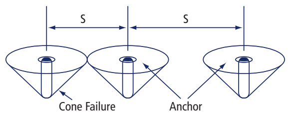
Anchor Spacing 's' [mm]	M8	M10	M12	M16	M20	M24	M27	M30
40	0.63							
45	0.64	0.63						
55	0.67	0.65	0.63					
65	0.70	0.68	0.65	0.63				
85	0.77	0.74	0.69	0.67	0.63			
105	0.83	0.79	0.74	0.71	0.65	0.63		
125	0.89	0.85	0.78	0.75	0.68	0.65	0.63	
135	0.92	0.88	0.81	0.77	0.70	0.66	0.64	0.63
160	1.00	0.94	0.86	0.82	0.74	0.69	0.66	0.65
180		1.00	0.91	0.86	0.76	0.71	0.68	0.67
220			1.00	0.94	0.82	0.76	0.72	0.70
250				1.00	0.87	0.80	0.75	0.73
340					1.00	0.90	0.84	0.81
420						1.00	0.92	0.89
500							1.00	0.96
540								1.00
Critical Spacing 's_{cr}' [mm]	160	180	220	250	340	420	500	540
Minimum Spacing 's_{min}' [mm]	40	45	55	65	85	105	125	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 [$\psi_{c,N}$]

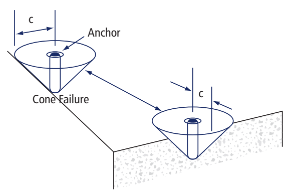
Edge Distance 'c' [mm]	M8	M10	M12	M16	M20	M24	M27	M30
40	0.65							
45	0.69	0.65						
55	0.78	0.73	0.65					
65	0.87	0.81	0.71	0.66				
80	1.00	0.92	0.81	0.75				
85		0.96	0.84	0.78	0.65			
90		1.00	0.87	0.80	0.67			
105			0.97	0.89	0.73	0.65		
110			1.00	0.92	0.75	0.67		
125				1.00	0.81	0.72	0.65	
135					0.86	0.75	0.68	0.65
170					1.00	0.87	0.78	0.74
210						1.00	0.89	0.84
250							1.00	0.95
270								1.00
Critical Edge Distance 'c_{cr}' [mm]	80	90	110	125	170	210	250	270
Minimum Edge Distance 'c_{min}' [mm]	40	45	55	65	85	105	125	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 RESISTANCE [$\Psi_{\beta,V}$]

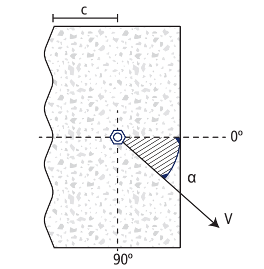
$$\Psi_{\beta,V} = \sqrt{\frac{f_{ck,cube}}{25}}$$

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

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	30	30	35	40	50
Concrete Cube Strength, $f_{ck,cube}$	[MPa]	25	30	37	45	50	60
Concrete Strength Factor		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°	$0° < \alpha \leq 15°$	1.00
Oblique 30°	$15° < \alpha \leq 37.5°$	1.14
Oblique 45°	$37.5° < \alpha \leq 52.5°$	1.35
Oblique 60°	$52.5° < \alpha \leq 67.5°$	1.71
Oblique 90°	$67.5° < \alpha \leq 90°$	2.00

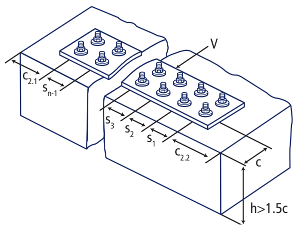


INFLUENCE OF ANCHOR SPACING AND EDGE DISTANCE ON CONCRETE EDGE SHEAR RESISTANCE [$\Psi_{sc,V}$]

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

EPG65 HIGH STRENGTH EPOXY
FOR POST-INSTALLED REBAR APPLICATIONS
(Design Load Approach with BS8110 Bond Strength Method)

Concrete Compressive Strength: $f_{ck,cube}$ = 25 N/mm² ~ 55 N/mm²

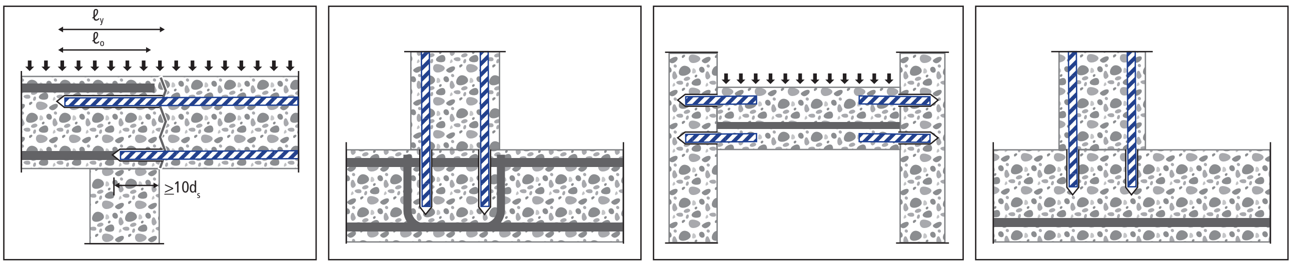
Rebar Size, d_s		ϕ10	ϕ12	ϕ16	ϕ20	ϕ25	ϕ32
Design Steel Resistance, $N_{Rd,s}$	[kN]	31.4	45.2	80.4	125.7	196.4	321.7
Design Bond Stress, τ_{Rd}	[N/mm²]	7.3	7.3	7.0	6.3	6.0	6.0
Drilled Hole Diameter, d_o	[mm]	13 ~ 14	15 ~ 16	20 ~ 22	25 ~ 28	30 ~ 32	40 ~ 42
Bar Spacing, s	[mm]	50	65	80	100	125	160
Edge Distance, c	[mm]	40	40	40	50	65	80
$L_{b,rqd}$ / Rebar ϕ		14	14	14	16	17	17
Anchorage Length, L_b [mm]		Design Tensile Bonding Capacity, N_{Rd} [kN]					
100		23.0					
120		27.6	33.2				
140		**31.4**	38.7				
160			44.2	56.3			
170			**45.2**	59.8			
200				70.4	79.6		
230				**80.4**	91.5		
250					99.5	117.8	
280					111.4	132.0	
320					**125.7**	150.8	193.0
350						165.0	211.1
400						188.5	241.3
420						**196.4**	253.4
550							**321.7**
Length to Develop Steel Yield, $L_{b,rqd}$ [mm]		136	163	228	316	417	533

"Minimum depth to develop full steel shear"

DESIGN CRITERIAS:
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 Concrete Pull-Out Resistance: $\gamma_{Mp,N}$ = 1.5.
3) Loading applicable to Non-Cracked Concrete with design comply in accordance to BS8110.
4) Safety factor for Design Tensile Concrete Cone Resistance: $\gamma_{MC,N}$ = 1.5
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.

TEST CERTIFICATIONS
1) Tested to SIRIM QAS to BS8539 for studs and rebars.

SUGGESTED APPLICATIONS



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.

EPG65 HIGH STRENGTH EPOXY
FOR POST-INSTALLED REBAR APPLICATIONS
(Design Load Approach with BS8110 & ACI 318 Concrete Splitting Criteria)

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

Rebar Size, d_s		ϕ10	ϕ12	ϕ16	ϕ20	ϕ25	ϕ32	ϕ40
Design Steel Resistance, $N_{Rd,s}$	[kN]	34.4	49.6	88.1	137.6	215.1	352.4	550.6
Splitting Bond Stress, $\tau_{Rd,d}$	[N/mm²]	3.49	3.49	3.49	3.25	2.80	2.80	2.80
Drilled Hole Diameter, d_o	[mm]	13 ~ 14	15 ~ 16	20 ~ 22	25 ~ 28	30 ~ 32	40 ~ 42	50 ~ 52
Bar Spacing, s	[mm]	50	60	80	100	125	160	200
Edge Distance, c	[mm]	40	40	40	50	65	80	100
Anchorage Length, L_b [mm]		Design Tensile Pull-Out/Concrete Cone Resistance, N_{Rd} [kN]						
100		11.0						
120		13.2	15.8					
160		17.5	21.1	28.1				
200		21.9	26.3	35.1	40.8			
250		27.4	32.9	43.9	51.1	55.0		
300		32.9	39.5	52.6	61.3	66.0		
320		**34.4**	42.1	56.1	65.4	70.4	90.1	
400			**49.6**	70.2	81.7	88.0	112.6	140.8
525				**88.1**	107.2	115.5	147.8	184.7
600					122.5	132.0	168.9	211.1
675					**137.6**	148.5	190.0	237.5
980						**215.1**	275.9	344.9
1000							281.5	351.9
1300							**352.4**	457.5
1400								492.7
1565								**550.6**
Length to Develop Steel Yield, $L_{b,rqd}$ [mm]		314	377	502	674	978	1,252	1,565

"Minimum depth to develop full steel shear"

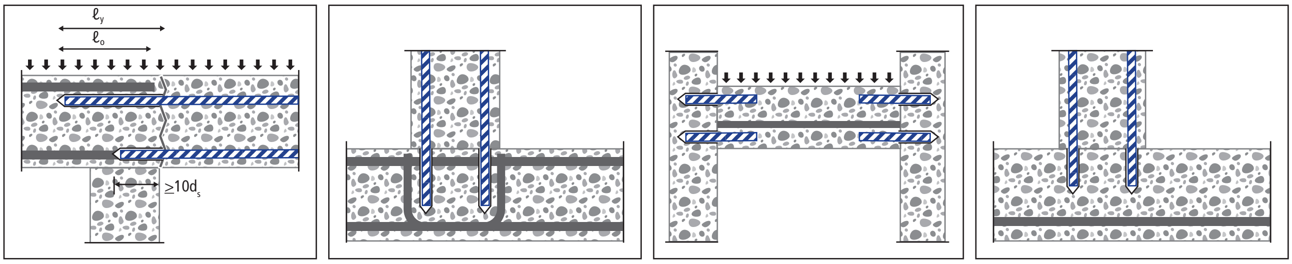
DESIGN CRITERIAS:

1) Design tensile steel resistance: $N_{Rd,s} = f_y * A_s / \gamma_{Ms,N}$ where $\gamma_{Ms,N}$ = 1.05 (based on steel yield of 460 N/mm²).
2) Design value complied in accordance to BS8110 and ACI 318 Concrete Splitting Criteria.
3) Minimum spacing shall be $4d_s$ bar to bar or $5d_s$ centre-to-centre.
4) Minimum edge distance shall be $2d_s$ bar to bar or $2.5d_s$ centre-to-centre.
5) Applicable to dry and wet concrete application.
6) Design value based on non-cracked concrete.

TEST CERTIFICATIONS

1) Tested to SIRIM QAS to BS8539 for studs and rebars.

SUGGESTED APPLICATIONS



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.

EPG65 HIGH STRENGTH EPOXY
FOR POST-INSTALLED REBAR APPLICATIONS
(Design Load Approach with BS8110 & ACI 318 Concrete Splitting Criteria)

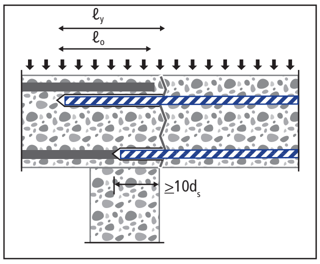
Concrete Compressive Strength: $f_{ck,cube}$ = 30 N/mm²

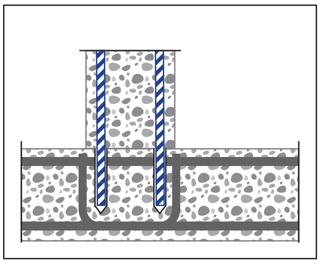
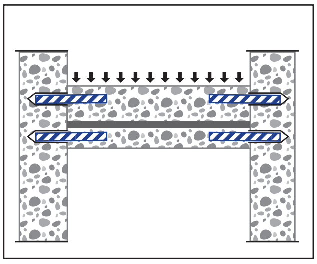
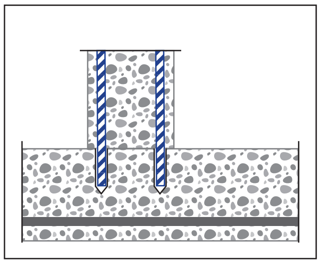
Rebar Size, d_s		ϕ10	ϕ12	ϕ16	ϕ20	ϕ25	ϕ32	ϕ40
Design Steel Resistance, $N_{Rd,s}$	[kN]	34.4	49.6	88.1	137.6	215.1	352.4	550.6
Splitting Bond Stress, $\tau_{sp,d}$	[N/mm²]	3.91	3.91	3.91	3.63	3.13	3.13	3.13
Drilled Hole Diameter, d_o	[mm]	13 ~ 14	15 ~ 16	20 ~ 22	25 ~ 28	30 ~ 32	40 ~ 42	50 ~ 52
Bar Spacing, s	[mm]	50	60	80	100	125	160	200
Edge Distance, c	[mm]	40	40	40	50	65	80	100
Anchorage Length, L_b [mm]		Design Tensile Pull-Out / Concrete Cone Resistance, N_{Rd} [kN]						
100		12.3						
120		14.7	17.7				*"Minimum depth to develop full steel shear"*	
160		19.7	23.6	31.5				
200		24.6	29.5	39.3	45.6			
250		30.7	36.9	49.1	57.0	61.5		
275		33.8	40.5	54.1	62.7	67.6		
300		**34.4**	44.2	59.0	68.4	73.8		
320			47.2	62.9	73.0	78.7	100.7	
350			**49.6**	68.8	79.8	86.1	110.1	
400				78.6	91.2	98.3	125.9	157.4
450				**88.1**	102.6	110.6	141.6	177.0
525					119.8	129.1	165.2	206.5
625					**137.6**	153.7	196.7	245.9
750						184.4	236.0	295.0
875						**215.1**	275.4	344.2
950							299.0	373.7
1120							**352.4**	440.6
1300								511.4
1400								**550.6**
Length to Develop Steel Yield, $L_{b,rqd}$ [mm]		280	336	448	603	875	1,120	1,400

DESIGN CRITERIAS:
1) Design tensile steel resistance: $N_{Rd,s} = f_y * A_s / \gamma_{Ms,N}$ where $\gamma_{Ms,N}$ = 1.05 (based on steel yield of 460 N/mm²).
2) Design value complied in accordance to BS8110 and ACI 318 Concrete Splitting Criteria.
3) Minimum spacing shall be 4d_s bar to bar or 5d_s centre-to-centre.
4) Minimum edge distance shall be 2d_s bar to bar or 2.5d_s centre-to-centre.
5) Applicable to dry and wet concrete application.
6) Design value based on non-cracked concrete.

TEST CERTIFICATIONS
1) Tested to SIRIM QAS to BS8539 for studs and rebars.

SUGGESTED APPLICATIONS



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.

EPG65 HIGH STRENGTH EPOXY
FOR POST-INSTALLED REBAR APPLICATIONS
(Design Load Approach with BS8110 & ACI 318 Concrete Splitting Criteria)

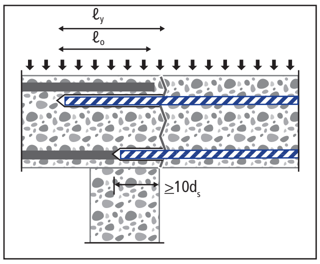
Concrete Compressive Strength: $f_{ck,cube}$ = 35 N/mm²

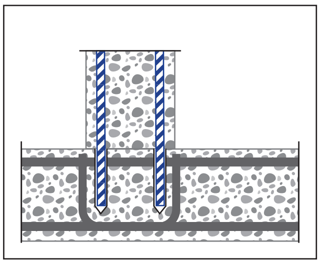
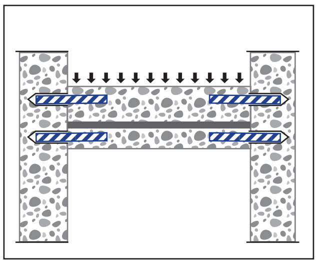
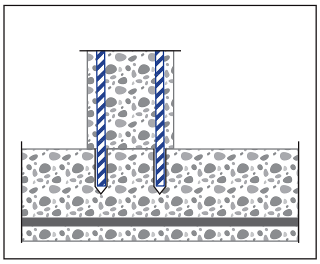
Rebar Size, d_s		ϕ10	ϕ12	ϕ16	ϕ20	ϕ25	ϕ32	ϕ40
Design Steel Resistance, $N_{Rd,s}$	[kN]	34.4	49.6	88.1	137.6	215.1	352.4	550.6
Splitting Bond Stress, $\tau_{sp,d}$	[N/mm²]	4.17	4.17	4.17	3.88	3.34	3.34	3.34
Drilled Hole Diameter, d_o	[mm]	13 ~ 14	15 ~ 16	20 ~ 22	25 ~ 28	30 ~ 32	40 ~ 42	50 ~ 52
Bar Spacing, s	[mm]	50	60	80	100	125	160	200
Edge Distance, c	[mm]	40	40	40	50	65	80	100
Anchorage Length, L_b [mm]		Design Tensile Pull-Out / Concrete Cone Resistance, N_{Rd} [kN]						
100		13.1						
120		15.7	18.9			*"Minimum depth to develop full steel shear"*		
160		21.0	25.2	33.5				
200		26.2	31.4	41.9	48.8			
250		32.8	39.3	52.4	61.0	65.6		
275		**34.4**	43.2	57.6	67.1	72.1		
300			47.2	62.9	73.1	78.7		
320			**49.6**	67.1	78.0	84.0	107.5	
375				78.6	91.4	98.4	125.9	
425				**88.1**	103.6	111.5	142.7	178.4
450					109.7	118.1	151.1	188.9
575					**137.6**	150.9	193.1	241.4
700						183.6	235.1	293.8
850						**215.1**	285.4	356.8
900							302.2	377.8
1050							**352.4**	440.8
1100								461.7
1200								503.7
1315								**550.6**
Length to Develop Steel Yield, $L_{b,rqd}$ [mm]		263	315	420	565	820	1,049	1,312

DESIGN CRITERIAS:
1) Design tensile steel resistance: $N_{Rd,s} = f_y * A_s / \gamma_{Ms,N}$ where $\gamma_{Ms,N}$ = 1.05 (based on steel yield of 460 N/mm²).
2) Design value complied in accordance to BS8110 and ACI 318 Concrete Splitting Criteria.
3) Minimum spacing shall be $4d_s$ bar to bar or $5d_s$ centre-to-centre.
4) Minimum edge distance shall be $2d_s$ bar to bar or $2.5d_s$ centre-to-centre.
5) Applicable to dry and wet concrete application.
6) Design value based on non-cracked concrete.

TEST CERTIFICATIONS
1) Tested to SIRIM QAS to BS8539 for studs and rebars.

SUGGESTED APPLICATIONS



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.

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