SUPERFIX®

PRODUCT CATALOGUE & TECHNICAL HANDBOOK

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122   Fax: (65) 6747 9838   Email: sales@superfix.com.sg   Website: www.superfix.com.sg

SUPERFIX®

- **A Leader In Customer Service**
- **Products Of Consistent Quality**
- **Continuous Research & Development**
- **Competitive Pricing**

Housing

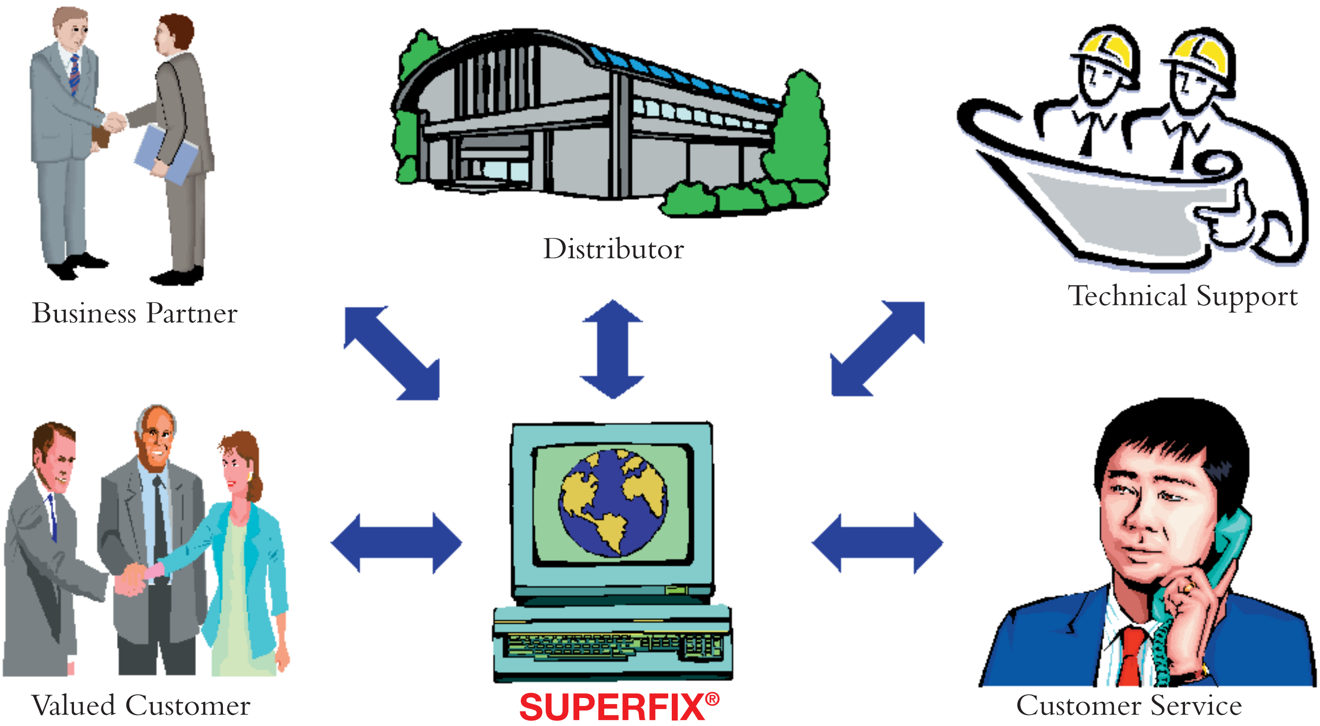
Infrastructure

Research & Development

Fastening systems are widely varied and applications range from the simple installation of household items to critical components of massive infrastructure projects like cladding of commercial buildings, upgrading of residential neighbourhoods, mechanical & electrical works, addition & alteration works to existing buildings, various components of public transportation systems.

We are firm in our endeavour to provide cost-effective design recommendations, and products of consistent quality. Over the recent years, we have not compromised the integrity towards our clients to ensure the smooth completion of their projects that require fastening applications. With a growing track record, we are ready and confident to face the challenges ahead.

To achieve excellence in customer service, we are looking into the possibility of providing a complete fastening solution package – supply, install, on-site testing and verification of reliable workmanship, right through to the complete handover of the anchoring portion of the project.



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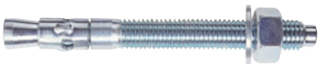
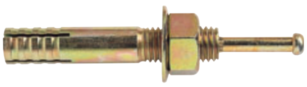
Selection Guide For Superfix Products

Page	Product	Name	Code	Concrete	Lightweight Concrete	Solid Brick	Hollow Brick	Plywood	Gypsum Board	Steel
Page	**Mechanical Expansion Anchors**									
36		Superfix High-Load Anchor	SLS	✔						
39		Superfix Undercut Anchor	SUA	✔						
42		Superfix Wedge Anchor	SWA	✔						
46		Superfix Through Anchor	STA	✔						
49		Superfix Drop-In Anchor	SDA	✔						
52		Superfix Set Anchor	SPA	✔						
55		Superfix Sleeve Anchor	SLA	✔						
58		Superfix Shield Anchor	SSA	✔						
62		Superfix Hammer Anchor	SHA	✔						
Page	**Adhesive Anchors**									
65		Superfix Chemical-Capsule Anchor	SVA	✔	✔	✔				

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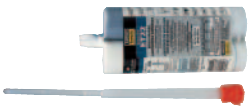
Page				Concrete	Lightweight Concrete	Solid Brick	Hollow Brick	Plywood	Gypsum Board	Steel
Page	**Adhesive Anchors**									
69		Superfix Hammer-In Capsule	SHC	✔	✔	✔				
72		Superfix Polyester System	SIS	✔	✔	✔	✔			
82		Superfix Epoxy-Acrylate System	SEA	✔	✔	✔	✔			
92		Superfix Epoxy System	SES	✔	✔	✔	✔			
Page	**Lightweight Fixings**									
105		Superfix Nylon Anchor	SNA	✔		✔	✔			
106		Superfix Nylon Plug	SNP	✔	✔	✔				
107		Superfix Universal Plug	SUP	✔	✔	✔	✔	✔	✔	
108		Superfix Thread Plug	STP	✔	✔					
109		Superfix Metal Frame	SMF	✔		✔	✔			
110		Superfix Plastic Frame	SPF	✔		✔	✔			

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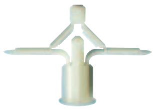
Page	Lightweight Fixings			Concrete	Lightweight Concrete	Solid Brick	Hollow Brick	Plywood	Gypsum Board	Steel
111		Superfix Frame Anchor	SFA	✔		✔	✔			
112		Superfix Cavity Anchor	SCA					✔	✔	
113		Superfix Plastic Toggle	SPT	✔		✔		✔	✔	
114		Superfix Spring Toggle	SST					✔	✔	
115		Superfix Hammer Nail	SHN	✔						
116		Superfix Brass Anchor	SBA	✔		✔				
117		Superfix Zinc Anchor	SZA	✔						
118		Superfix Quickfix Nail	SQN	✔		✔				
119		Superfix Wire Hanger	SWH	✔						
120		Superfix Self-Drill Fixing	SSF					✔	✔	
121		Superfix Self-Tapping Bolt	STB	✔						

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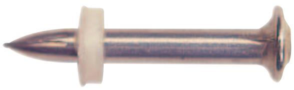
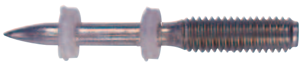
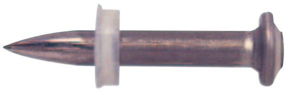
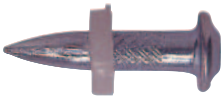
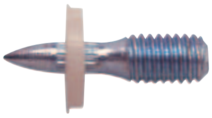
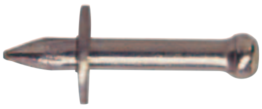
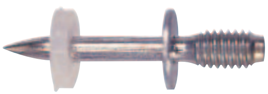
Page	Powder-Actuated Tools & Drive Pins			Concrete	Lightweight Concrete	Solid Brick	Hollow Brick	Plywood	Gypsum Board	Steel
122		Superfix LV360	LV360	✔		✔				✔
122		Drive Pin	SN	✔		✔				
122		Threaded Drive Pin	SX	✔		✔				
123		Stainless Steel Drive Pin	SNS	✔		✔				
123		Knurled Drive Pin	SNK							✔
123		Knurled And Threaded Drive Pin	SXK							✔
123		LV360 Cartridges	–							
124		Superfix LV550	LV550	✔		✔				✔
124		Drive Pin	SK	✔		✔				
124		Threaded Drive Pin	SM	✔		✔				
125		Knurled Drive Pin	SKK							✔

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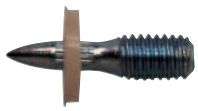
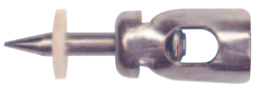
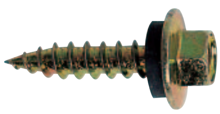
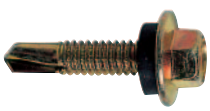
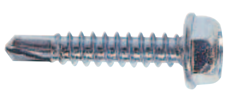
				Concrete	Lightweight Concrete	Solid Brick	Hollow Brick	Plywood	Gypsum Board	Steel
Page	**Powder-Actuated Tools & Drive Pins**									
125		Knurled And Threaded Drive Pin	SMK							✔
125		Eyelet Drive Pin	SB	✔						
125		LV550 Cartridges	–							
126		Superfix HV660	HV660	✔						✔
126		Drive Pin	SH	✔						
126		Threaded Drive Pin	ST	✔						
127		Eyelet Pin	EP	✔						
127		HV660 Cartridge	–							
Page	**Self-Drilling Screws**									
129		Hex Washer Flange Type 17	HWW					✔		
129		Hex Washer Flange	HWF							✔
129		Hex Washer Head	HWH							✔

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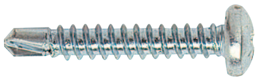
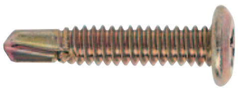
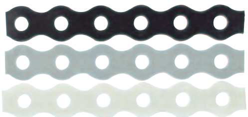
Page				Concrete	Lightweight Concrete	Solid Brick	Hollow Brick	Plywood	Gypsum Board	Steel
Page	**Self-Drilling Screws**									
130		Pan Head Phillips	PHP							✔
130		Countersunk Head Phillips	CSK							✔
131		Wafer Head Phillips	WHP							✔
Page	**Miscellaneous**									
132		Superfix Flexible Band	SFB							
134		Superfix Hand Drive Tool	HDT	✔						
134		Superfix Hammer Pin	MP	✔						
134		Superfix Spindle Pin	SSP							
135		Superfix Cast-In Socket	SCS	✔						
136		Superfix Drill Bit Plus	DBP	✔						
138		Superfix Drill Bit Max	DBM	✔						

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1. Mission Statement

A leader in customer service, with technical competence to ensure compliance to international standards of safety and quality, continuous research and development, and providing products of consistent quality at competitive prices.

2. Company Introduction

Superfix (Singapore) Pte Ltd is a dynamic and progressive contract manufacturer specializing in mechanical expansion anchors, chemical anchors and fastening systems. Our products are beginning to establish within Singapore through various government and private construction or redevelopment projects. The nominal safe tensile resistances are derived from static tensile tests conducted in conformance to BS 5080 Part 1, ETAG No. 001 and ASTM E 1512. The nominal safe shear resistances are derived from static tests conducted in conformance to BS 5080 Part 2, ETAG No. 001 and ASTM E 1512. In view of our Mission Statement, we shall proceed to seek the relevant approvals from the various Statutory Boards of the Government of Singapore, as well as from various international organisations pertinent to the assurance of the quality of our products.

3. Company Profile

Superfix was incorporated in 1995 to provide fastening systems. Our focus is on providing a total solution offering sales and services to customers in the construction and building industry. Over the years, with our commitment to total quality excellence, we were able to build up a team of dedicated professionals with a wide spectrum of expertise. It was through collective effort, with the support of valued clients and business partners, that we established our presence in the local industry, as well as the international arena.

The Superfix product range extends from simple fixing elements, through complex fastening system solutions, to specially designed products applied to specific requirements. Driven by our long-term vision (see **Mission Statement**), we will continue to be a responsible and professional supplier of fastening systems. Superfix is adaptable to changes and will continuously strive to provide innovative products geared to the market's requirements, and foster excellent business relations with our customers.

4. Important Note

4.1 Disclaimer

4.1.1 Superfix (Singapore) Pte Ltd ("Superfix") does not warrant that the use of this user manual together with the information and data (Product Catalogue & Technical Handbook) or any part thereof by you shall not infringe the rights of any third party, including without limitation the infringement of any trademark, copyright, design right, patent, trade secret or other intellectual property rights of any third party and all warranties in respect of the Product Catalogue & Technical Handbook are excluded to the fullest extent permitted by law.

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5. Definitions

Loads

F_N	(kN)	Nominal safe tensile resistance
$F_{N,REC}$	(kN)	Recommended safe tensile resistance
F_V	(kN)	Nominal safe shear resistance
$F_{V,REC}$	(kN)	Recommended safe shear resistance
F_{Shear}	(kN)	Applied shear load
F_Z	(kN)	Applied tensile load
M	(kNm)	Applied moment
$F_{N,DESIGN}$	(kN)	Design tensile resistance
$F_{V,DESIGN}$	(kN)	Design shear resistance

Factors

i	Constant for f_A
j	Constant for f_{RN}
k	Constant for f_{RV}
l	Constant for f_B
m	Constant for f_T
f_A	Reduction factor for reduced spacing
f_B	Applied factor for variation in concrete grade
f_{RV}	Reduction factor for reduced edge distance (shear)
f_{RN}	Reduction factor for reduced edge distance (tension)
f_T	Reduction factor for reduced setting depth

Anchor Installation, Spacing, Distances

C	(mm)	Reduced edge distance
C_{cr}	(mm)	Characteristic edge distance
C_{min}	(mm)	Minimum edge distance
d_0	(mm)	Drill hole diameter
h	(mm)	Concrete thickness
h_{min}	(mm)	Minimum concrete thickness
h_0	(mm)	Drill hole depth
h_s	(mm)	Setting depth
$h_{s\ cr}$	(mm)	Characteristic setting depth
S	(mm)	Reduced anchor-to-anchor spacing
S_{min}	(mm)	Minimum anchor spacing
S_{cr}	(mm)	Characteristic anchor spacing
T	(Nm)	Tightening Torque

Materials
(N/mm^2)

f_{CC}	28-day compressive strength of concrete cube of dimensions 200mm x 200mm x 200mm
$f_{CK,Cyl}$ or f_{CK}	28-day compressive strength of concrete cylinder of dimensions 150mm diameter x 300mm length
$f_{CK,Cube}$ or f_{CU}	28-day compressive strength of concrete cube of dimensions 150mm x 150mm x 150mm
f_{Bond}	Characteristic bond strength corresponding to the 5% fractile value of the ultimate load
f_y	Characteristic yield strength of reinforcement steel, at 460 N/mm^2 in Singapore.

6. Summarised Design Approach

Anchor Design Concept

Partial Factors Of Safety	Abbreviation	
Scatter of tensile strength of site concrete	γ_1	1.2
Installation safety of anchor system (Tension)	γ_2	1.2
Installation safety of anchor system (Shear)	γ_2	1.0
Concrete under compression	γ_c	1.5
Anchor steel	γ_{Ms}	1.5
Chemical bond	γ_{Mb}	1.4

Safe Tensile Resistance	Abbreviation	
Applied load	γ_F	1.4
Anchor pullout, concrete cone failure, splitting failure, anchor steel failure, chemical bond failure	$\gamma_{Mp/Mc/Msp/Ms/Mb}$	2.16 governs
Overall Factor Of Safety		**3.02**

Safe Shear Resistance For $C < C_{cr}$	Abbreviation	
Applied load	γ_F	1.4
Concrete edge failure, pryout failure, chemical bond failure	$\gamma_{Mc/Mcp/Mb}$	1.8 governs
Overall Factor Of Safety		**2.52**

Safe Shear Resistance For $C \geq C_{cr}$	Abbreviation	
Applied load	γ_F	1.4
Anchor steel failure, chemical bond failure	$\gamma_{Ms/Mb}$	1.5 governs
Overall Factor Of Safety		**2.1**

Combined-Load Check	Abbreviation	
$\left(\frac{F_Z}{F_{N,REC}}\right)^N + \left(\frac{F_{Shear}}{F_{V,REC}}\right)^N$	CLC	Value ≤ 1.0

N = 2 for steel as the mode of failure
N = 1.5 for all other modes of failure

Rebar Design Concept

Partial Factors Of Safety	Abbreviation	
Scatter of tensile strength of site concrete	γ_1	1.2
Installation safety of chemical anchor system (Tension)	γ_2	1.2
Installation safety of chemical anchor system (Shear)	γ_2	1.0
Concrete under compression	γ_c	1.5
Rebar steel	γ_{Ms}	1.15
Chemical bond	γ_{Mb}	1.4

Design Approach #1: Ultimate Limit State (ULS) Design

1.1 Design embedment depth should be such that the bond resistance is greater than the tensile yield value of the steel ($1.0\ f_y.A_s$) at the ULS, with an additional Factor of Safety of 1.2 for installation inconsistency.

1.2 Check for adequate concrete strength (> $1.0\ f_y.A_s$):

Bar Size (mm)	Minimum Embedment In Cracked Concrete (mm)		
	20 N/mm²	30 N/mm²	40 N/mm²
T10 Rebar	110	95	90
M12 Rod	140	125	110
T13 Rebar	155	135	125
T16 Rebar	205	180	165
T20 Rebar	275	240	220
M24 Rod	350	305	280
T25 Rebar	370	325	295
T28 Rebar	430	375	340
T32 Rebar	510	445	405

1.3 Ensure that the yielding of steel is the governing mode of failure:
Bond resistance, ($F_{N,Bond}$ / 1.2) > $1.0\ f_y.A_s$
Concrete resistance, $F_{N,Concrete}$ > $1.0\ f_y.A_s$
The deeper embedment depth shall govern the design.

1.4 For addition and alteration works, the designer must ensure that the localised shear capacity of the concrete is not exceeded, and that the flow of forces to the existing structure is within acceptable limits.

Design Approach #2: Design Resistances For Ultimate Loads

2.1 Calculate the ultimate applied tensile and shear forces from the end-moments and effective lever arm.

2.2 From the design embedment depth or reduced embedment depth, obtain the design resistance forces due to limiting concrete strength, bond strength, and steel strength.

2.3 Perform the combined-load interaction check where N=1.5 for all modes of failure:

$$\left(\frac{F_z}{F_{N,DESIGN}}\right)^N + \left(\frac{F_{Shear}}{F_{N,DESIGN}}\right)^N \leq 1.0$$

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

7. Concrete As A Base Material

In Singapore, characteristic compressive strengths of concrete are evaluated by tests using specimen cubes of 150mm dimensions, in accordance with BS1881: Part 116. In other parts of the world, the concrete test specimens may be of different dimensions or shapes. Examples are cubes of 200mm dimensions used in Germany, and cylinders of 150mm diameter and 300mm length used in the United States, Japan, and Europe. The tests on the various specimens will result in different compressive strength values.

To account for the differences in the test specimens, the following information is recommended to convert the compressive strength values to the standard in which the designer is familiar with:

$f_{cc} = 0.95\ f_{cu}$
$f_{cc} = 1.25\ f_{ck}$ (for $f_{ck} \leq 15$)
$f_{cc} = 1.18\ f_{ck}$ (for $f_{ck} \geq 25$)

(Extracted from DIN 1045)

f_{ck} or $f_{ck,cyl}$ (N/mm^2)	12	16	20	25	30	35	40	45	50
f_{cu} or $f_{ck,cube}$ (N/mm^2)	15	20	25	30	37	45	50	55	60

(Extracted from ENV 206, Eurocode 2)

For concrete cylinders with length (L) to diameter (D) ratio less than 1.8, reduce the f_{ck} value according to the following recommendation:

L / D	1.75	1.5	1.25	1.00
Reduction Factor	0.98	0.96	0.93	0.87

*Values not given in the table shall be determined by interpolation
*Reduction factors are applicable only for nominal concrete strengths from 13.8 N/mm^2 to 41.4 N/mm^2
(Extracted from ASTM C39)

- f_{cc} – 28-day compressive strength of concrete cube of 200mm lengths
- f_{ck} or $f_{ck,cyl}$ – 28-day compressive strength of concrete cylinder of 150mm diameter and 300mm length
- $f_{ck,cube}$ or f_{cu} – 28-day compressive strength of concrete cube of 150mm lengths

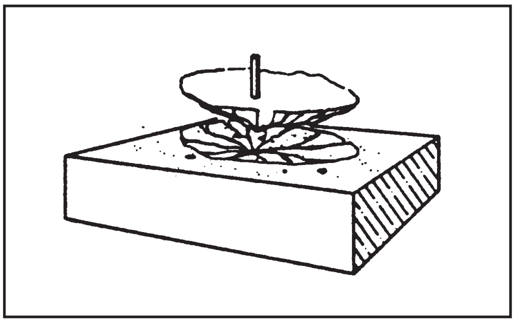
8. Superfix Design Approach

For each product application, various considerations are taken to ensure the suitability and reliability of Superfix products. This chapter will subsequently explain the following concepts and approaches used: the **Anchor Fastening Concept**, the **Rebar Fastening Concept**, the **Concept For Lightweight Fixings**, the **Powder-Actuated Tools**, and the **Drive Pins Fastening Concept**.

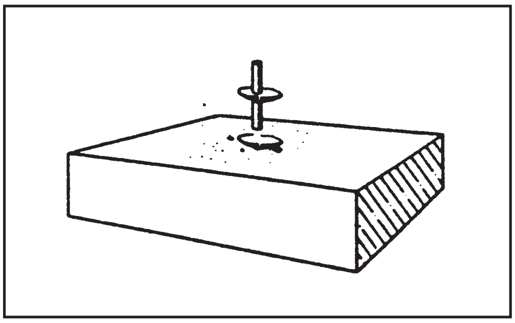
8.1 Anchor Fastening Concept

Anchor fastening systems have a few main working principles: **friction** (by applying expansion forces to the anchor), **keying** (cutting by drilling or crushing the base material by expanding the anchor), **adhesion** (chemical bonding of the anchor and the wall of the drilled portion), and a combination of the above working principles.

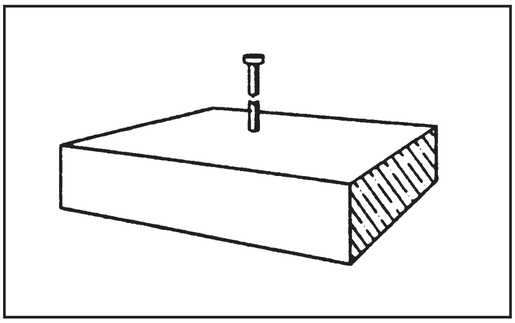
From static load tests, the failure of a fastening system is governed by one of the following failure modes:



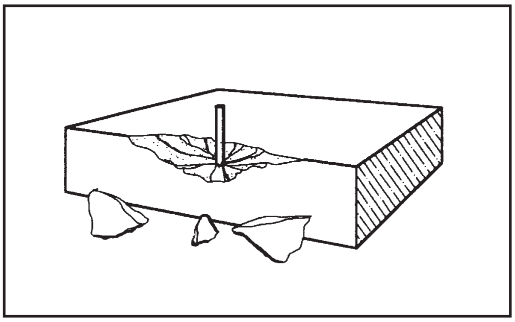
Concrete Cone Failure – this occurs when the tensile capacity of the concrete is exceeded, resulting in a conical-shaped concrete break out. For mechanical expansion anchors, the spall cone will tend to have a steeper inclination angle as the embedment depth increases. For adhesive anchors, the spall cones depend on the size and embedment depth of the anchor, and are most often limited to the upper 80 mm of the anchor.



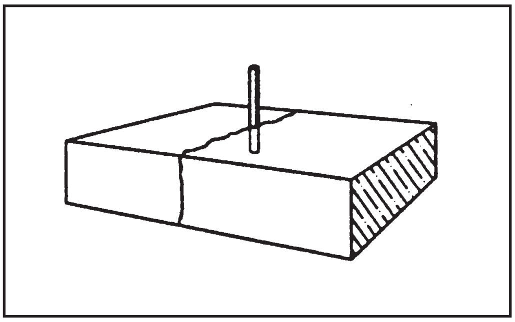
Anchor Pullout – this occurs usually when less expansion force is applied to the anchor during installation, or for anchors with thin expansion sleeves. Compared to anchors using a forceful expansion which usually reflect the Concrete Cone Failure mode if sufficiently spaced from the edge of the concrete, fastening systems that fail due to slippage are associated with lower ultimate loads and higher values of displacement.



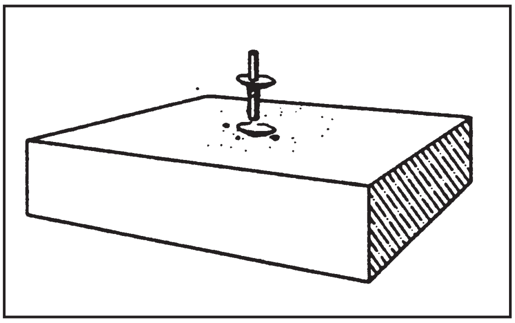
Steel Failure – this occurs when a part of the anchor exceeds the ultimate stress capacity (tension or shear). For high strength concrete or reinforced concrete, this failure mode may be reflected for anchors of lower steel grade. The ultimate load is then a function of the stress capacity of the anchor, and the displacement will depend on the working principle of the anchor and the ductility of the steel material.



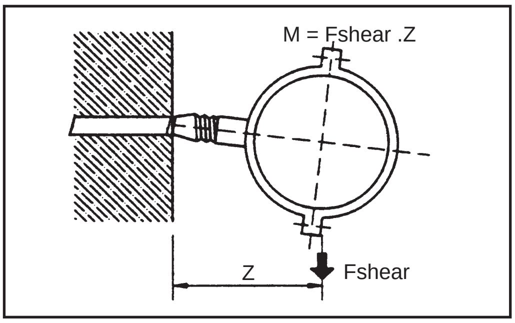
Concrete Edge Failure – this occurs when an anchor is installed close to the edge of the concrete, and is subjected to tension, or shear load in the direction of the free edge. As there is insufficient distance to form the respective concrete failure cones, the ultimate tension and shear loads obtained are reduced.



Concrete Splitting – this occurs when the base material is of small width or length, where failure may be caused by any form of loading, or even at the installation phase due to the expansion forces.



Bond Failure – this occurs for adhesive anchors where the concrete strength and steel strength exceeds the bond strength of the adhesive material. Failure is observed by continuous slippage of the anchor, where either the bond between the adhesive and the steel yields, or the bond between the adhesive and the concrete yields. Often, a shallow spall cone forms at the surface of the concrete. Different adhesive composition, concrete aggregate content and admixture result in a scatter of tensile load values at failure.



Bending Failure – the excessive moments will cause the anchor to fail as shown. Superfix does not recommend a single anchor to be subjected to flexural moments because of the weak bending resistance of anchors in general. To resolve such load situations, a group of 2 or more anchors should be considered.

Concrete Capacity Method

The design approach Superfix adopts is a hybrid of the American and European approaches, and shall be explained in detail. The load recommendations are all based on the capacity of the concrete, steel or chemical bond whichever is lower. For some cases, the basis of the load recommendations is on the displacement tolerance for those particular types of product applications. For concrete, the concrete capacity method is adopted. From site constraints and other influencing factors, the recommended loads are then adjusted accordingly.

Static pull out tests reveal that the failure pattern at the surface is never circular, an average value of the distance from the central axis of the anchor is taken from the perimeter of the affected area. This is done after omitting any extended portion ripped off due to concrete spalling at the surface. With the failure cone idealised, the characteristics of a particular anchor can then be obtained. The failure angle varies for each type of anchor as different working principles will give rise to different angles of conical break out, with the conical break out starting from different depths of the anchor.

Spacing

The characteristic spacing is then expected to be two times the radial effect of the idealised failure cone, illustrated in **Figure 1**. However, as different working principles of anchors give rise to different angle of conical break out, the characteristic spacing of some types of anchors are less than two times the radial effect of the idealised failure cone. As the anchor-to-anchor spacing reduces, the overlapping of the cones increase, resulting in a non-linear decrease in the ultimate load capacity, illustrated in **Figure 2**. Since the original loads are obtained from the concrete capacity method with idealised failure cones, the actual behaviour will definitely have situations where the failure cone overlaps. This should lead to a reduction factor being applied even though the spacing of the anchors is greater or equal to the characteristic spacing described. Hence, load reductions that Superfix recommend are already adjusted to account for this unpredictability in the failure pattern.

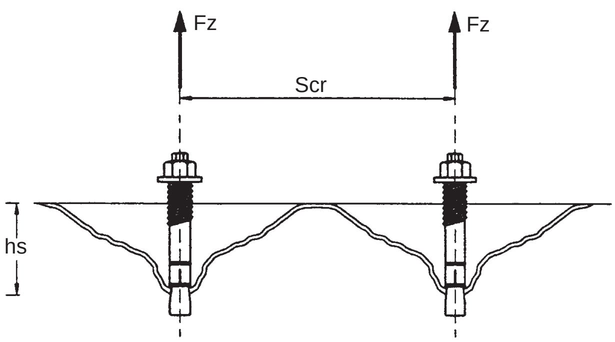


Figure 1: *Characteristic spacing of anchors*

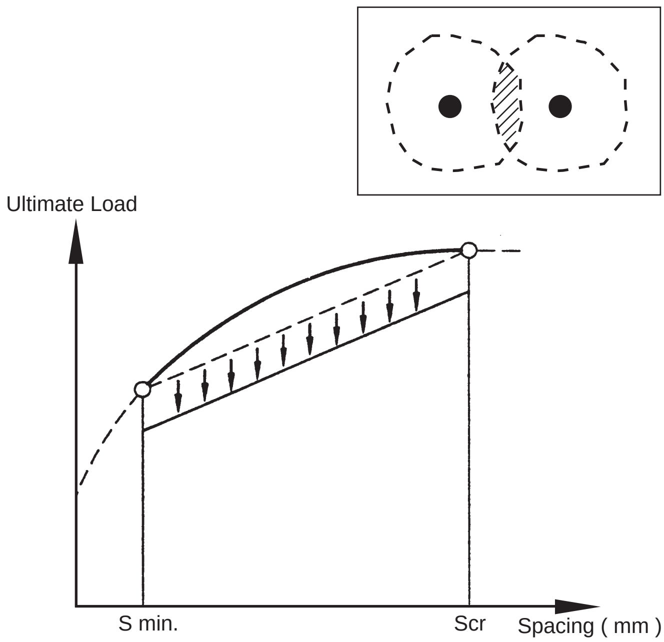


Figure 2: *Influence of spacing on the ultimate tensile load of anchors*

For anchors subjected to shear loads, analogy is drawn to the stress distribution of laterally loaded piles in geotechnical engineering, with the behaviour illustrated in **Figure 3.** Although the concrete will not break out, there may be overlapping of stress influences if the anchors are installed in close proximity. Hence a reduction factor should be applied to the recommended shear load if the stress zones overlap. The characteristic spacing S_{cr} is then the spacing from which a reduction factor need not be applied to the recommended shear resistance. **Figure 4** illustrates the assumption applied for stress distribution within the concrete base material. Note that Superfix always specifies a minimum permissible setting depth because of the possible concrete pryout at significantly lower loads.

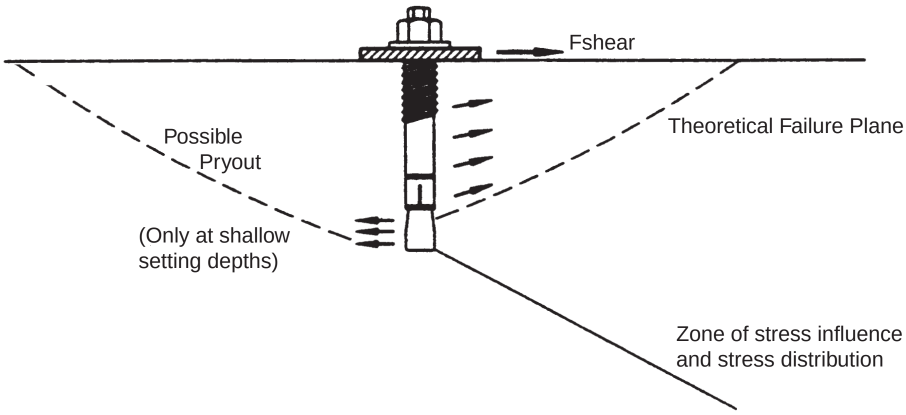


Figure 3: *Behaviour of anchors subjected to shear loads*

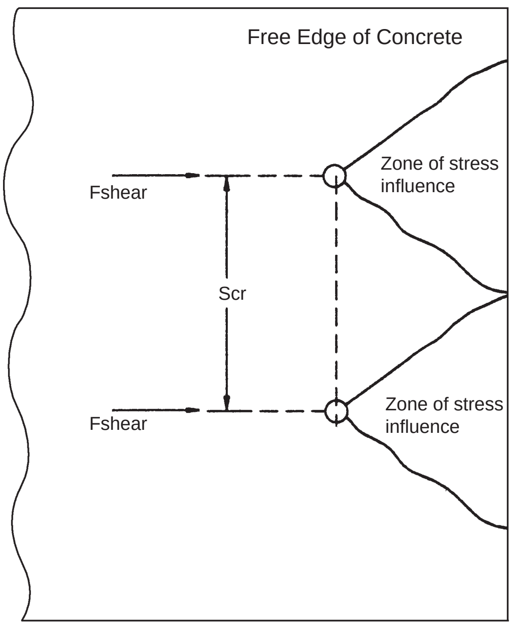


Figure 4: *Influence of spacing for anchors subjected to shear loads*

Edge Distance

Similar to the spacing considerations, the load capacity will be reduced if the anchor is situated close to the edge. As the edge distance decreases, the effective area contributing to the load capacity is reduced. **Figure 5** illustrates the effect of edge distance for tensile loads and **Figure 6** illustrates the effect of edge distance for shear loads. Again, reduction factors that Superfix recommend are already adjusted to account for the unpredictability in the failure pattern. Furthermore, note that for shear loading on an anchor near the edge of the base material, Superfix recommends at least nominal reinforcements between the anchor and the edge to enhance the safety against concrete break out.

As a general guideline, load-testing an anchor at the characteristic edge distance should yield approximately the same value as that of a single anchor without any constraints.

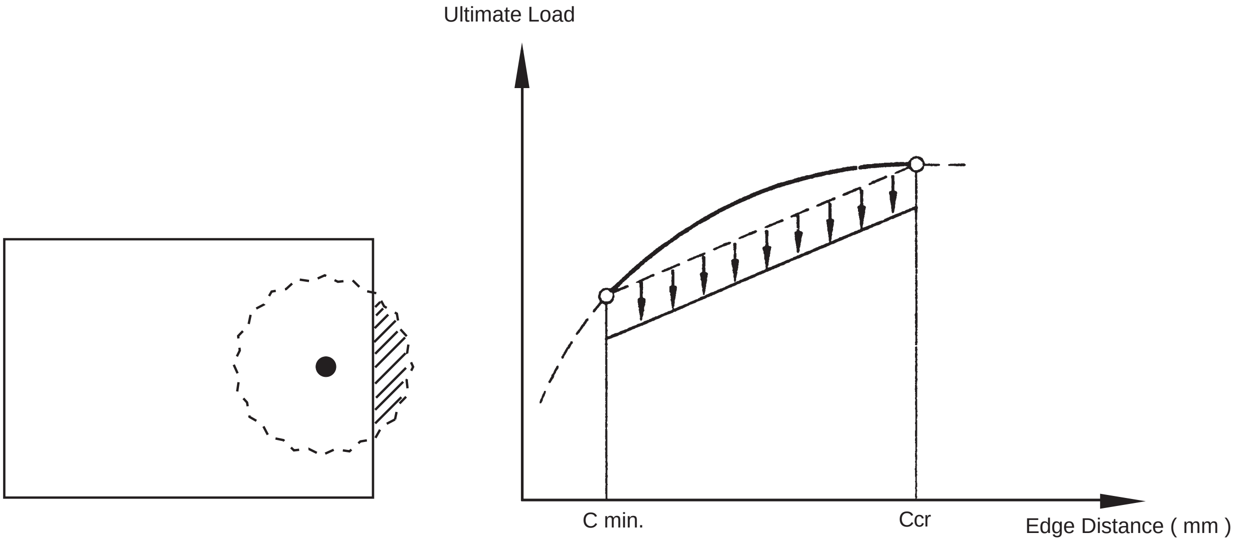


***Figure 5:** Influence of edge distance on the ultimate tensile load of anchors*

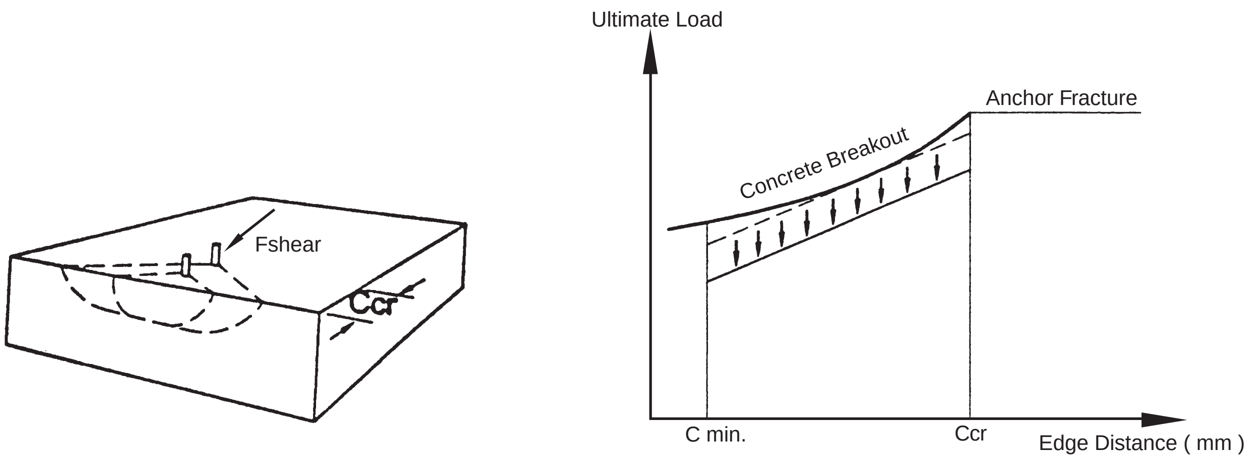


***Figure 6:** Influence of edge distance on the ultimate shear load of anchors*

Concrete Strength

The interlocking of the aggregates and the bonding within the concrete are the main factors contributing to the load capacity of anchors. For shear loads, if the anchor is sufficiently far from the edge, the concrete strength has negligible effect on the ultimate shear load, which is governed by the failure of the anchor itself. However, if the anchor is installed close to the edge, the ultimate shear load will be affected by the concrete strength as the failure of the fastening system is then governed by concrete break out. For tension, as the concrete strength increases, there will be a transition where the failure of the fastening system is governed by steel failure of the anchor, or anchor slippage (**Figure 7**). The mode of failure also depends on the grade of steel of the anchor.

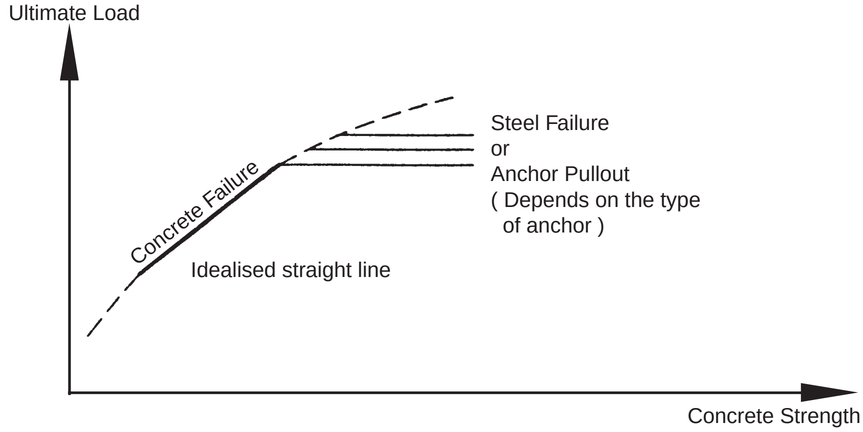


Figure 7: *Influence of concrete strength on the ultimate load of anchors*

Setting Depth

The effect of the setting depth of the anchor is illustrated in **Figure 8**. For setting depths exceeding Superfix recommendations, we do not recommend an enhancement factor to be applied to the ultimate loads as the failure mode may switch to anchor breakage. However, for shallow setting depths, a reduction factor must be applied as the effective load resisting area of the concrete is reduced.

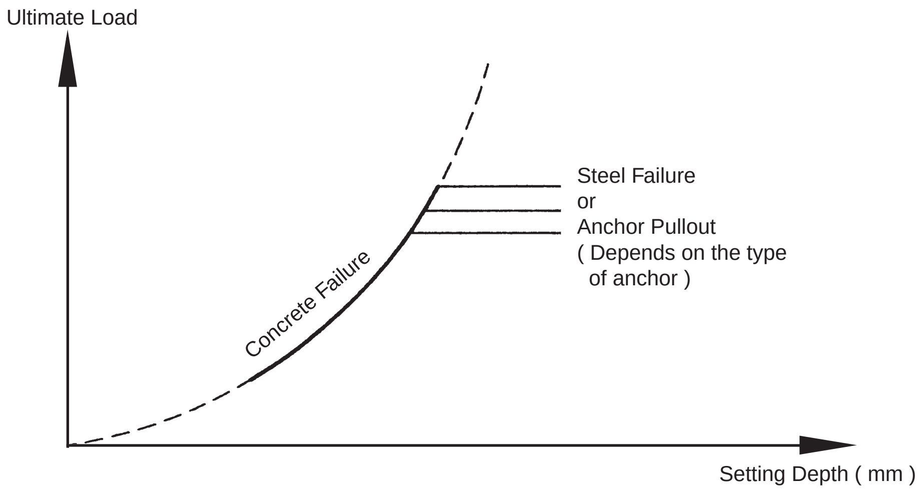


Figure 8: *Influence of setting depth on the ultimate tensile load of anchors*

Cracked Concrete

In the design of anchor fastening systems in the tension or cracked zone of structural members, the formation of cracks will prevent the concrete failure cone from developing fully, and subsequently lead to a reduction in the load resisting capacity of the anchors. It is important to note that anchors with thin shield (expansion sleeves) often result in slippage at low loads, and high displacement at higher loads due to the friction principle from which the anchors grip onto the concrete (as compared to anchors which key into the concrete). These anchors are particularly sensitive to drill hole diameters and installation methods, and perform poorly in cracks because the shields (sleeves) are too thin to compensate for movement. **Figure 9** illustrates the effect of crack planes on the development of the concrete failure cone. It can be seen that the most critical condition is when the crack lines propagate along 2 axes. However in practise, locations with crack lines propagating along 1 axis will reach the 0.3mm crack width limit, way before the locations with cracks propagating along 2 axes reach the same limiting 0.3mm crack width. As an industry norm, cracks widths of 0.3mm or less are acceptable for anchor fastening systems with appropriately reduced recommended loads.

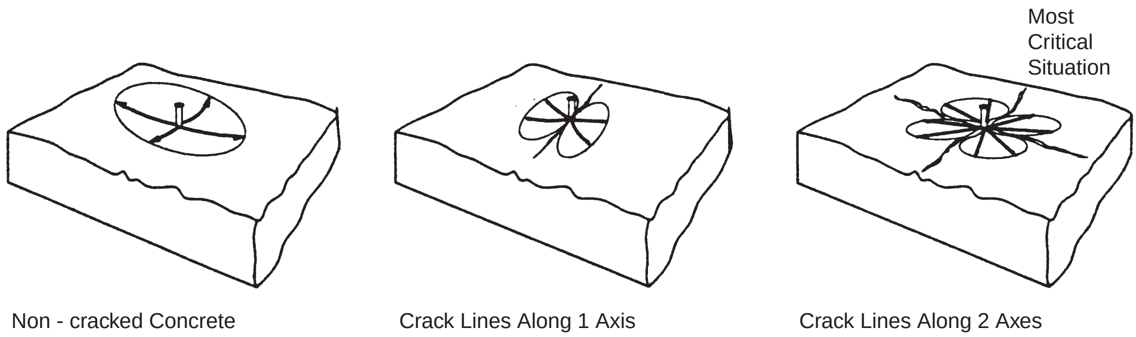


Figure 9: *Influence of crack planes on the failure pattern of concrete*

Displacement Tolerance

While some anchors display near-zero displacement behaviour even when the load is close to the failure value (ultimate limit state) some anchors may have high displacements (maximum slip) before the full grip onto the concrete causes the concrete cone to break out. Other anchors may fail due to anchor pullout although the ultimate loads achieved may be reasonable and sufficient – these anchors must not be used for cyclic loads nor periodic loads as each load cycle will cause some degree of displacement, which is cumulative and will ultimately lead to the failure of the fastening system. Hence for anchorage systems, the ultimate loads and recommended loads are insufficient in determining the suitability of an anchor for the specific task at hand. Superfix adopts a stable and safe approach for load recommendations, and some anchors (due to different working principles and design of the mechanical expansion system) will exhibit a higher factor of safety, because the recommended loads are limited by the displacement constraints (serviceability limit state).

Partial Factors Of Safety	Abbreviation	
Scatter of tensile strength of site concrete	γ_1	1.2
Installation safety of anchor system (Tension)	γ_2	1.2
Installation safety of anchor system (Shear)	γ_2	1.0
Concrete under compression	γ_c	1.5
Anchor steel	γ_{Ms}	1.5
Chemical bond	γ_{Mb}	1.4

Safe Tensile Resistance	Abbreviation			
Applied load	γ_F	1.4		
Anchor pullout, concrete cone failure, splitting failure	$\gamma_{Mp/Mc/Msp}$	$\gamma_c.\gamma_1.\gamma_2$	123	2.16 Governs
Steel failure	γ_{Ms}	1.5		
Bond failure	γ_{Mb}	1.4		
Overall Factor Of Safety		**3.02**		

Safe Shear Resistance For $C < C_{cr}$	Abbreviation			
Applied load	γ_F	1.4		
Concrete edge failure, pryout failure	$\gamma_{Mc/Mcp}$	$\gamma_c.\gamma_1.\gamma_2$	123	1.8 Governs
Steel failure	γ_{Ms}	1.5		
Bond failure	γ_{Mb}	1.4		
Overall Factor Of Safety		**2.52**		

Safe Shear Resistance For $C \geq C_{cr}$	Abbreviation			
Applied load	γ_F	1.4		
Steel failure	γ_{Ms}	1.5	123	1.5 Governs
Bond failure	γ_{Mb}	1.4		
Overall Factor Of Safety		**2.1**		

Design Principles

With the definitions in **Page 9**, the nominal recommended loads shall be reduced according to the constraints faced. The general formula should be:

$$F_{N,REC} = F_N . f_{A1} . f_{A2} . f_{RN1} . f_{RN2} . f_B . f_T$$
$$F_{V,REC} = F_V . f_{A1} . f_{RV1} . f_B . f_T$$

For an anchor group subjected to tensile forces, the minimum tensile load resistance of any anchor should govern the design, unless externally applied moments allow the anchors to resist different magnitudes of tensile forces.

For an anchor group at a corner with inclined applied shear force acting towards two free edges at reduced distances, separate analysis should be performed for each free edge. For each shear direction, the minimum shear resistance of any anchor shall govern the design.

The design should be such that:

$F_{N,REC} \geq F_Z$ (recommended safe tensile resistance ≥ applied tensile load)

$F_{V,REC} \geq F_{Shear}$ (recommended safe shear resistance ≥ applied shear load)

For combined tensile and shear loads, the following combined-load interaction checks are recommended:

$$\left(\frac{F_Z}{F_{N,REC}}\right)^{1.5} + \left(\frac{F_{Shear}}{F_{V,REC}}\right)^{1.5} \leq 1.0$$ (All failure modes other than steel failure)

$$\left(\frac{F_Z}{F_{N,REC}}\right)^{2} + \left(\frac{F_{Shear}}{F_{V,REC}}\right)^{2} \leq 1.0$$ (For steel as the governing mode of failure)

Overall, there may be other design guidelines relevant to the building codes the designer has to adhere to – Superfix makes recommendations for its products only, and the recommendations are not intended to supersede any relevant guideline or design code of practice.

Recommended Checking Procedures

It is important to follow the recommended installation procedures. All anchors subjected to proper tightening will have a pre-load clamping effect on the fixture plate. Over time, the steel relaxation will cause a loss in the clamping force. The residual pre-load is estimated to be 60% of the initial clamping force. As a general guideline, as long as a mechanical expansion anchor is installed at the recommended torque value, the residual pre-load due to the tightening torque ensures 100% reliability of proper fastening.

Equipment such as torque wrenches provides a good empirical check on the reliability of the anchors fastened. This check can be performed on bonded anchors as well after the full cure time is achieved. 100% of the initial clamping force is utilised when the bonded anchor is tightened to the recommended torque value. Note that over-tightening may cause the anchor steel to fail in bending or torsion. Also, if the applied loads are higher than the recommended loads, there may be excessive displacements, or creep pullout of the anchors may occur.

If on-site load verification tests are required to check the reliability of workmanship, Superfix recommends an anchor to be loaded to the maximum design service load. Loads in excess of this value may cause a permanent displacement and loss of setting depth, which serves no meaningful evaluation.

8.2 Rebar Fastening Concept

Often, addition and alteration works on structures require the use of adhesive bonds to install rebars into existing structures. The Rebar Fastening Concept is based on the evaluation of the weakest mode of failure at the Ultimate Limit State.

Figure 10 illustrates the contribution of the reinforcement steel, to account for the flow of forces for post-installed rebars. Different adhesive composition, concrete aggregate content and admixture result in varying tensile load values at failure. This scatter of tensile strength of site concrete enforces the need for the partial factor of safety of 1.2.

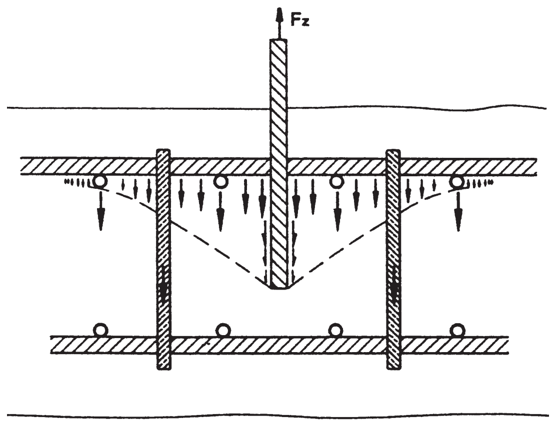
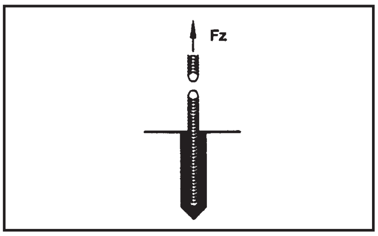
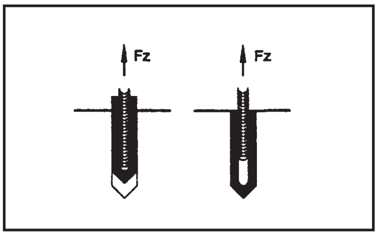


Figure 10: *Flow of forces for rebar installed in reinforced concrete*

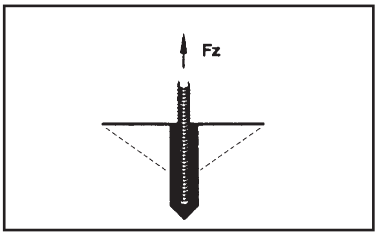
The following are the three possible modes of failure for post-installed rebar fastening:



Steel Failure – this occurs when the tensile load exceeds the tensile capacity of the rebar, which can be calculated by the multiplication of the cross-sectional area and the characteristic strength of the rebar.



Bond Failure – this occurs when the bond between the adhesive and the steel yields, or when the bond between the adhesive and the concrete yields. Often, a shallow spall cone forms at the surface of the concrete.



Concrete Failure – this occurs at shallow embedment depths where the capacity of concrete is exceeded. A conical breakout of the concrete is expected at less than half the embedment depth.

For shallow setting depth (anchorage length), the contribution of the reinforcement within the concrete may be minimal, which leads to concrete failure when the rebar is loaded in tension. Hence, for rebars installed at shallow setting depth, or if the steel reinforcement within the concrete is unknown, the Anchor Fastening Concept should be adopted. It must be noted that design embedment depths differ for unsaturated polyester, epoxy-acrylate, epoxy resin adhesives. **Figure 11** shows the theoretical failure modes in relation to the concrete strength and the setting depth (anchorage length).

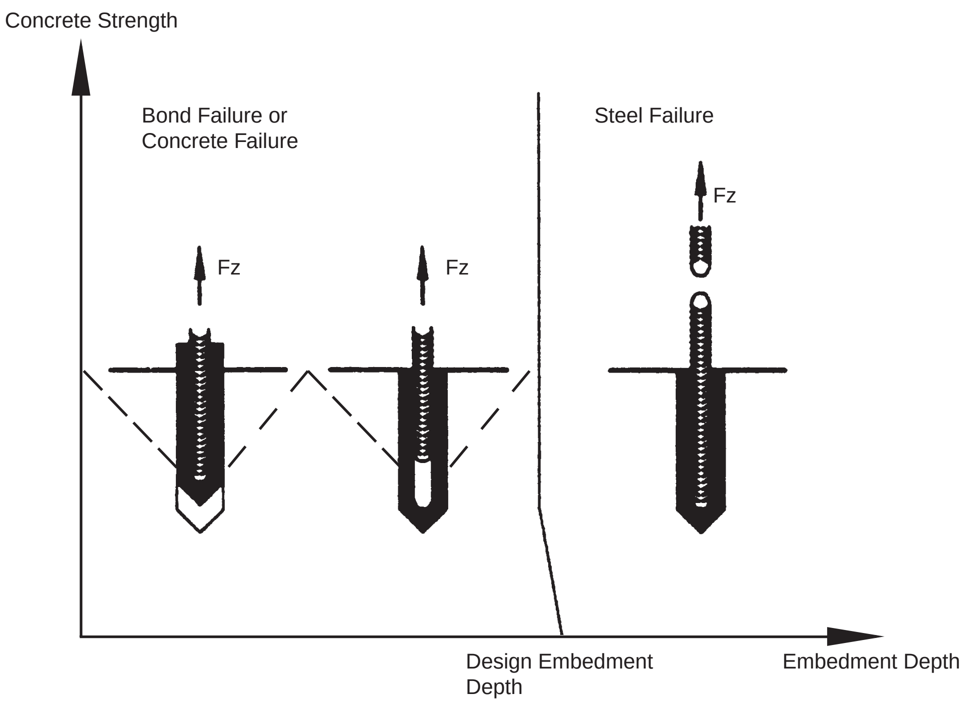


Figure 11: *Expected failure modes for rebar installed in reinforced concrete*

Rebar Design Principles

The post-installed rebar should have load characteristics that normal cast-in rebars display. Based on design principles for reinforced concrete structures, steel is used as the load transfer mechanism for tensional forces, and design often provides for the minimum area of steel required. At the ultimate limit state (ULS), the rebars must yield before the limiting concrete strength or bond strength of the chemical is exceeded. The fundamental principle here is that the anchorage system provided must ensure continuity in the reinforcement where other design provisions (eg. shear reinforcements) can subsequently be provided. If the yield of steel is not the governing mode of failure, there are two possible drastic consequences. Firstly, inadequate concrete resistance will lead to a local break out of the concrete. Secondly, inadequate bond strength will result in an anchorage system that is not a fixed-end condition (i.e. the rows of rebars subjected to tension will slip, and are unable to transfer the end-moments to the adjoining component). Design is based on the guidelines stipulated in Singapore Standard CP 65: Part 1: 1999. Design for critical structural elements ensure continuity of reinforcement, in accordance with Clause 3.12.8 & 3.12.9. Design for general application based on limiting bond strength, and cases of reduced embedment depths, are permitted by Clause 2.6 of the code.

If design shear load values are required based on the limiting bond, concrete or steel strength, an appropriate approach will be to consider the connection as a joint, where the steel reinforcement resists the shear force due to the design ultimate loads, and tan α_f accounts for the friction of the concrete to concrete interface between the two adjoining components. For general applications, checks should be performed on the various limiting strengths, where the lowest resistances govern the design. A conservative approach is to assign the reinforcement provided to resist the entire shear force due to design ultimate loads, and the interface of the concrete to be smooth and untreated (CP65 Cl. 5.3.7d).

Characteristic bond strength corresponds to the 5% fractile value of the ultimate load. Characteristic yield strength of reinforcement steel, f_y = 460 N/mm^2. Characteristic strength of concrete is calculated using simplified formulae from ETAG 001 - Annex C. Relevant partial factors of safety are: concrete material, γ_{Mc} = 1.8; chemical bond, γ_{Mb} = 1.4; steel material, γ_{Ms} = 1.15. For bond performance, an additional partial factor of safety of 1.2 is recommended for installation inconsistency.

Note 1: **Post-installed rebars must be within the reinforcement cage.**

Note 2: **If rebars are installed into normal weight concrete, or if the reinforcement steel is uncertain, please adopt the Anchor Design Concept.**

Note 3: **Superfix recommendations are for load bearing characteristics only. All detailing and construction provisions are to adhere to the relevant design codes, unless otherwise approved by the relevant authorities.**

Superfix recommends either of the two different approaches to rebar design: **Ultimate Limit State (ULS) Design**, and **Design Resistances For Ultimate Loads**.

Design Approach #1: Ultimate Limit State (ULS) Design

#1.1 Design embedment depth should be such that the bond resistance is greater than the tensile yield value of the steel (1.0 $f_y.A_s$) at the ULS, with an additional partial factor of safety of 1.2 for installation inconsistency.

The characteristic bond resistance in tension is calculated by:
$F_{N,Bond} = \pi . d . h_s . f_{Bond} / 1000$ [kN]

#1.2 Check that the concrete strength is adequate.

The characteristic concrete resistance in tension is calculated by:
$F_{N,Concrete} = (7.2) . (f_{CU})^{0.5} . (h_s)^{1.5} . f_{Crack} . f_{AN} . f_{RN} / 1000$ [kN]

Where **f_{AN}** is the reduction factor for close rebar spacing
f_{RN} is the reduction factor for close edge distance
f_{Crack} accounts for the application in cracked or non-cracked concrete

#1.3 Ensure that the yielding of steel is always the governing mode of failure.

The characteristic yield of reinforcement steel is calculated by:
$F_{N,Steel} = f_y . \pi . (d^2/4) / 1000$ [kN]

$F_{N,Bond} / 1.2 > F_{N,Steel}$
$F_{N,Concrete} > F_{N,Steel}$

The design embedment depth shall be the greater value of $\mathbf{h_s}$ from #1.1 and #1.2.

#1.4 For addition and alteration works, the designer must ensure that the localised shear capacity of the concrete is not exceeded, and that the flow of forces to the existing structure is within acceptable limits.

Design Approach #2: Design Resistances For Ultimate Loads

#2.1 Calculate the ultimate applied tensile and shear forces from the end-moments and effective lever arm.

#2.2 From the design embedment depth or reduced embedment depth, obtain the design resistance forces due to the limiting bond strength, concrete strength, and steel strength.

Partial Factors Of Safety	**Abbreviation**	
Scatter of tensile strength of site concrete	γ_1	1.2
Installation safety of anchor system (Tension)	γ_2	1.2
Installation safety of anchor system (Shear)	γ_2	1.0
Concrete under compression	γ_c	1.5
Rebar steel	γ_{Ms}	1.15
Chemical bond	γ_{Mb}	1.4

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

Design For Tensile Forces:

The design bond resistance in tension is calculated by:
$F_{N,Bond} = (n.\pi.d.h_s.f_{Bond}) / \{(1000).(1.2).(1.4)\}$ [kN]

Where **n** is the number of rebars resisting tensile loads

The design concrete resistance in tension is calculated by:
$F_{N,Concrete} = \{n.(7.2).(f_{CU})^{0.5}.(h_s)^{1.5}.f_{Crack}.f_{AN}.f_{RN}\} / \{(1000).(1.8)\}$ [kN]

Where **n** is the number of rebars resisting tensile loads
$\mathbf{f_{AN}}$ is the reduction factor for close rebar spacing
$\mathbf{f_{RN}}$ is the reduction factor for close edge distance
$\mathbf{f_{Crack}}$ accounts for the application in cracked or non-cracked concrete

Note: For a group of rebars subjected to tensile load (usually the top row of rebars), the lowest value of $F_{N,Concrete}$ applies after accounting for the various factors due to site constraint.

The design steel resistance in tension is calculated by:
$F_{N,Steel} = \{n.f_y.\pi.(d^2/4)\} / (1000).(1.15)\}$ [kN]

Where **n** is the number of rebars resisting tensile loads

The design tensile resistance shall be:
$\mathbf{F_{N,Design} = minimum\ (F_{N,Bond}, F_{N,Concrete}, F_{N,Steel})}$

Design For Shear Forces:

The design bond resistance in shear is calculated by:
$F_{V,Bond} = \{n.(0.6).(\tan\alpha_f).\pi.d.h_s.f_{Bond}\} / \{(1000).(1.4)\}$ [kN]

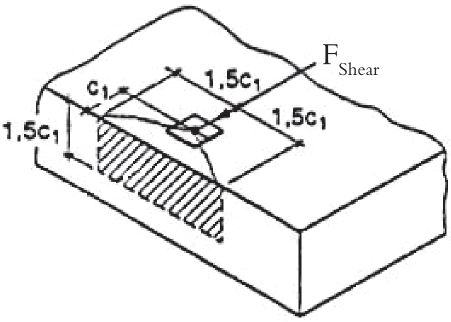
Where **n** is the number of rebars resisting shear loads
$\mathbf{\tan\alpha_f}$ accounts for the concrete to concrete interface of the joint

The design concrete resistance in shear is calculated by:
$F_{V,Concrete} = \{(0.45).d^{0.5}.(h_s/d)^{0.2}.f_{CU}^{0.5}.c_1^{1.5}.f_\alpha.f_{ER}.(A_c/A_0)\} / \{(1000).(1.8)\}$ [kN]

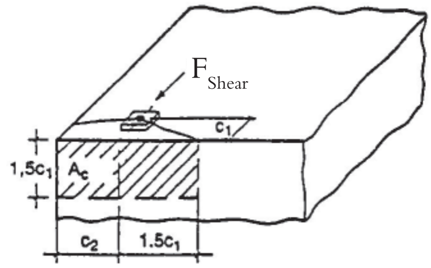
Where $\mathbf{c_1}$ is the reduced edge distance of the post-installed rebars
$\mathbf{f_\alpha}$ accounts for the applied load direction in relation to the reduced free edge
$\mathbf{f_{ER}}$ accounts for the position in cracked or non-cracked concrete, and the type of edge reinforcement used
$\mathbf{A_0}$ is the area of concrete cone of an individual rebar at the lateral concrete surface not affected by edges parallel to the assumed loading direction
$\mathbf{A_c}$ is the actual area of concrete cone of the rebars at the lateral concrete surface

The following are examples to calculate A_0 and A_c:

$A_0 = 4.5\ c_1^2$

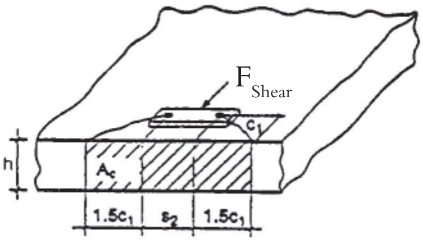


Example: $A_c = (1.5\ c_1).(1.5\ c_1 + c_2)$



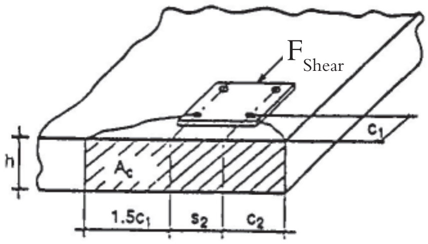
Provided
$h > 1.5c_1$
$c_2 \leq 1.5c_1$

Example: $A_c = (3c_1 + s_2).(h)$



Provided
$h \leq 1.5c_1$
$s_2 \leq 3c_1$

Example: $A_c = (1.5\ c_1 + s_2 + c_2).(h)$



Provided
$h \leq 1.5c_1$
$s_2 \leq 3c_1$
$c_2 \leq 1.5c_1$

Note that the concrete shear capacity of the row of rebars nearest the free edge governs. The contribution of the inner rows of rebars must not be included.

The design steel resistance in shear is calculated by:
$F_{V,Steel} = \{n. (0.6). (\tan \alpha_f). \pi. (d^2/4). f_y\} \ / \ \{(1000). (1.15)\}$ [kN]

Where **n** is the number of rebars resisting shear loads
tan α_f accounts for the concrete to concrete interface of the joint

The design shear resistance shall be:
$F_{V,Design}$ = minimum ($F_{V,Bond}$, $F_{V,Concrete}$, $F_{V,Steel}$)

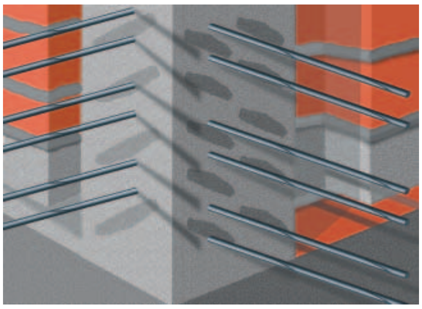
#2.3 Perform the combined-load interaction check where N = 1.5 for all modes of failure:

$$\left(\frac{F_z}{F_{N,Design}}\right)^N + \left(\frac{F_{Shear}}{F_{V,Design}}\right)^N \leq 1,$$

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

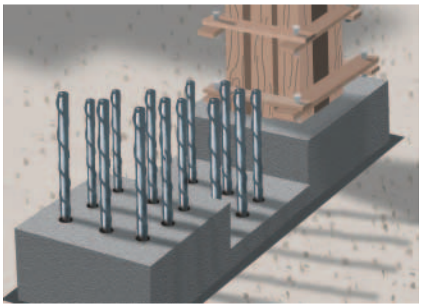
Applications For Adhesives

Horizontal extension to existing structures:



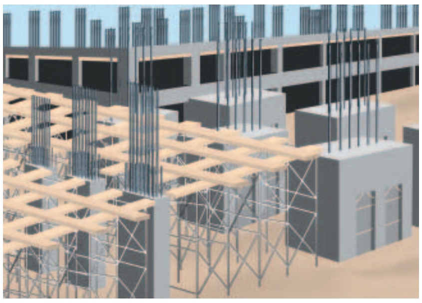
- Extending anchorage bars for slab
- Upstand beam
- Parapet – Platform landings
- Reconstruction of wall

Vertical reinforcement bars for increased anchorage / lap:



- Increasing lap length of column rebars
- Retaining wall
- Basement wall
- Structure columns with framework

Missing bars for reinforcement and reconstruction of structures:



- Wall connection
- Extension from existing floor slab
- Parapet corridor
- Extension to structure
- Adding longer starter bars for column

8.3 Concept For Lightweight Fixings

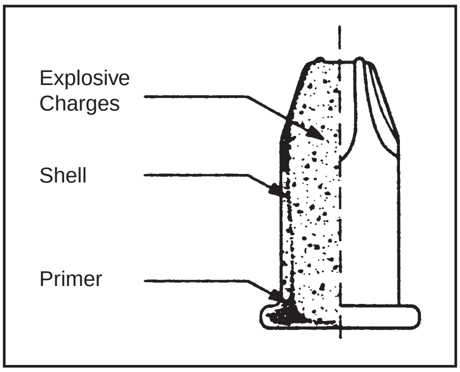
This section shall explain the basis of Superfix recommendations for common household applications and light construction works such as facades, partitions, plasterboards, door frames, kitchen fittings, bathroom fittings, electrical cables and switches, lighting support systems, shelves, curtain rails, ceiling fittings, etc.

These fixing systems often have shallow setting depths (mostly less than 50mm depth), and the base materials (bricks, boards, plastics, etc) may be weaker than non-reinforced concrete. For concrete, the surface layer may have a slight inconsistency in the interlocking of the aggregates, affecting the tensile strength of the concrete. Furthermore, for such lightweight fixings, there is often a layer of floor topping or wall plaster, which will give way at lower applied loads.

Hence, Superfix recommends an overall Factor of Safety of 5, obtained from the average ultimate load capacities, for the safe working loads of all Lightweight Fixings.

8.4 Powder-Actuated Tools

The fixing of drive pins is carried out using specially designed nail guns. The energy released by the ignition of the explosive cartridges is transferred onto the drive pins, thereby punching into steel, concrete or brick materials. Superfix Powder-Actuated Tools are designed and manufactured to meet users' safety needs, and can be used for a wide range of applications such as the fixing of doors, windows, boards, pipes, tiles, steel and metal sheets, cables, wooden beams, kitchen cabinets, etc. These fixing systems can be used for either permanent or temporary works, and has a few advantages over the traditional fixing methods. No external supply of energy is required in the work tools – making works high above the ground more convenient, reducing the time needed to accomplish works, and offering practical solutions to some constraints faced at construction sites.



The explosive cartridge consists of a metal case, filled with explosive charges and primer. Once the firing pin strikes the base of the cartridge, the primer is ignited and sets off the explosive charges. The instantaneous temperature can reach over 2000°C and the pressure can reach over 200 N/mm^2.

Superfix Powder-Actuated Tools have 2 main modes of driving the nail into the base material – direct acting principle, and indirect (piston) acting principle.

Superfix High Velocity Tool HV660 uses the direct acting principle where the pressure of the explosion is channelled directly to the nail, causing the driving velocity to be around 500 m/s. Such a forceful driving velocity can cause danger to the operators, and damage to the base material. Hence, care must be taken when using the Superfix HV660, and applications are limited (usually for fixing timber to concrete). **Figure 12** illustrates the differences in the driving principles of Superfix Powder-Actuated Tools.

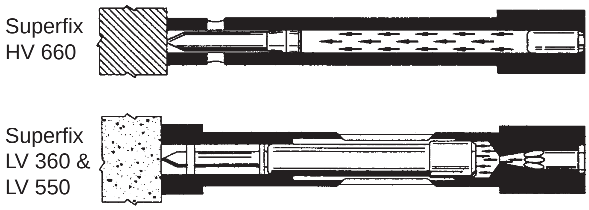


Figure 12: *Driving principles of Superfix Powder-Actuated Tools*

Superfix Low Velocity Tools LV360 and LV550 use the indirect acting principle where the pressure of the explosion is channelled to the piston, which subsequently forces the nail into the base material. The low driving velocities of less than 100 m/s significantly increase the safety and reliability of the Superfix LV360 and Superfix LV550.

The reduction of driving velocities can be explained using kinetic energy considerations of the 2 different driving principles of the powder-actuated tools. Where **m** is the mass of the nail, **M** is the mass of the piston (usually $M \approx (50 \sim 150) \times m$), $\mathbf{V_l}$ is the driving velocity due to the indirect (piston) acting mode, $\mathbf{V_h}$ is the driving velocity due to the direct acting mode, and assuming no losses due to friction:

Kinetic energy when using the low velocity tool = $0.5\,(m + M).V_l^2$
Kinetic energy when using the high velocity tool = $0.5\,m.V_h^2$
Assuming that the same cartridge is being fired, the energy released will be the same. Hence,

$$0.5\,(m + M).V_l^2 = 0.5\,m.V_h^2$$
$$(m + 99m).V_l^2 = m.V_h^2 \quad \text{(assuming } M = 99m\text{)}$$
$$V_h / V_l = (100)^{0.5}$$
$$\text{Hence } V_h = 10V_l$$

Superfix LV360 operates on a medium-recoil, impact piston concept where the nail is in contact with the base material, and a distance **X** is overcome by the piston before it drives the nail into the base material. Superfix LV550 operates on a low-recoil, co-acting piston concept where the nail is pushed into the fastener guide assembly until it makes contact with the piston, and subsequently moving together with the piston over a distance **Y**, before penetrating the base material. **Figure 13** illustrates both the above mentioned piston principles.

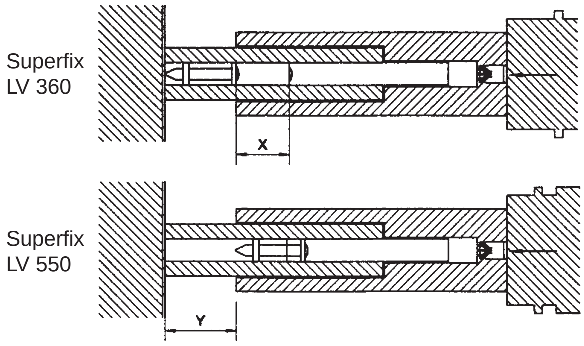


Figure 13: *Piston principles of Superfix LV360 and Superfix LV550*

When the nail reaches the object to be fastened or the base material, it is rapidly decelerated. For the indirect (piston) acting mode, the driving process stops very soon after the piston is held back by the powder-actuated tool (because the kinetic energy of the nail is significantly lower when using the indirect acting mode, as compared to using the direct acting mode). **Figure 14** compares the possible consequences of the different driving principles of Superfix Powder-Actuated Tools.

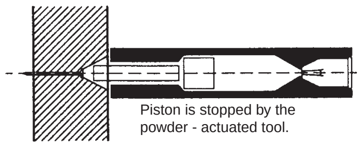
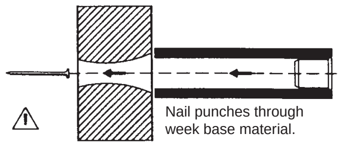
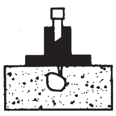
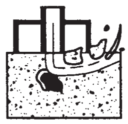
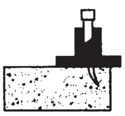
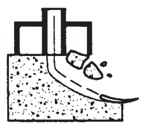
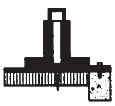
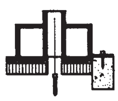
Situation	Indirect (Piston) Acting		Direct Acting	
Soft base material				
Presence of hard object		Good fixing		Nail flies out
Near the edge		No damage to the edge		Damages the edge
Insufficient base material thickness		Will not over penetrate		over penetrate

Figure 14: *Comparing the direct and indirect driving principles*

Experiments For Safety Considerations

- Cook-off temperature for the explosive cartridges is 130°C. Below this temperature, the cartridges will not fire off on its own.
- When exposed to direct fire, boxes of cartridges will go off like firecrackers. No large explosion is caused, and there is no damage to objects or harm to people at a distance of 5 metres.
- Cartridges that were dropped from a height of 12 metres caused no ignition of the explosive charges.

Safety Features

- Direct pressure: The gun will not fire until it is sufficiently compressed against a hard surface. The trigger mechanism can only fire when the spring-loaded firing pin gains enough energy from the direct pressure.
- Dropping discharge: If accidentally dropped on the ground, the loaded gun will not fire off.
- Tilting: If the gun is tilted by and angle 7° or more, the gun will not fire.
- Safety cover: All Superfix Powder-Actuated Tools come with a safety cover, preventing the nails or debris from hurting people.

Storage

- Warehouses for keeping explosive charges must be kept clean and dry with good ventilation. There should be no fire source, and the temperature must be below 40°C.
- Avoid mixing the explosive charges with any kind of chemical product or inflammable material.

Loading, Unloading, And Transportation

- The products inside moving vehicles must be stabilised.
- The products should not be mixed with inflammable materials (gas, alcohol, etc) or any kind of chemical product.
- No throwing, dragging or crushing is allowed. Special care should be taken when mechanical devices are used for moving the products.
- Trains, boats, automobiles can be used for transporting, but should be sheltered against water.
- Containers loaded with explosive charges should be fireproof. Separate them when there is a fire.
- When transporting the explosive charges, rules and regulations for transporting dangerous goods are to be followed.

Usage

- Always choose the right colour cartridge and respective powder-actuated tool, and follow the instructions strictly.
- Avoid placing explosive charges close to objects with high temperatures like stoves or hot steel ingots.
- Do not give the explosive cartridges to unauthorised people or to children. Place them in a safe place when not in use.
- Do not crush explosive charges. To avoid friction, do not mix them with ordinary steel nails.
- Do not release the safety device of the gun when an explosive charge is still in the barrel. When the gun is out of order, remove the explosive charge before attempting any troubleshooting or repairs.
- If the cartridge does not fire off after depressing the trigger, wait for 5 seconds, then remove the cartridge from the gun.
- The gun should be maintained after usage. Eventually, the fastener guide, piston, and firing pin will wear out, and should be replaced.

8.5 Drive Pins Fastening Concept

Superfix Drive Pins are made of high quality steel and have excellent ductility. Usually, nails are made up of the nail itself and a washer. These washers have diameters close to the barrel diameter, and ensure proper alignment of the nail within the barrel. When punching into the base material, these washers are ideal for providing the damping force needed to stop the nail. For Drive Pins with threaded studs, the transition from shank to the threaded portion during the penetration also helps in bringing the Drive Pins to a stop. For softer fixture material, larger washers can be used to ensure proper fixing without damaging the fixture material (see **Figure 15**). There are many kinds of drive pins and their purposes vary. It is essential to select the suitable drive pin and its compatible powder-actuated tool to accomplish the job effectively and efficiently.

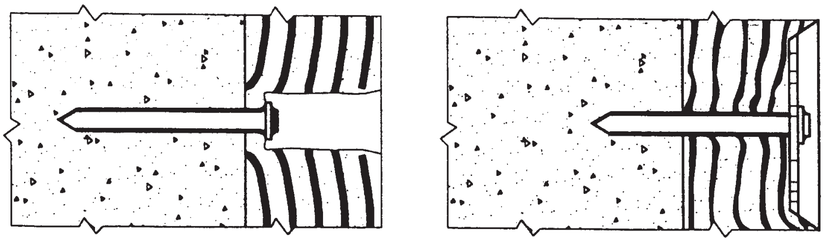


Figure 15: *Effect of washer diameter on fixing softer fixture materials*

The following are **suitable base materials**:

Concrete – Good structural concrete with a strength between 20 N/mm^2 to 50 N/mm^2. Limited range of Drive Pins for precast concrete due to buckling of slender nails (the total length of the Drive Pin should be less than or equal to 52mm, and the suitable length of the Drive Pin also depends on the grade of the precast concrete).

Brick – Solid bricks with strength between 10 N/mm^2 and 40 N/mm^2, with good joint conditions.

Metals – Mild steel, certain types of aluminium and other metals.

The following are **unsuitable base materials**:

Brittle or hard materials – Cast iron, cast steel, hardened steel, perforated bricks, glass, glazed tiles, quarry tiles, slate, marble, and hard stones.

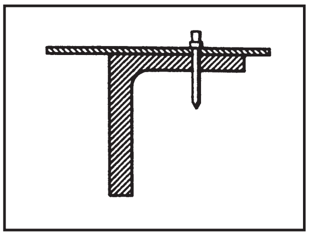
Soft or thin materials – Aerated concrete, lightweight concrete, plasterboard, plywood, and hardboard.

For fixings into concrete or brick, the drive pin penetrates into the base material and creates a stress bulb within its proximity. This localised stress zone accounts for the clamping force acting on the fastener. Apart from the friction due to the reactive forces, the intense heat generated while the Drive Pin is driven into the base material causes the Drive Pin to bond with it. This bonding is strong and the failure mode during pullout tests is usually cone failure or splitting of the brick (provided the fixture material is strong also).

For fixings into steel, the steel is subjected to elastic and plastic deformation. Similar to concrete or brick, the compressive stresses around the Drive Pin accounts for the clamping force acting on the fastener. Apart from this, the intense heat generated makes the steel mould plastically into the grooves of the knurled shank, fusing the Drive Pin to the base material.

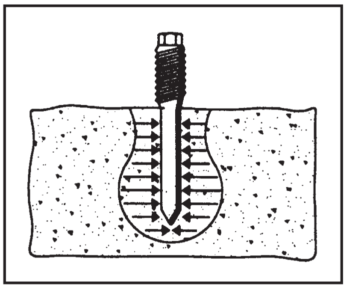
Figure 16 shows the stresses within the base material for a good fastening.

- Washer tight against the sheet
- Sheet tightly clamped against the base material

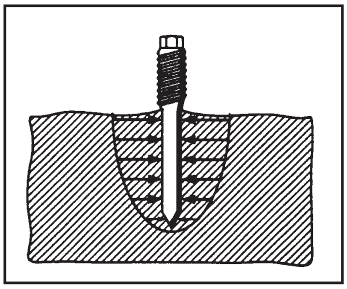


Steel

- Proper penetration into the base material



Concrete

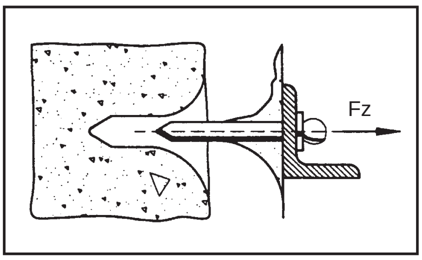


Steel

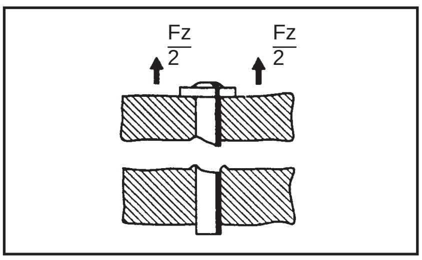
Figure 16: *Good fastening using Superfix Drive Pins*

Modes Of Failure

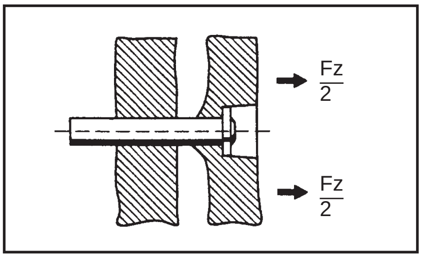
Under tensile loading, the following are the possible modes of failure for a good fixing:



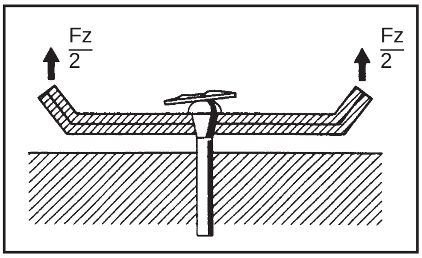
Pullout Failure – this occurs when the Drive Pin slips or rips off a cone-shaped portion of the base material (depending on the type of base material).



Steel Failure – this occurs when the Drive Pin breaks under tensile loading (usually for fixings of strong base material and fixture material).

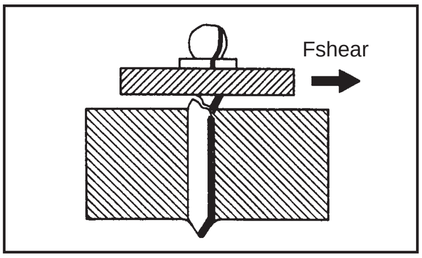


Fixture Failure – this occurs when the soft fixture material yields and is pulled over the head of the Drive Pin.

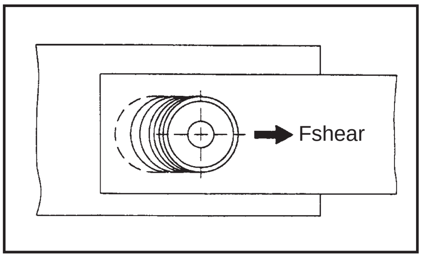


Washer Failure – this occurs when the washer is pulled over the head of the Drive Pin (usually for fixings of strong base material and fixture material).

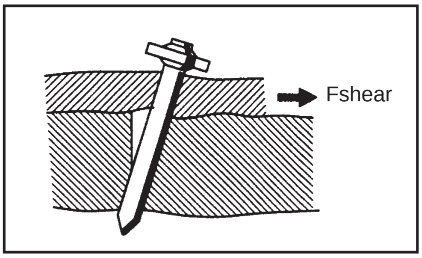
Under shear loading, the following are the possible modes of failure for a good fixing:



Steel Failure – this occurs when the Drive Pin breaks under shear loading (usually for fixings of strong base material and fixture material).

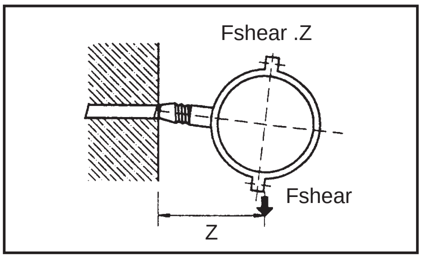


Fixture Failure – this occurs when the soft fixture material yields and elongates the fixture hole until an edge of the fixture fails.



Base Failure – this occurs when the soft base material yields and deforms under shear loading. Depending on the base material, the Drive Pin may eventually slip out, or rip through the base material in a manner similar to that of the Fixture Failure.

Under flexural bending (stand-off fastening), the following mode of failure is expected:



Bending Failure – the excessive moments will cause the Drive Pin to fail as shown. As with the Anchor Fastening Concept, Superfix does not recommend single anchor subjected to flexural moments because of the weak bending resistance of anchors in general. To resolve such load situations, a group of 2 or more Drive Pins should be considered.

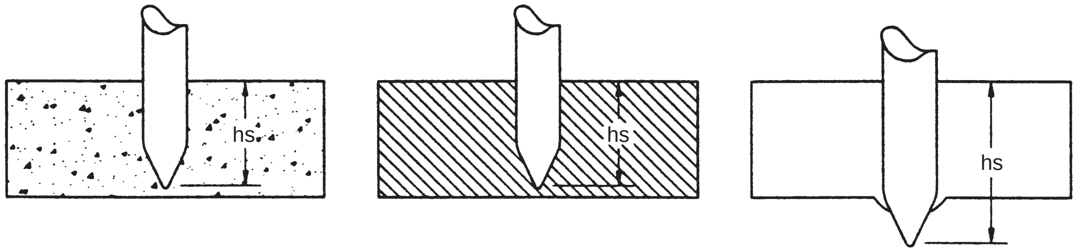
Design Of Support Systems Using Superfix Drive Pins

Similar to the Concept For Lightweight Fixings, all load values for Superfix Drive Pins have an overall Factor of Safety of 5, obtained from the average ultimate load capacities. Instead of considering individual fixings with adequate factor of safety, the design of support systems using Superfix Drive Pins should allow for a fixing failure rate of 20%. Hence, a redundant approach is recommended where at least 20% more numbers of fixings should be performed instead of the bare minimum number of fixings to withstand the design load. This will provide adequate safety for installation errors by the workers, and localised weak zones in the structure (small voids or honeycombs), and allow the load to be transferred between the Drive Pins should slippage or failure of fixing(s) occur. Since the setting depth is very shallow, the load factors vary often. Hence, the edge and spacing distances recommended are the critical values to enable the full load capacities to develop. The safe working loads that Superfix recommends are meant for concrete of $f_{CU} \geq 30$ N/mm². Suitability trials should be conducted prior to installation, for fastening into higher-grade concrete of $f_{CU} \geq 40$ N/mm².

Drive Pin length = Setting depth (h_s) + Allowance for fixture (h_f)

Setting depth (h_s)

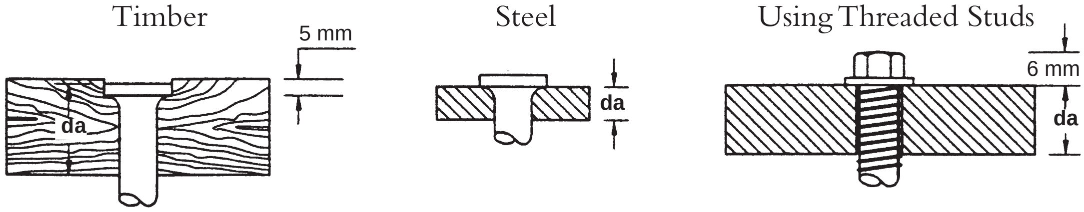
Concrete | Brick | Steel



$h_s = 22 \sim 30$ mm (25mm Recommended) | $h_s = 25 \sim 40$ mm (35mm Recommended) | $h_s = 10 \sim 12$ mm (12mm Recommended)

Allowance for fixture (h_f)

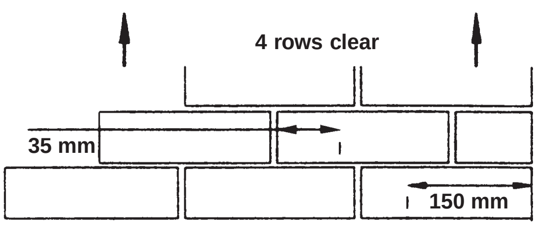
Timber | Steel | Using Threaded Studs



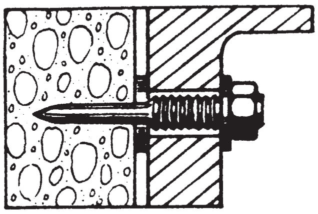
$h_f = d_a - 5$ mm | $h_f = d_a$ | $h_f = d_a + 6$ mm

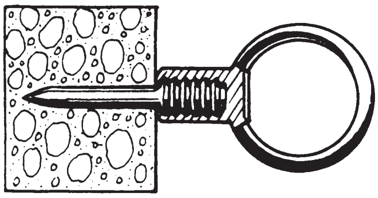
Base Material	Shank Diameter (mm)	Minimum Edge Distance (mm)	Minimum Spacing (mm)	Minimum BaseMaterial Thickness (mm)
Concrete	3.7 ~ 3.8	75	75	3 x h_s
Brick	3.7 ~ 3.8	150	★	3 x h_s
Steel	3.7 ~ 3.8	15	22	4

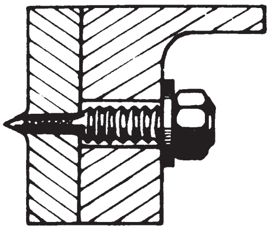
★ Fix to solid bricks with good mortar joints. Fix only 1 Drive Pin per brick, at a minimum of 35mm from the end of the brick, 150mm from the edge of the wall, and 4 rows from the top of the wall.

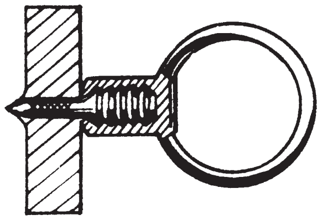


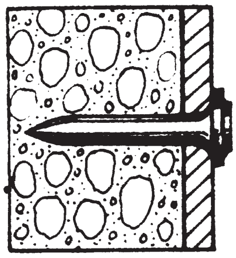
Examples Of Fixing Connections

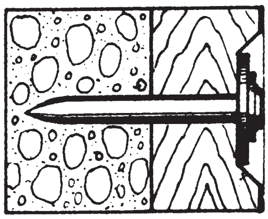

To connect angle steel to concrete by bolt

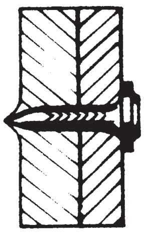

To connect ring to concrete by bolt

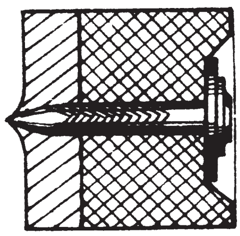

To connect angle steel to steel plate by bolt


To connect ring to steel plate by bolt

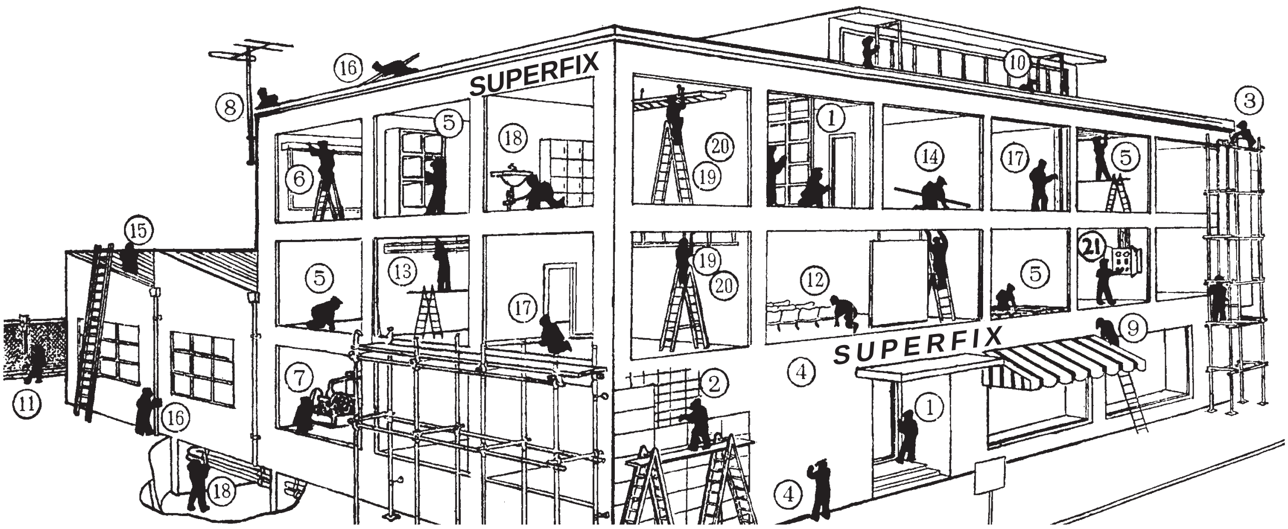

To fasten steel plate to concrete by nail

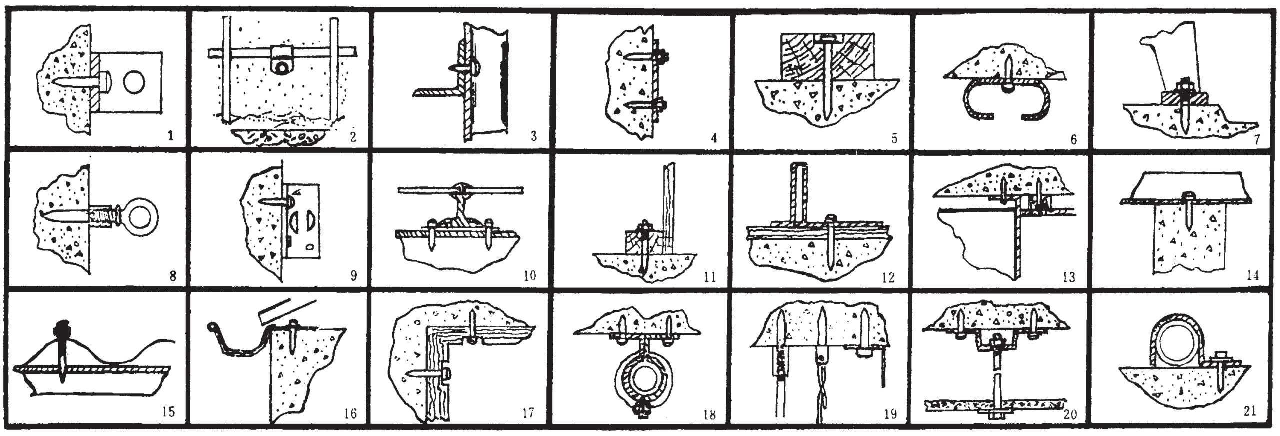

To fasten wood to concrete by nail


To fasten steel plate to steel plate by nail


To fasten soft plate to steel by nail

Applications Of Superfix Powder-Actuated Tools & Drive Pins



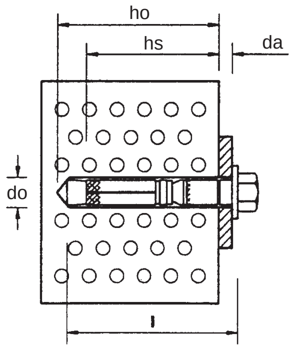


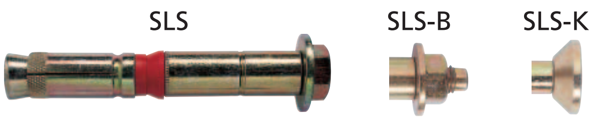
1. To fix doors, windows and cupboards.
2. To fix marble and decorative boards.
3. To fix neon signs and fences.
4. To fix boards.
5. To fix and support wooden beams, kitchen cabinets.
6. To fix curtain rails.
7. To fix permanent equipment, scaffolding.
8. To fix aerials and lightning conductors.
9. To fix canopies.
10. To fix glass frames and brackets.
11. To fix shop windows and steel-framed partition walls.
12. To fix chairs in theatres and outdoor stadiums.
13. To fix air-conditioner pipes and ceiling tiles.
14. To fix steel to concrete.
15. To fix asbestos sheets and galvanised sheets.
16. To fix drains and vertical pipes.
17. To fix wooden frames, doors and windows.
18. To fix heating equipment, pipe and support frames.
19. To fix suspended ceilings and partition walls.
20. To fix suspended runway for fire sprinklers, sanitary pipes.
21. To fix power distribution switchboard and cables.

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

9. Superfix High-Load Anchor – SLS

Features:
Heavy load, torque-controlled expansion anchor.
Hex head, threaded rod with hex nut, counter-sunk head.
Deformable centre ring ensures positive fixing.
Ideal for high-rise shelves, steel structures and facades.
Galvanised steel or stainless steel A4/316

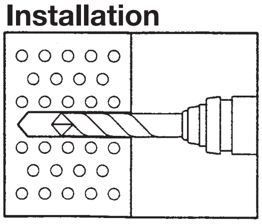




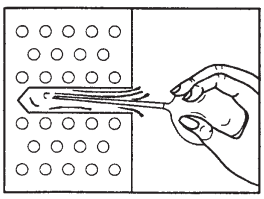
Product Range And Installation Data

SLS SLS-B SLS-K	Description	Fixture Thickness d_a (mm)		Anchor Length l (mm)		Fixture Hole (mm)	Drill Hole d_0 x h_0 (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Tighten Torque ($f_{CU} \geq 20$ N/mm^2) (Nm)
		SLS/B	K	SLS/K	B				
M6	SL 10/0	0	-	55	60	12	10 x 60	53	10
M6	SL 10/10	10	15	65	70	12	10 x 60	53	10
M6	SL 10/25	25	30	80	85	12	10 x 60	53	10
M6	SL 10/50	50	55	100	110	12	10 x 60	53	10
M6	SL 10/75	75	-	-	140	12	10 x 60	53	10
M6	SL 10/100	100	-	150	160	12	10 x 60	53	10
M8	SL 12/0	0	-	65	75	14	12 x 70	63	25
M8	SL 12/10	10	20	75	85	14	12 x 70	63	25
M8	SL 12/25	25	35	90	100	14	12 x 70	63	25
M8	SL 12/50	50	60	115	125	14	12 x 70	63	25
M8	SL 12/75	75	-	140	150	14	12 x 70	63	25
M8	SL 12/100	100	-	160	170	14	12 x 70	63	25
M10	SL 14/0	0	-	75	90	16	14 x 85	73	50
M10	SL 14/10	10	20	85	100	16	14 x 85	73	50
M10	SL 14/25	25	35	100	115	16	14 x 85	73	50
M10	SL 14/50	50	60	125	140	16	14 x 85	73	50
M10	SL 14/75	75	-	150	165	16	14 x 85	73	50
M10	SL 14/100	100	-	170	185	16	14 x 85	73	50
M10	SL 14/125	125	-	-	210	16	14 x 85	73	50
M10	SL 14/160	160	-	-	245	16	14 x 85	73	50
M12	SL 18/0	0	-	95	110	20	18 x 100	93	80
M12	SL 18/15	15	25	105	120	20	18 x 100	93	80
M12	SL 18/25	25	-	115	130	20	18 x 100	93	80
M12	SL 18/40	40	50	130	145	20	18 x 100	93	80
M12	SL 18/70	70	-	160	175	20	18 x 100	93	80
M12	SL 18/100	100	-	190	205	20	18 x 100	93	80
M16	SL 24/0	0	-	110	135	26	24 x 125	107	200
M16	SL 24/25	25	-	140	160	26	24 x 125	107	200
M16	SL 24/50	50	-	160	185	26	24 x 125	107	200
M16	SL 24/100	100	-	210	230	26	24 x 125	107	200
M20	SL 28/0	0	-	140	165	31	28 x 150	135	400
M20	SL 28/30	30	-	170	190	31	28 x 150	135	400
M20	SL 28/60	60	-	200	220	31	28 x 150	135	400
M20	SL 28/100	100	-	240	260	31	28 x 150	135	400

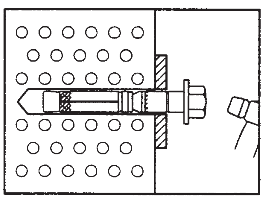
Installation



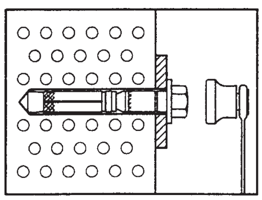
Drill to specified diameter and depth.



Clean the hole with blowout pump.



Using a hammer, tap the anchor through the fixture into the hole until the bolt head is firmly seated against the fixture.



Tighten the anchor to the specified torque.

Technical Specifications (Anchor Design Concept)

SLS SLS-B SLS-K	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist. In Normal Concrete C_{min} (mm)	Min. Edge Dist. In Reinforced Concrete C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Conc. Thickness h_{min} (mm)	Min. Reinforced Concrete Thickness h_{min} (mm)
M6	50	130	75	50	130	120	100
M8	60	180	90	60	180	140	120
M10	70	210	105	70	210	165	140
M12	80	240	120	80	240	200	170
M16	100	300	150	110	300	235	200
M20	130	390	195	150	390	300	250

SLS SLS-B SLS-K	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
M6	14.7	4.8	0.1	13.9	6.6	5.5
M8	21.3	7.0	0.1	22.9	10.9	9.1
M10	31.5	10.4	0.15	32.0	15.2	12.7
M12	47.9	15.8	0.15	56.2	26.7	22.3
M16	77.1	25.5	0.2	99.3	47.2	39.4
M20	101.8	33.7	0.3	143.1	68.1	56.8

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- All loads are derived from static load tests on non-cracked concrete of $f_{CU} = 30\ N/mm^2$, apply adjustment factor f_B for other concrete grades.

* For SLS, an enhancement factor of 1.17 can be applied to the recommended shear resistance.

Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	50	60	70	80	90	100	120	140	160	200	250	300	350	400
M6	0.69	0.73	0.77	0.81	0.85	0.88	0.96	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	0.67	0.69	0.72	0.75	0.78	0.83	0.89	0.94	1.00	1.00	1.00	1.00	1.00
M10	-	-	0.67	0.69	0.71	0.74	0.79	0.83	0.88	0.98	1.00	1.00	1.00	1.00
M12	-	-	-	0.67	0.69	0.71	0.75	0.79	0.83	0.92	1.00	1.00	1.00	1.00
M16	-	-	-	-	-	0.67	0.70	0.73	0.77	0.83	0.92	1.00	1.00	1.00
M20	-	-	-	-	-	-	-	0.68	0.71	0.76	0.82	0.88	0.95	1.00

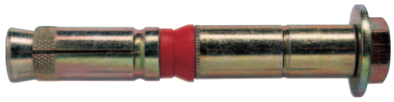
Type	Reduction Factor Table For Tension – Edge Distance (mm)													
	60	70	80	90	100	120	140	160	180	200	250	300	350	400
M6	(0.73)	(0.77)	0.81	0.85	0.88	0.96	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	(0.67)	(0.69)	(0.72)	0.75	0.78	0.83	0.89	0.94	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	(0.67)	(0.69)	(0.71)	(0.74)	0.79	0.83	0.88	0.93	0.98	1.00	1.00	1.00	1.00
M12	-	-	(0.67)	(0.69)	(0.71)	0.75	0.79	0.83	0.88	0.92	1.00	1.00	1.00	1.00
M16	-	-	-	-	(0.67)	(0.70)	(0.73)	0.77	0.80	0.83	0.92	1.00	1.00	1.00
M20	-	-	-	-	-	-	(0.68)	(0.71)	(0.73)	0.76	0.82	0.88	0.95	1.00

( ) : Anchors are recommended if installed into reinforced concrete only.

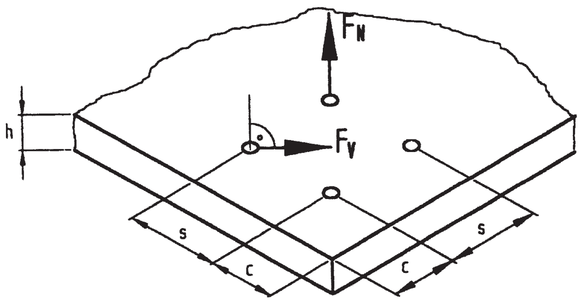
Type	Reduction Factor Table For Shear – Edge Distance (mm)													
	60	70	80	90	100	120	140	160	180	200	250	300	350	400
M6	(0.46)	(0.54)	0.62	0.69	0.77	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	(0.33)	(0.39)	(0.44)	0.50	0.56	0.67	0.78	0.89	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	(0.33)	(0.38)	(0.43)	(0.48)	0.57	0.67	0.76	0.86	0.95	1.00	1.00	1.00	1.00
M12	-	-	(0.33)	(0.38)	(0.42)	0.50	0.58	0.67	0.75	0.83	1.00	1.00	1.00	1.00
M16	-	-	-	-	(0.33)	(0.40)	(0.47)	0.53	0.60	0.67	0.83	1.00	1.00	1.00
M20	-	-	-	-	-	-	(0.36)	(0.41)	(0.46)	0.51	0.64	0.77	0.90	1.00

( ) : Anchors are recommended if installed into reinforced concrete only.

Superfix Recommendations For SLS (Anchor Design Concept)



- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances $< C_{cr}$, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.5\ (S / S_{cr}) + 0.5$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 0.5\ (C / C_{cr}) + 0.5$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = C / C_{cr}$

Formula no. 4: Influence of concrete strength:

$f_B = 0.02\ (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\ cr})^{1.5}$

Where $h_{s\ min} \geq 0.7\ h_{s\ cr}$

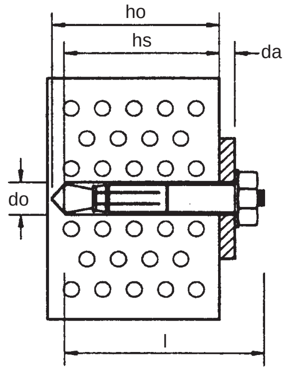
Concrete grade range:

$15 \leq f_{CU} \leq 50$

- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

10. Superfix Undercut Anchor – SUA

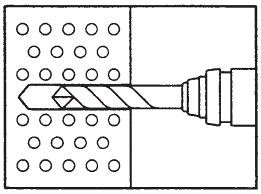
Features:
Heavy load, torque-controlled undercut anchor.
Virtually expansion-free anchoring.
Automatic undercutting on application of required torque.
Ideal for usage with reduced edge distances and anchor spacing.
Galvanised steel, or stainless steel A4/316.



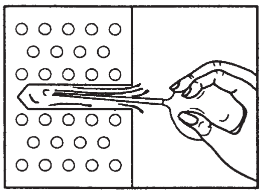
Product Range And Installation Data

SUA	Description	Fixture Thickness d_a (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole d_0 x h_0 (mm)	Char. Setting Depth $h_{s\ cr}$ (mm)	Min. Normal Conc. Thickness h_{min} (mm)	Tighten Torque ($f_{CU} \geq 20$ N/mm^2) (Nm)
M8	14/40/5	5	69	16	14 x 60	40	100	25
M8	14/40/15	15	79	16	14 x 60	40	100	25
M8	14/50/5	5	79	16	14 x 70	50	110	25
M8	14/50/20	20	94	16	14 x 70	50	110	25
M8	14/60/10	10	94	16	14 x 80	60	120	25
M8	14/60/20	20	104	16	14 x 80	60	120	25
M8	14/80/10	10	114	16	14 x 100	80	140	25
M8	14/80/25	25	129	16	14 x 100	80	140	25
M12	20/80/15	15	125	21	20 x 105	80	160	80
M12	20/80/30	30	140	21	20 x 105	80	160	80
M12	20/80/50	50	160	21	20 x 105	80	160	80
M12	20/100/15	15	140	21	20 x 125	100	180	80
M12	20/100/30	30	160	21	20 x 125	100	180	80
M12	20/100/50	50	180	21	20 x 125	100	180	80
M12	20/125/15	15	180	21	20 x 150	125	205	80
M12	20/125/30	30	200	21	20 x 150	125	205	80
M12	20/125/50	50	200	21	20 x 150	125	205	80
M12	20/150/15	15	200	21	20 x 175	150	230	80
M12	20/150/30	30	200	21	20 x 175	150	230	80
M12	20/150/50	50	220	21	20 x 175	150	230	80

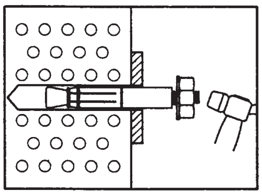
Installation



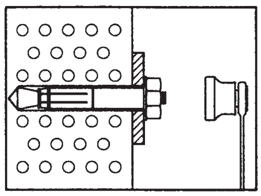
Drill to specified diameter and depth.



Clean the hole with blowout pump.



Drive anchor carefully with hammer into hole until nut and washer are flush with the fixture.



Tighten the anchor to the specified torque.

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

Technical Specifications (Anchor Design Concept)

SUA	Min. Spacing S_{min} (mm)	Char Spacing S_{cr} (mm)	Min. Edge Dist In Normal Concrete C_{min} (mm)	Min. Edge Dist In Reinforced Concrete C_{min} (mm)	Char. Edge Dist In Normal Concrete C_{cr} (mm)	Char. Edge Dist In Reinforced Concrete C_{cr} (mm)
M8	40	140	40	40	180	140
M12	50	200	70	60	240	200

SUA	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For C , C_{cr} F_v (kN)
M8	19.9	6.6	0.1	37.0	17.6	14.6
M12	55.6	18.4	0.2	86.5	41.1	34.3

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- All loads are derived from static load tests on non-cracked concrete of $f_{CU} = 30$ N/mm^2, apply adjustment factor f_B for other concrete grades.

Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	40	50	60	70	80	90	100	110	120	130	140	160	180	200
M8	0.64	0.68	0.71	0.75	0.79	0.82	0.86	0.89	0.93	0.96	1.00	1.00	1.00	1.00
M12	-	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.90	0.95	1.00

Type	Reduction Factor Table For Tension (In Normal Concrete) – Edge Distance (mm)													
	40	50	60	70	80	90	100	120	140	160	180	200	220	240
M8	0.61	0.64	0.67	0.69	0.72	0.75	0.78	0.83	0.89	0.94	1.00	1.00	1.00	1.00
M12	-	0.60	0.63	0.65	0.67	0.69	0.71	0.75	0.79	0.83	0.88	0.92	0.96	1.00

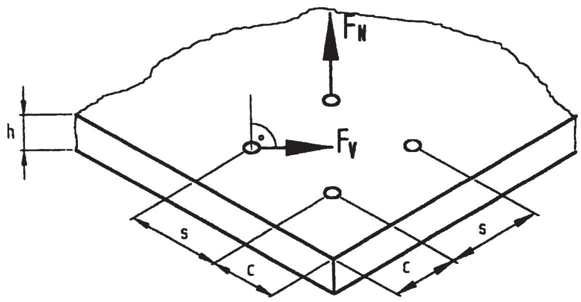
Type	Reduction Factor Table For Tension (In Reinforced Concrete) – Edge Distance (mm)													
	40	50	60	70	80	90	100	110	120	130	140	160	180	200
M8	0.64	0.68	0.71	0.75	0.79	0.82	0.86	0.89	0.93	0.96	1.00	1.00	1.00	1.00
M12	-	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.90	0.95	1.00

Type	Reduction Factor Table For Shear (In Normal Concrete) – Edge Distance (mm)													
	40	50	60	70	80	90	100	120	140	160	180	200	220	240
M8	0.22	0.28	0.33	0.39	0.44	0.50	0.56	0.67	0.78	0.89	1.00	1.00	1.00	1.00
M12	-	-	-	0.29	0.33	0.38	0.42	0.50	0.58	0.67	0.75	0.83	0.92	1.00

Type	Reduction Factor Table For Shear (In Reinforced Concrete) – Edge Distance (mm)													
	40	50	60	70	80	90	100	110	120	130	140	160	180	200
M8	0.29	0.36	0.43	0.50	0.57	0.64	0.71	0.79	0.86	0.93	1.00	1.00	1.00	1.00
M12	-	-	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.80	0.90	1.00

Superfix Recommendations For SUA (Anchor Design Concept)

- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances $< C_{cr}$, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.5\ (S / S_{cr}) + 0.5$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 0.5\ (C / C_{cr}) + 0.5$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = (C / C_{cr})$

Formula no. 4: Influence of concrete strength:

$f_B = 0.02\ (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\ cr})^2$

Where $h_{s\ min} \geq 0.8\ h_{s\ cr}$

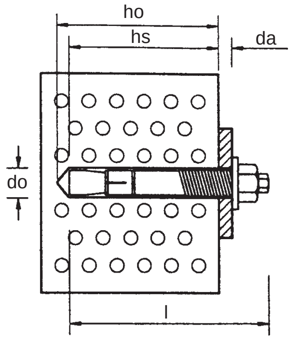
Concrete grade range:

$20 \leq f_{CU} \leq 55$

- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

11. Superfix Wedge Anchor – SWA

Features:
Medium to heavy load, torque-controlled expansion anchor.
Fast and efficient through fixing. Large range of type and length. Approved by the German fire prevention service.
Ideal for pipe suspensions, ducts, brackets, angles and shelves, window support system.
Galvanised steel with a supplementary chromate treatment, or hot dip galvanised, or stainless steel A4/316, or stainless steel A2/304.



Product Range And Installation Data

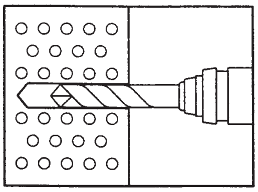
SWA	Description	Fixture Thickness d_a (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole $d_0 \times h_0$ (mm)	Setting Depth h_s (mm)	Tighten Torque ($f_{CU} \geq 20$ N/mm^2) (Nm)
M6	6-5/40	5	40	7	6 x 40	(30)	5
M6	6-10/65	10	65	7	6 x 60	50	6
M6	6-25/80	25	80	7	6 x 60	50	6
M6	6-40/95	40	95	7	6 x 60	50	6
M8	8-5/50	5	50	9	8 x 45	(35)	10
M8	8-10/60	10	60	9	8 x 50	(40)	10
M8	8-10/75	10	75	9	8 x 65	55	15
M8	8-15/80	15	80	9	8 x 65	55	15
M8	8-20/85	20	85	9	8 x 65	55	15
M8	8-25/90	25	90	9	8 x 65	55	15
M8	8-30/95	30	95	9	8 x 65	55	15
M8	8-45/110	45	110	9	8 x 65	55	15
M8	8-55/120	55	120	9	8 x 65	55	15
M10	10-10K/60	10	60	11	10 x 50	(40)	25
M10	10-10/80	10	80	11	10 x 70	60	30
M10	10-15/85	15	85	11	10 x 70	60	30
M10	10-20/90	20	90	11	10 x 70	60	30
M10	10-30/100	30	100	11	10 x 70	60	30
M10	10-45/115	45	115	11	10 x 70	60	30
M10	10-50/120	50	120	11	10 x 70	60	30
M10	10-70/140	70	140	11	10 x 70	60	30
M10	10-100/170	100	170	11	10 x 70	60	30
M10	10-140/210	140	210	11	10 x 70	60	30

Product Range And Installation Data

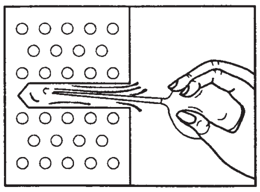
SWA	Description	Fixture Thickness d_a (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole $d_0 \times h_0$ (mm)	Setting Depth h_s (mm)	Tighten Torque ($f_{CU} \geq 20$ N/mm^2) (Nm)
M12	12-5/75	5	75	14	12 x 60	(50)	40
M12	12-10/95	10	95	14	12 x 80	(70)	50
M12	12-15/105	15	105	14	12 x 90	80	50
M12	12-20/110	20	110	14	12 x 90	80	50
M12	12-30/120	30	120	14	12 x 90	80	50
M12	12-50/140	50	140	14	12 x 90	80	50
M12	12-65/155	65	155	14	12 x 90	80	50
M12	12-85/175	85	175	14	12 x 90	80	50
M12	12-105/195	105	195	14	12 x 90	80	50
M12	12-125/215	125	215	14	12 x 90	80	50
M12	12-145/235	145	235	14	12 x 90	80	50
M12	12-160/250	160	250	14	12 x 90	80	50
M12	12-190/280	190	280	14	12 x 90	80	50
M12	12-230/320	230	320	14	12 x 90	80	50
M12	12-260/350	260	350	14	12 x 90	80	50
M16	16-5/90	5	90	18	16 x 70	(60)	70
M16	16-15/115	15	115	18	16 x 90	(80)	80
M16	16-30/145	30	145	18	16 x 110	100	100
M16	16-60/175	60	175	18	16 x 110	100	100
M16	16-80/195	80	195	18	16 x 110	100	100
M16	16-100/215	100	215	18	16 x 110	100	100
M16	16-130/245	130	245	18	16 x 110	100	100
M16	16-165/280	165	280	18	16 x 110	100	100
M16	16-200/315	200	315	18	16 x 110	100	100
M20	20-25/145	25	145	22	20 x 110	100	150
M20	20-60/180	60	180	22	20 x 110	100	150
M20	20-120/240	120	240	22	20 x 110	100	150

( ): Recommended loads for anchors of reduced setting depth should be reduced accordingly.

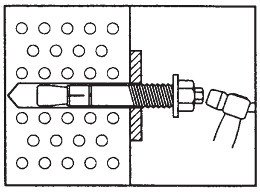
Installation



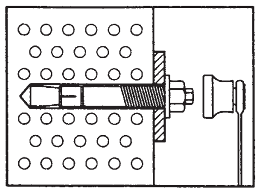
Drill to specified diameter and depth.



Clean the hole with blowout pump.



Drive anchor carefully with hammer into hole until nut and washer are flush with the fixture.



Tighten the anchor to the specified torque.

Technical Specifications (Anchor Design Concept)

SWA	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Conc. Thickness h_{min} (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)
M6	50	100	50	100	90	50
M8	60	120	60	120	100	55
M10	65	130	65	130	100	60
M12	80	160	80	160	135	80
M16	100	200	100	200	170	100
M20	125	250	125	250	170	100

SWA	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For C , C_{cr} F_v (kN)
M6	9.4	3.1	0.1	6.8	3.2	2.7
M8	13.9	4.6	0.1	9.4	4.4	3.7
M10	17.6	5.8	0.15	13.1	6.2	5.2
M12	28.4	9.4	0.2	21.9	10.4	8.7
M16	41.4	13.7	0.25	33.7	16.0	13.4
M20	48.7	16.1	0.3	58.0	27.6	23.0

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- All loads are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm², apply adjustment factor f_B for other concrete grades.

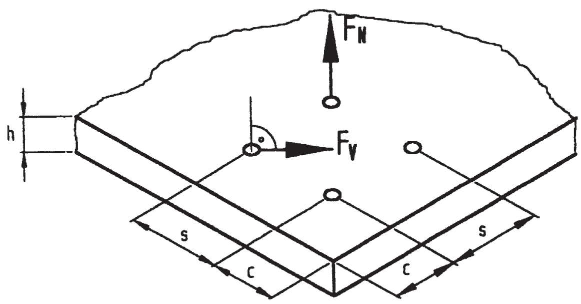
Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	40	50	60	70	80	90	100	120	140	160	180	200	250	300
M6	-	0.65	0.72	0.79	0.86	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	-	0.65	0.71	0.77	0.83	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	-	-	0.68	0.73	0.78	0.84	0.95	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	-	0.65	0.69	0.74	0.83	0.91	1.00	1.00	1.00	1.00	1.00
M16	-	-	-	-	-	-	0.65	0.72	0.79	0.86	0.93	1.00	1.00	1.00
M20	-	-	-	-	-	-	-	-	0.69	0.75	0.80	0.86	1.00	1.00

Type	Reduction Factor Table For Tension – Edge Distance (mm)													
	50	60	70	80	90	100	120	140	160	180	200	220	240	260
M6	0.65	0.72	0.79	0.86	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	0.65	0.71	0.77	0.83	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	-	0.68	0.73	0.78	0.84	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	0.65	0.69	0.74	0.83	0.91	1.00	1.00	1.00	1.00	1.00	1.00
M16	-	-	-	-	-	0.65	0.72	0.79	0.86	0.93	1.00	1.00	1.00	1.00
M20	-	-	-	-	-	-	-	0.69	0.75	0.80	0.86	0.92	0.97	1.00

Type	Reduction Factor Table For Shear – Edge Distance (mm)													
	50	60	70	80	90	100	120	140	160	180	200	220	240	260
M6	0.50	0.60	0.70	0.80	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	0.50	0.58	0.67	0.75	0.83	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	-	0.54	0.62	0.69	0.77	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	0.50	0.56	0.63	0.75	0.88	1.00	1.00	1.00	1.00	1.00	1.00
M16	-	-	-	-	-	0.50	0.60	0.70	0.80	0.90	1.00	1.00	1.00	1.00
M20	-	-	-	-	-	-	-	0.56	0.64	0.72	0.80	0.88	0.96	1.00

Superfix Recommendations For SWA (Anchor Design Concept)

- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances $< C_{cr}$, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.7 (S / S_{cr}) + 0.3$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 0.7 (C / C_{cr}) + 0.3$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = C / C_{cr}$

Formula no. 4: Influence of concrete strength:

$f_B = 0.015 (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\ cr})^2$

Where $h_{s\ min} \geq 0.6\ h_{s\ cr}$

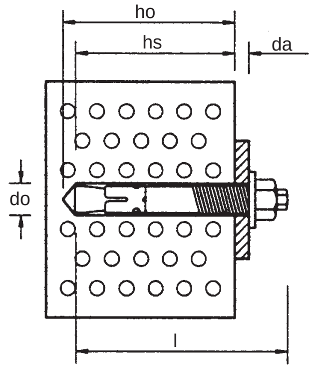
Concrete grade range:

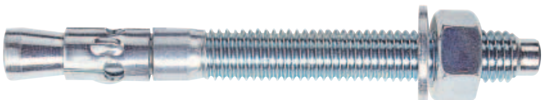
$20 \leq f_{CU} \leq 45$

- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

12. Superfix Through Anchor – STA

Features:
Medium to heavy load, torque-controlled expansion anchor.
Fast and efficient through fixing.
Economical and dependable for a wide range of fastening application.
Ideal for pipe suspensions, ducts, brackets, angles and shelves, window support system.
Galvanised steel, or stainless steel A4/316, or stainless steel A2/304.



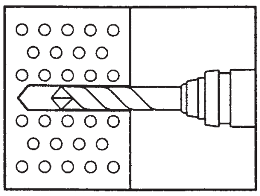


Product Range And Installation Data

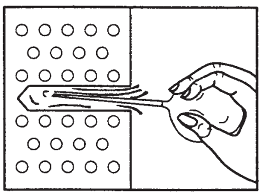
STA	Description	Fixture Thickness d_a (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole $d_0 \times h_0$ (mm)	Setting Depth h_s (mm)	Tighten Torque ($f_{CU} \geq 20$ N/mm^2) (Nm)
M6	6 x 40	5	40	7	6 x 40	(30)	8
M6	6 x 70	10	70	7	6 x 60	50	10
M6	6 x 95	40	95	7	6 x 60	50	10
M8	8 x 50	5	50	9	8 x 45	(35)	20
M8	8 x 65	10	65	9	8 x 50	(40)	20
M8	8 x 80	15	80	9	8 x 65	55	25
M8	8 x 105	45	105	9	8 x 65	55	25
M8	8 x 120	55	120	9	8 x 65	55	25
M10	10 x 65	10	65	11	10 x 50	(40)	40
M10	10 x 80	10	80	11	10 x 70	60	40
M10	10 x 95	20	95	11	10 x 70	60	40
M10	10 x 115	45	115	11	10 x 70	60	40
M12	12 x 80	5	80	14	12 x 60	(50)	50
M12	12 x 100	10	100	14	12 x 80	(70)	60
M12	12 x 120	30	120	14	12 x 90	80	70
M12	12 x 135	45	135	14	12 x 90	80	70
M12	12 x 150	65	150	14	12 x 90	80	70
M16	16 x 105	15	105	18	16 x 90	(80)	90
M16	16 x 125	20	125	18	16 x 90	(80)	90
M16	16 x 140	20	140	18	16 x 110	100	100
M16	16 x 180	60	180	18	16 x 110	100	100
M16	16 x 220	100	220	18	16 x 110	100	100
M20	20 x 125	15	125	22	20 x 90	(80)	150
M20	20 x 160	40	160	22	20 x 110	100	150
M20	20 x 200	80	200	22	20 x 110	100	150

( ): Recommended loads for anchors of reduced setting depth should be reduced accordingly.

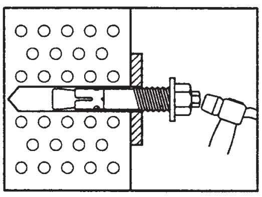
Installation



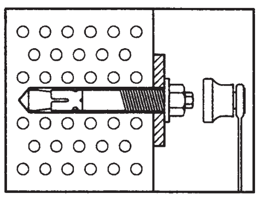
Drill to specified diameter and depth.



Clean the hole with blowout pump.

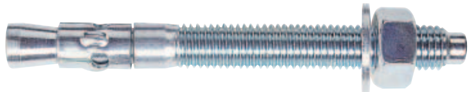


Drive anchor carefully with hammer into hole until nut and washer are flush with the fixture.



Tighten the anchor to the specified torque.

Technical Specifications (Anchor Design Concept)



STA	Min. Spacing In Normal Concrete S_{min} (mm)	Min. Spacing In Reinforced Concrete S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist In Normal Concrete C_{min} (mm)	Min. Edge Dist In Reinforced Concrete C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Conc. Thickness h_{min} (mm)	Min. Reinforced Conc. Thickness h_{min} (mm)	Setting Depth $h_{s\,cr}$ (mm)
M6	50	40	120	50	40	100	90	70	50
M8	60	45	140	60	45	120	95	80	55
M10	70	55	160	70	55	130	100	90	60
M12	80	65	190	80	65	160	135	125	80
M16	100	80	240	100	80	200	170	150	100
M20	130	100	300	130	100	250	185	160	100

STA	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
M6	9.4	3.1	0.1	6.8	3.2	2.7
M8	13.9	4.6	0.1	9.4	4.4	3.7
M10	17.6	5.8	0.15	13.1	6.2	5.2
M12	28.4	9.4	0.2	21.9	10.4	8.7
M16	41.4	13.7	0.25	33.7	16.0	13.4
M20	48.7	16.1	0.3	58.0	27.6	23.0

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- All loads are derived from static load tests on non-cracked concrete of $f_{CU} = 30$ N/mm^2, apply adjustment factor f_B for other concrete grades.

Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	40	50	60	70	80	90	100	120	140	160	180	200	250	300
M6	(0.67)	0.71	0.75	0.79	0.83	0.88	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	(0.68)	0.71	0.75	0.79	0.82	0.86	0.93	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	-	(0.69)	0.72	0.75	0.78	0.81	0.88	0.94	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	(0.68)	0.71	0.74	0.76	0.82	0.87	0.92	0.97	1.00	1.00	1.00
M16	-	-	-	-	(0.67)	(0.69)	0.71	0.75	0.79	0.83	0.88	0.92	1.00	1.00
M20	-	-	-	-	-	-	(0.67)	(0.70)	0.73	0.77	0.80	0.83	0.92	1.00

( ): Anchors are recommended if installed into reinforced concrete only.

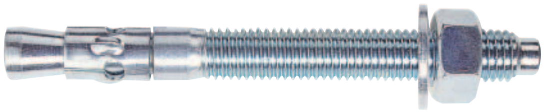
Type	Reduction Factor Table For Tension – Edge Distance (mm)													
	40	50	60	70	80	90	100	120	140	160	180	200	220	250
M6	(0.64)	0.70	0.76	0.82	0.88	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	(0.65)	0.70	0.75	0.80	0.85	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	-	(0.68)	0.72	0.77	0.82	0.86	0.95	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	(0.66)	0.70	0.74	0.78	0.85	0.93	1.00	1.00	1.00	1.00	1.00
M16	-	-	-	-	(0.64)	(0.67)	0.70	0.76	0.82	0.88	0.94	1.00	1.00	1.00
M20	-	-	-	-	-	-	(0.64)	(0.69)	0.74	0.78	0.83	0.88	0.93	1.00

( ): Anchors are recommended if installed into reinforced concrete only.

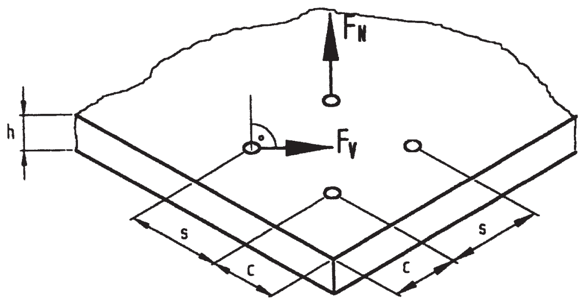
Type	Reduction Factor Table For Shear – Edge Distance (mm)													
	40	50	60	70	80	90	100	120	140	160	180	200	220	250
M6	(0.40)	0.50	0.60	0.70	0.80	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	(0.42)	0.50	0.58	0.67	0.75	0.83	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	-	(0.46)	0.54	0.62	0.69	0.77	0.92	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	(0.44)	0.50	0.56	0.63	0.75	0.88	1.00	1.00	1.00	1.00	1.00
M16	-	-	-	-	(0.40)	(0.45)	0.50	0.60	0.70	0.80	0.90	1.00	1.00	1.00
M20	-	-	-	-	-	-	(0.40)	(0.48)	0.56	0.64	0.72	0.80	0.88	1.00

( ): Anchors are recommended if installed into reinforced concrete only.

Superfix Recommendations For STA (Anchor Design Concept)



- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances $< C_{cr}$, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.5 (S / S_{cr}) + 0.5$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 0.6 (C / C_{cr}) + 0.4$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = C / C_{cr}$

Formula no. 4: Influence of concrete strength:

$f_B = 0.02 (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\,cr})^2$

Where $h_{s\,min} \geq 0.6\, h_{s\,cr}$

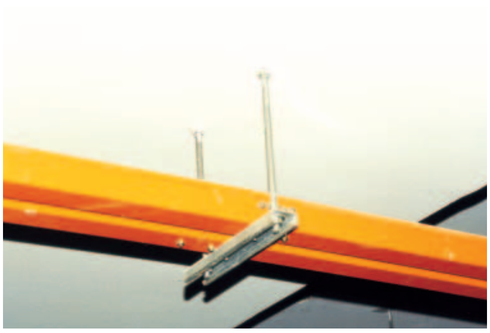
Concrete grade range:

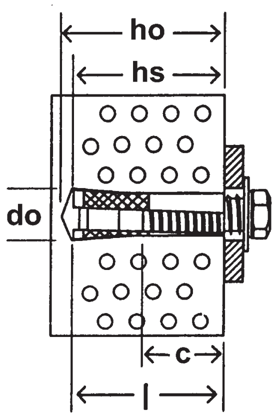
$20 \leq f_{CU} \leq 50$

- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

13. Superfix Drop-In Anchor – SDA

Features:
Medium load, expansion anchor installed by means of appropriate setting tool.
Shallow embedment depth.
Surface flush or sub set installation.
Easy and economical fastening.
Ideal for electrical cable tray, suspended pipe-works, air-con ducting, sprinkler and assembly support systems.
Galvanised steel, or stainless steel A4/316, or stainless steel A2/304.





Product Range And Installation Data

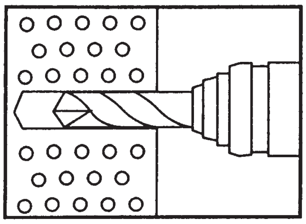
SDA	Description	Thread Length c (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole $d_0 \times h_0$ (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Tighten Torque ($f_{CU} \geq 20$ N/mm^2) (Nm)
Ø1/4"	1/4" x 25	11	25	7	8 x 27	25	5
Ø5/16"	5/16" x 30	13	30	9	10 x 33	30	8
Ø3/8"	3/8" x 30	12	30	11	12 x 33	(30)	18
Ø3/8"	3/8" x 40	15	40	11	12 x 44	40	20
Ø1/2"	1/2" x 50	18	50	14	16 x 54	50	40
Ø5/8"	5/8" x 65	23	65	18	20 x 71	65	50
Ø3/4"	3/4" x 80	24	80	22	25 x 86	80	60
M6	6 x 25	11	25	7	8 x 27	25	5
M8	8 x 30	13	30	9	10 x 33	30	8
M10	10 x 40	15	40	11	12 x 44	40	20
M12	12 x 50	18	50	14	16 x 54	50	40
M16	16 x 65	23	65	18	20 x 71	65	50
M20	20 x 80	24	80	22	25 x 86	80	60

( ): Recommended loads for anchors of reduced setting depth should be reduced accordingly.

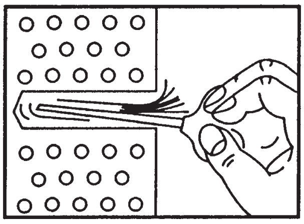
Setting Tool

ST-SDA 6	ST-SDA 8	ST-SDA 10	ST-SDA 12	ST-SDA 16	ST-SDA 20

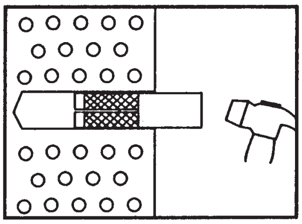
Installation



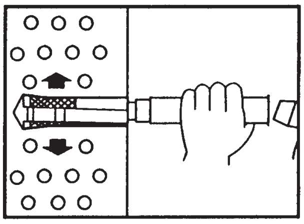
Drill to specified diameter and depth.



Clean the hole with blowout pump.

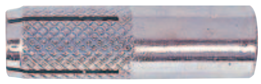


Tap anchor until it is flush with the surface.



Using a proper setting tool, hammer until the setting tool shoulder meets the top of the anchor.

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg



Technical Specifications (Anchor Design Concept)

SDA	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Conc. Thickness h_{min} (mm)
Ø1/4"	60	100	100	100	80
Ø5/16"	80	110	110	110	90
Ø3/8" x 30	95	145	145	145	100
Ø3/8" x 40	95	145	145	145	100
Ø1/2"	120	180	180	180	150
Ø5/8"	160	240	240	240	180
Ø3/4"	200	300	300	300	200
M6	60	100	100	100	80
M8	80	110	110	110	90
M10	95	145	145	145	100
M12	120	180	180	180	150
M16	160	240	240	240	180
M20	200	300	300	300	200

SDA	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
Ø1/4"	*7.4	*2.4	0.1	*4.0	*1.9	*1.5
Ø5/16"	*11.7	*3.8	0.1	*7.4	*3.5	*2.9
Ø3/8 x 30"	*11.7	*3.8	0.1	*7.4	*3.5	*2.9
Ø3/8 x 40"	*14.8	*4.9	0.1	*9.2	*4.3	*3.6
Ø1/2"	*26.2	*8.6	0.15	*17.9	*8.5	*7.1
Ø5/8"	*34.0	*11.2	0.2	*30.8	*14.7	*12.2
Ø3/4"	*46.3	*15.3	0.25	*42.6	*20.2	*16.9
M6	*7.4	*2.4	0.1	*4.0	*1.9	*1.5
M8	*11.7	*3.8	0.1	*7.4	*3.5	*2.9
M10	*14.8	*4.9	0.1	*9.2	*4.3	*3.6
M12	*26.2	*8.6	0.15	*17.9	*8.5	*7.1
M16	*34.0	*11.2	0.2	*30.8	*14.7	*12.2
M20	*46.3	*15.3	0.25	*42.6	*20.2	*16.9

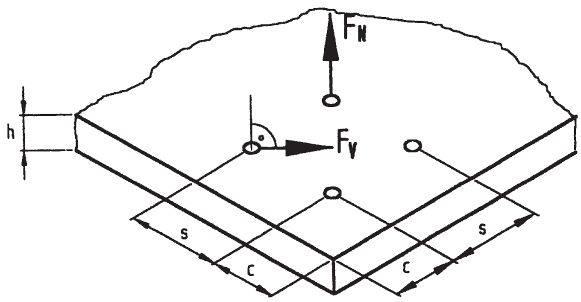
- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- All loads are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2, apply adjustment factor f_B for other concrete grades.

*** Recommended loads are for bolts of Steel Grade 4.8 and will differ for other steel grade values.**

Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	60	70	80	90	100	120	140	160	180	200	220	240	260	300
M6, Ø1/4"	0.74	0.81	0.87	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8, Ø5/16"	-	-	0.82	0.88	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10, Ø3/8"	-	-	-	-	0.80	0.89	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12, Ø1/2"	-	-	-	-	-	0.78	0.86	0.93	1.00	1.00	1.00	1.00	1.00	1.00
M16, Ø5/8"	-	-	-	-	-	-	-	0.78	0.84	0.89	0.95	1.00	1.00	1.00
M20, Ø3/4"	-	-	-	-	-	-	-	-	-	0.78	0.83	0.87	0.91	1.00

Superfix Recommendations For SDA (Anchor Design Concept)

- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances $< C_{cr}$, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.65 (S / S_{cr}) + 0.35$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 1$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = 1$

Formula no. 4: Influence of concrete strength:

$f_B = 0.02 (f_{CU} – 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\ cr})^{0.8}$

Where $h_{s\ min} \geq 0.75\ h_{s\ cr}$

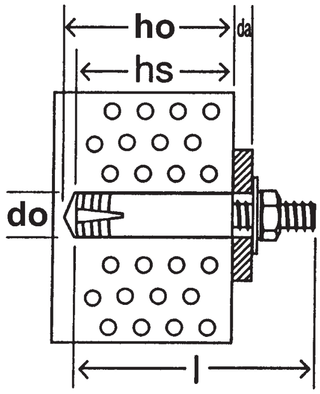
Concrete grade range:

$20 \leq f_{CU} \leq 45$

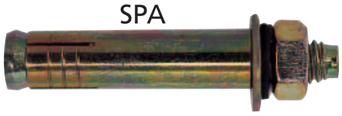
- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

14. Superfix Set Anchor – SPA

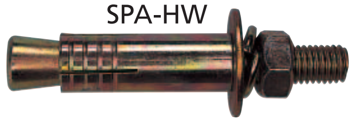
Features:
Medium load, expansion anchor installed by means of appropriate setting tool, or with sufficient torque value.
Spring washer to absorb mild vibration and dynamic loads.
Ideal for ductwork, pipes, cable trunking, support rails, support system for lifts, signs.
Galvanised steel, or stainless steel A4/316, or stainless steel A2/304.



SPA



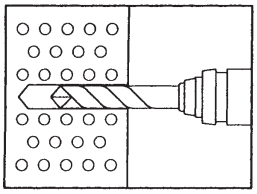
SPA-HW



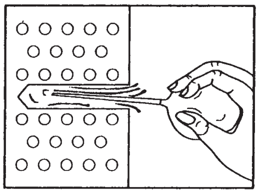
Product Range And Installation Data

SPA SPA-HW	Description	Fixture Thickness d_a (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole d_0 x h_0 (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Tighten Torque ($f_{CU} \geq 20$ N/mm^2) (Nm)
Ø1/4"	1/4" x 50	6	50	7	8 x 42	37	8
Ø5/16"	5/16" x 55	7	55	8.5	10 x 45	37	20
Ø3/8"	3/8" x 75	8	75	10	13 x 58	50	40
Ø1/2"	1/2" x 100	17	100	13	17 x 70	60	55
Ø5/8"	5/8" x 125	22	125	17	20 x 88	75	70
M12	HW 12 x 100	17	100	14	18 x 65	50	60
M16	HW 16 x 125	25	120	18	22 x 85	70	80

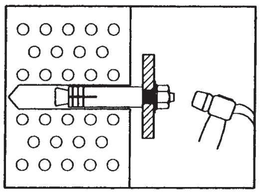
Installation for SPA Ø1/4", Ø5/16", Ø3/8", Ø1/2", Ø5/8"



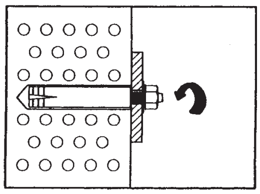
Drill to specified diameter and depth.



Clean the hole.



Drive anchor carefully with hammer into hole until nut is flush with the fixture.

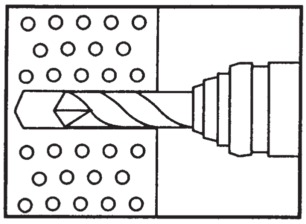


Tighten the anchor to the specified torque.

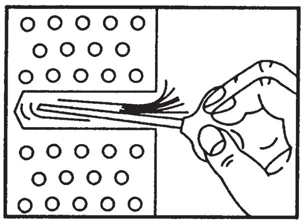
Setting Tool

ST-SPA 12
ST-SPA 16

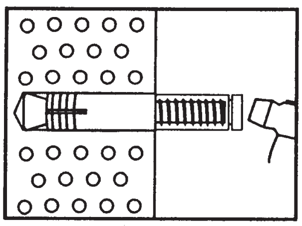
Installation for SPA-HW M12, M16



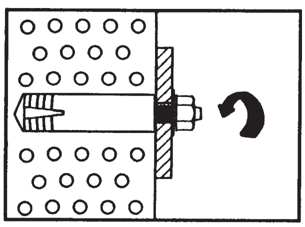
Drill to specified diameter and depth.



Clean the hole with blowout pump.

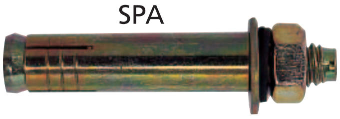


Install anchor using proper setting tool until sleeve is flush with the surface.

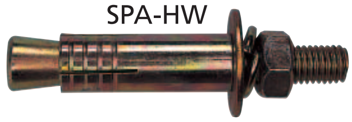


Tighten the anchor to the specified torque.

SPA



SPA-HW



Technical Specifications (Anchor Design Concept)

SPA SPA-HW	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Conc. Thickness h_{min} (mm)
Ø1/4"	50	100	50	100	70
Ø5/16"	60	120	60	120	80
Ø3/8"	70	130	70	130	100
Ø1/2"	80	160	80	160	125
Ø5/8"	80	200	80	180	150
M12	80	200	120	180	150
M16	100	300	130	220	200

SPA SPA-HW	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
Ø1/4"	5.2	1.7	0.1	3.7	1.7	1.4
Ø5/16"	7.7	2.2	0.1	6.8	3.2	2.7
Ø3/8"	11.7	3.8	0.15	10.8	5.1	4.2
Ø1/2"	15.4	5.1	0.15	16.1	7.6	6.3
Ø5/8"	19.1	6.3	0.25	24.7	11.7	9.8
M12	33.3	11.0	0.15	24.7	11.7	9.8
M16	46.3	15.3	0.25	46.3	22.0	18.3

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- All loads are derived from static load tests on non-cracked concrete of $f_{CU} = 30\ N/mm^2$, apply adjustment factor f_B for other concrete grades.

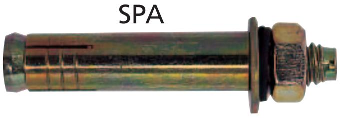
Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	50	60	70	80	100	120	140	160	180	200	220	240	260	300
Ø1/4"	0.75	0.80	0.85	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ø5/16"	-	0.75	0.79	0.83	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ø3/8"	-	-	0.77	0.81	0.88	0.96	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ø1/2"	-	-	-	0.75	0.81	0.88	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ø5/8"	-	-	-	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.00	1.00	1.00	1.00
M16	-	-	-	-	0.67	0.70	0.73	0.77	0.80	0.83	0.87	0.90	0.93	1.00

Type	Reduction Factor Table For Tension – Edge Distance (mm)													
	50	60	70	80	90	100	110	120	130	140	160	180	200	220
Ø1/4"	0.73	0.78	0.84	0.89	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ø5/16"	-	0.73	0.77	0.82	0.86	0.91	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ø3/8"	-	-	0.75	0.79	0.83	0.87	0.92	0.96	1.00	1.00	1.00	1.00	1.00	1.00
Ø1/2"	-	-	-	0.73	0.76	0.79	0.83	0.86	0.90	0.93	1.00	1.00	1.00	1.00
Ø5/8"	-	-	-	0.69	0.73	0.76	0.79	0.82	0.85	0.88	0.94	1.00	1.00	1.00
M12	-	-	-	-	-	-	-	0.82	0.85	0.88	0.94	1.00	1.00	1.00
M16	-	-	-	-	-	-	-	-	0.78	0.80	0.85	0.90	0.95	1.00

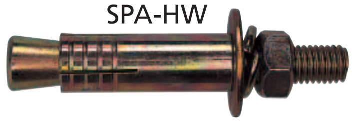
Type	Reduction Factor Table For Shear – Edge Distance (mm)													
	50	60	70	80	90	100	110	120	130	140	160	180	200	220
Ø1/4"	0.50	0.60	0.70	0.80	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ø5/16"	-	0.50	0.58	0.67	0.75	0.83	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ø3/8"	-	-	0.54	0.62	0.69	0.77	0.85	0.92	1.00	1.00	1.00	1.00	1.00	1.00
Ø1/2"	-	-	-	0.50	0.56	0.63	0.69	0.75	0.81	0.88	1.00	1.00	1.00	1.00
Ø5/8"	-	-	-	0.44	0.50	0.56	0.61	0.67	0.72	0.78	0.89	1.00	1.00	1.00
M12	-	-	-	-	-	-	-	0.67	0.72	0.78	0.89	1.00	1.00	1.00
M16	-	-	-	-	-	-	-	-	0.59	0.64	0.73	0.82	0.91	1.00

Superfix Recommendations For SPA (Anchor Design Concept)

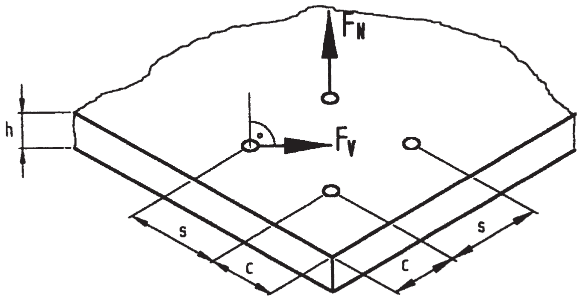
SPA



SPA-HW



- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances $< C_{cr}$, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.5\ (S / S_{cr}) + 0.5$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 0.55\ (C / C_{cr}) + 0.45$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = C / C_{cr}$

Formula no. 4: Influence of concrete strength:

$f_B = 0.02\ (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\,cr})^{1.8}$

Where $h_{s\,min} \geq 0.7\ h_{s\,cr}$

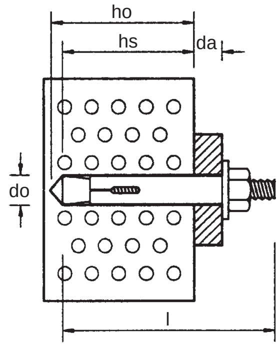
Concrete grade range:

$20 \leq f_{CU} \leq 50$

- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

15. Superfix Sleeve Anchor – SLA

Features:
Light to medium load, torque-controlled expansion anchor.
Efficient through fixing.
Ideal for ductwork, pipes, battens, support rails, clothes racks.
Galvanised steel, or stainless steel A4/316, or stainless steel A2/304.

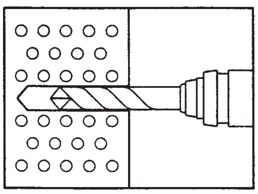


Product Range And Installation Data

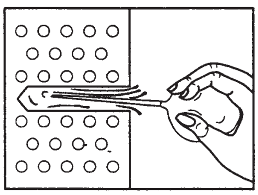
SLA	Description	Fixture Thickness d_a (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole $d_0 \times h_0$ (mm)	Setting Depth h_s (mm)	Tighten Torque ($f_{CU} \geq 20$ N/mm^2) (Nm)
M5	6.5 x 25	4	36	7	6.5 x 24	(18)	6
M5	6.5 x 36	6	40	7	6.5 x 33	27	6
M5	6.5 x 56	22	61	7	6.5 x 33	27	6
M6	8 x 25	4	36	9	8 x 24	(18)	15
M6	8 x 40	7	46	9	8 x 36	30	15
M6	8 x 65	32	71	9	8 x 36	30	15
M6	8 x 85	52	89	9	8 x 36	30	15
M8	10 x 40	6	48	11	10 x 40	(30)	25
M8	10 x 50	6	59	11	10 x 50	40	25
M8	10 x 60	16	68	11	10 x 50	40	25
M8	10 x 77	33	85	11	10 x 50	40	25
M8	10 x 97	53	105	11	10 x 50	40	25
M10	12 x 60	10	69	14	12 x 56	46	40
M10	12 x 75	25	84	14	12 x 56	46	40
M10	12 x 99	49	108	14	12 x 56	46	40
M10	12 x 129	79	138	14	12 x 56	46	40
M12	16 x 65	8	76	18	16 x 64	52	70
M12	16 x 111	54	122	18	16 x 64	52	70
M12	16 x 147	90	159	18	16 x 64	52	70
M16	20 x 75	10	91	22	20 x 75	62	100
M16	20 x 107	39	124	22	20 x 75	62	100
M16	20 x 151	83	171	22	20 x 75	62	100

( ): Recommended loads for anchors of reduced setting depth should be reduced accordingly.

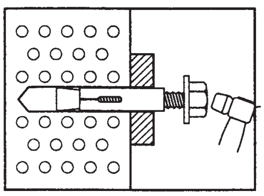
Installation



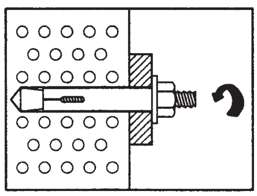
Drill to specified diameter and depth.



Clean the hole with blowout pump.



Drive anchor carefully with hammer into hole until nut and washer are flush with the fixture.



Tighten the anchor to the specified torque.

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

Technical Specifications (Anchor Design Concept)

SLA	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Conc. Thickness h_{min} (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)
M5	40	80	40	70	70	27
M6	50	85	50	80	80	30
M8	60	100	60	90	90	40
M10	70	130	70	100	110	46
M12	80	160	80	130	130	52
M16	100	200	100	180	150	62

SLA	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
M5	4.3	1.4	0.1	2.5	1.1	1.0
M6	6.2	2.0	0.1	6.1	2.9	2.4
M8	11.1	3.6	0.15	7.7	3.6	3.0
M10	14.8	4.9	0.2	12.6	6.0	5.0
M12	17.9	5.9	0.25	18.5	8.8	7.3
M16	24.7	8.1	0.3	31.5	15.0	12.5

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- All loads are derived from static load tests on non-cracked concrete of $f_{CU} = 30\ N/mm^2$, apply adjustment factor f_B for other concrete grades.

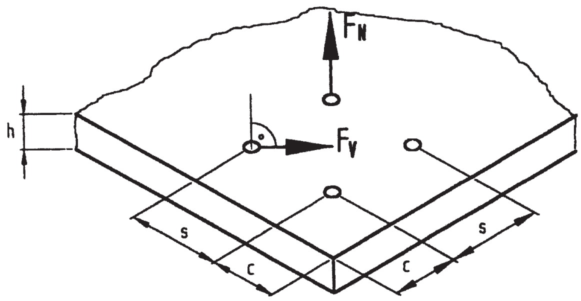
Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	40	50	60	70	80	90	100	110	120	130	140	160	180	200
M5	0.78	0.83	0.89	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M6	-	0.81	0.87	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	-	0.82	0.87	0.91	0.96	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	-	-	0.79	0.83	0.86	0.90	0.93	0.97	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	-	0.78	0.80	0.83	0.86	0.89	0.92	0.94	1.00	1.00	1.00
M16	-	-	-	-	-	-	0.78	0.80	0.82	0.84	0.87	0.91	0.96	1.00

Type	Reduction Factor Table For Tension – Edge Distance (mm)													
	40	50	60	70	80	90	100	110	120	130	140	150	160	180
M5	0.79	0.86	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M6	-	0.81	0.88	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	-	0.83	0.89	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	-	-	0.85	0.90	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	-	0.81	0.85	0.88	0.92	0.96	1.00	1.00	1.00	1.00	1.00
M16	-	-	-	-	-	-	0.78	0.81	0.83	0.86	0.89	0.92	0.94	1.00

Type	Reduction Factor Table For Shear – Edge Distance (mm)													
	40	50	60	70	80	90	100	110	120	130	140	150	160	180
M5	0.57	0.71	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M6	-	0.63	0.75	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	-	0.67	0.78	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	-	-	0.70	0.80	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	-	0.62	0.69	0.77	0.85	0.92	1.00	1.00	1.00	1.00	1.00
M16	-	-	-	-	-	-	0.56	0.61	0.67	0.72	0.78	0.83	0.89	1.00

Superfix Recommendations For SLA (Anchor Design Concept)

- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances $< C_{cr}$, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.45 (S / S_{cr}) + 0.55$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 0.5 (C / C_{cr}) + 0.5$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = C / C_{cr}$

Formula no. 4: Influence of concrete strength:

$f_B = 0.02 (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\,cr})^{1.75}$

Where $h_{s\,min} \geq 0.6\, h_{s\,cr}$

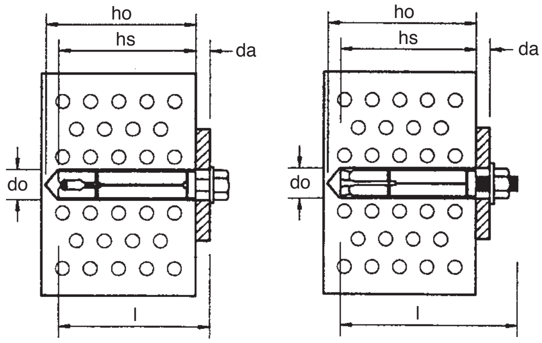
Concrete grade range:

$20 \leq f_{CU} \leq 50$

- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

16. Superfix Shield Anchor – SSA

Features:
Light to medium load, torque-controlled expansion anchor.
Hex head, bolt, eye and hook for a wide range of fastening applications.
Ideal for racks, shelves, cable trunking, air-con compressor, chain barriers and other metal works.
Galvanised steel.



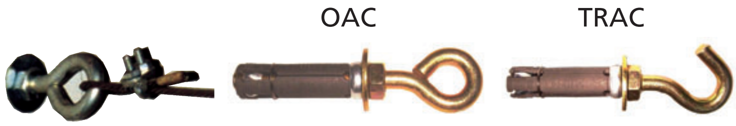
TAC

KAC

Product Range And Installation Data

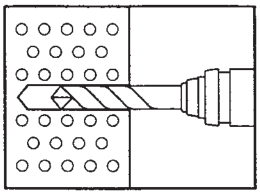
TAC KAC	Description	Fixture Thickness d_a (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole d_0 x h_0 (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Tighten Torque (Nm)
TAC 110	M6 x 50 x 40	10	50	7	10 x 45	40	8
TAC 120	M6 x 70 x 40	30	70	7	10 x 45	40	8
TAC 130	M8 x 65 x 50	15	65	9	14 x 55	50	25
TAC 140	M8 x 90 x 50	40	90	9	14 x 55	50	25
TAC 150	M10 x 70 x 60	10	70	11	16 x 65	60	45
TAC 160	M10 x 90 x 60	30	90	11	16 x 65	60	45
TAC 170	M12 x 90 x 80	10	90	14	20 x 85	80	70
TAC 180	M12 x 120 x 80	40	120	14	20 x 85	80	70
KAC 510	M5 x 50 x 35	10	50	6	8 x 40	35	8
KAC 520	M5 x 60 x 35	20	60	6	8 x 40	35	8
KAC 530	M5 x 80 x 35	40	80	6	8 x 40	35	8
KAC 540	M6 x 60 x 35	8	60	7	10 x 40	35	8
KAC 550	M6 x 50 x 40	13	50	7	10 x 45	40	8
KAC 560	M6 x 75 x 40	26	75	7	10 x 45	40	8
KAC 570	M6 x 100 x 40	53	100	7	10 x 45	40	8
KAC 580	M8 x 55 x 40	7	55	9	14 x 45	40	25
KAC 590	M8 x 75 x 40	27	75	9	14 x 45	40	25
KAC 600	M8 x 75 x 50	17	75	9	14 x 55	50	25
KAC 610	M8 x 100 x 50	42	100	9	14 x 55	50	25
KAC 610A	M8 x 120 x 50	62	120	9	14 x 55	50	25
KAC 620	M8 x 140 x 50	82	140	9	14 x 55	50	25
KAC 620A	M8 x 160 x 50	102	160	9	14 x 55	50	25
KAC 640	M10 x 70 x 50	10	70	11	17 x 55	50	45
KAC 650	M10 x 80 x 50	20	80	11	17 x 55	50	45
KAC 660	M10 x 80 x 60	10	80	11	17 x 65	60	45
KAC 670	M10 x 100 x 50	40	100	11	17 x 55	50	45
KAC 680	M10 x 100 x 60	30	100	11	17 x 65	60	45
KAC 690	M10 x 120 x 60	50	120	11	17 x 65	60	45
KAC 700	M10 x 140 x 60	70	140	11	17 x 65	60	45
KAC 700A	M10 x 160 x 60	90	160	11	17 x 65	60	45
KAC 740	M12 x 110 x 60	38	110	14	20 x 70	60	70
KAC 750	M12 x 110 x 80	18	110	14	20 x 90	80	70
KAC 760	M12 x 120 x 60	48	120	14	20 x 70	60	70
KAC 770	M12 x 120 x 80	28	120	14	20 x 90	80	70
KAC 780	M12 x 140 x 80	48	140	14	20 x 90	80	70
KAC 790	M12 x 140 x 100	28	140	14	20 x 110	100	70
KAC 800	M12 x 160 x 80	68	160	14	20 x 90	80	70
KAC 810	M12 x 160 x 100	48	160	14	20 x 110	100	70

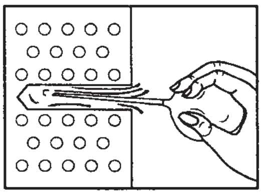
Product Range And Installation Data

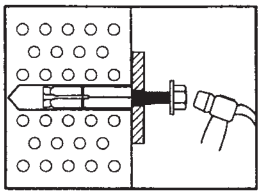


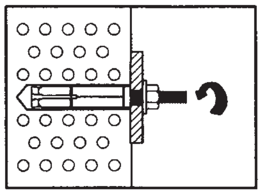
OAC TRAC	Description	Anchor Length l (mm)	Eye/Hook Internal Diameter (mm)	Drill Hole d_0 x h_0 (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Tighten Torque (Nm)
OAC 110	M5 x 60 x 35	60	7	8 x 40	35	8
OAC 120	M6 x 70 x 40	70	10	11 x 45	40	8
OAC 130	M8 x 90 x 50	90	12	14 x 55	50	25
OAC 140	M10 x 110 x 60	110	15	17 x 65	60	45
OAC 150	M12 x 180 x 80	180	20	20 x 90	80	70
TRAC 110	M5 x 60 x 35	60	7	8 x 40	35	8
TRAC 120	M6 x 70 x 40	70	10	11 x 45	40	8
TRAC 130	M8 x 90 x 50	90	12	14 x 55	50	25
TRAC 140	M10 x 110 x 60	110	15	17 x 65	60	45
TRAC 150	M12 x 180 x 80	180	20	20 x 90	80	70

Installation


Drill to specified diameter and depth.

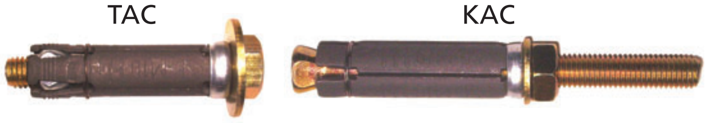

Clean the hole with blowout pump.


Drive anchor carefully with hammer into hole until nut and washer are flush with the fixture.


Tighten the anchor to the specified torque.

Technical Specifications (Anchor Design Concept)

TAC KAC



TAC KAC	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Conc. Thickness h_{min} (mm)
M6	50	165	50	100	90
M8	60	170	60	110	100
M10	70	210	70	140	120
M12	80	250	80	180	150

TAC KAC	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_V (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_V (kN)
M6	6.8	2.2	0.1	3.7	1.7	1.4
M8	11.7	3.8	0.1	6.5	3.0	2.5
M10	16.0	5.3	0.15	10.1	4.8	4.0
M12	24.1	8.0	0.2	15.7	7.4	6.2

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- All loads are derived from static load tests on non-cracked concrete of $f_{CU} = 30$ N/mm², apply adjustment factor f_B for other concrete grades.

OAC TRAC	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Conc. Thickness h_{min} (mm)	Safe Tensile Resistance F_N (kN)	Tensile Displacement δ (mm)	Safe Shear Resistance F_V (kN)
M5	50	50	60	60	90	*0.1	N.A.	*0.1
M6	50	50	60	60	90	*0.3	N.A.	*0.3
M8	60	60	70	70	100	*1.0	N.A.	*1.0
M10	70	70	80	80	120	*2.0	N.A.	*2.0
M12	80	80	100	100	150	*2.5	N.A.	*2.5

* For OAC and TRAC, mode of failure is governed by the yield of the eye or hook.

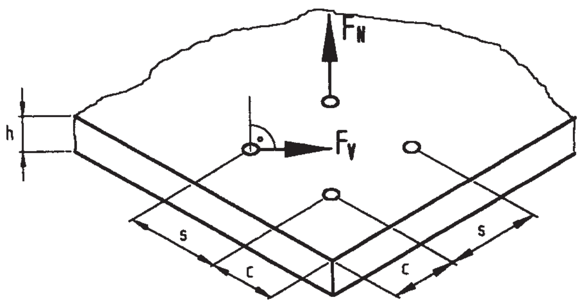
TAC KAC Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	50	60	70	80	90	100	110	120	140	160	180	200	220	250
M6	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.92	0.98	1.00	1.00	1.00	1.00
M8	-	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.91	0.97	1.00	1.00	1.00	1.00
M10	-	-	0.67	0.69	0.71	0.74	0.76	0.79	0.83	0.88	0.93	0.98	1.00	1.00
M12	-	-	-	0.66	0.68	0.70	0.72	0.74	0.78	0.82	0.86	0.90	0.94	1.00

TAC KAC Type	Reduction Factor Table For Tension – Edge Distance (mm)													
	50	60	70	80	90	100	110	120	130	140	150	160	170	180
M6	0.75	0.80	0.85	0.90	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	0.77	0.82	0.86	0.91	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	-	0.75	0.79	0.82	0.86	0.89	0.93	0.96	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	0.72	0.75	0.78	0.81	0.83	0.86	0.89	0.92	0.94	0.97	1.00

TAC KAC Type	Reduction Factor Table For Shear – Edge Distance (mm)													
	50	60	70	80	90	100	110	120	130	140	150	160	170	180
M6	0.50	0.60	0.70	0.80	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	0.55	0.64	0.73	0.82	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	-	0.50	0.57	0.64	0.71	0.79	0.86	0.93	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	0.44	0.50	0.56	0.61	0.67	0.72	0.78	0.83	0.89	0.94	1.00

Superfix Recommendations For SSA (Anchor Design Concept)

- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formula 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – E.g. $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$
- Where edge distances < C_{cr}, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe tensile resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.5\ (S / S_{cr}) + 0.5$ (For TAC & KAC)
$f_A = 1$ (For OAC & TRAC)

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 0.5\ (C / C_{cr}) + 0.5$ (For TAC & KAC)
$f_{RN} = 1$ (For OAC & TRAC)

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = C / C_{cr}$ (For TAC & KAC)

$f_{RV} = 1$ (For OAC & TRAC)

Formula no. 4: Influence of concrete strength:

$f_B = 0.015\ (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)
(For TAC & KAC)

$f_B = 1$ (For OAC & TRAC)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\ cr})^2$ (For TAC & KAC)
$f_T = 1$ (For OAC & TRAC)

Where $h_{s\ min} \geq 0.8\ h_{s\ cr}$

Concrete grade range:

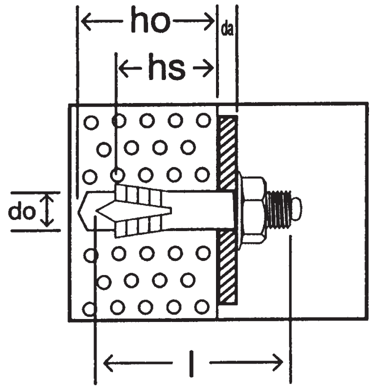
$25 \leq f_{CU} \leq 50$

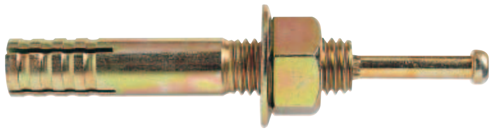
- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

★ OAC & TRAC do not have reduction formulae because the mode of failure is governed by the yield of the eye or hook, which occurs at significantly lower loads.

17. Superfix Hammer Anchor – SHA

Features:
Medium load, wedge expansion anchor installed by means of hammering the steel nail.
Fast and efficient installation (with sufficient torque value to hold fixture).
Suitable for concrete and natural stone.
Ideal for metal railings, machinery and equipment, and conveyor belt systems.
Galvanised steel, or stainless steel A4/316, or stainless steel A2/304.



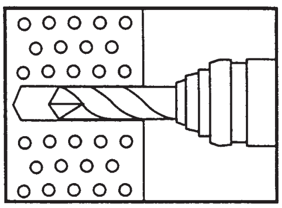


Product Range And Installation Data

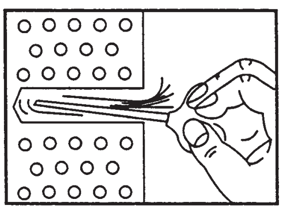
SHA	Description	Fixture Thickness d_a (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole $d_0 \times h_0$ (mm)	Setting Depth h_s (mm)	Tighten Torque ($f_{CU} \geq 20$ N/mm^2) (Nm)
M6	6 x 45	7	45	7	6 x 33	30	6
M6	6 x 60	22	60	7	6 x 33	30	6
M8	8 x 50	7	50	9	8 x 39	35	10
M8	8 x 70	27	70	9	8 x 39	35	12
M10	10 x 50	8	50	11	10 x 33	(30)	15
M10	10 x 60	7	60	11	10 x 45	40	20
M10	10 x 80	27	80	11	10 x 45	40	20
M10	10 x 90	37	90	11	10 x 45	40	20
M10	10 x 100	47	100	11	10 x 45	40	20
M12	12 x 60	12	60	14	12 x 40	(35)	20
M12	12 x 70	12	70	14	12 x 50	45	25
M12	12 x 90	32	90	14	12 x 50	45	25
M12	12 x 100	42	100	14	12 x 50	45	25
M12	12 x 120	62	120	14	12 x 50	45	25
M16	16 x 100	16	100	18	18 x 72	65	40
M16	16 x 120	36	120	18	18 x 72	65	40
M16	16 x 150	66	150	18	18 x 72	65	40
M20	20 x 130	20	130	22	22 x 95	85	40
M20	20 x 150	40	150	22	22 x 95	85	40

( ): Recommended loads for anchors of reduced setting depth should be reduced accordingly.

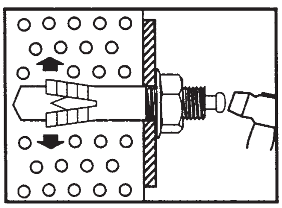
Installation



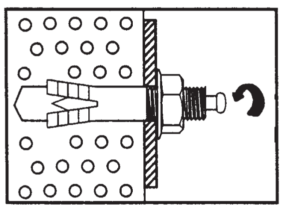
Drill to specified diameter and depth.



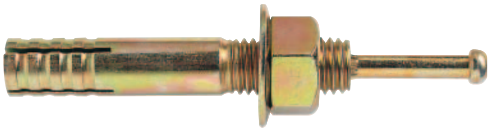
Clean the hole with blowout pump.



Drive anchor carefully with hammer into hole until the nail penetrates and rests on the anchor.



Tighten the anchor to the specified torque.



Technical Specifications (Anchor Design Concept)

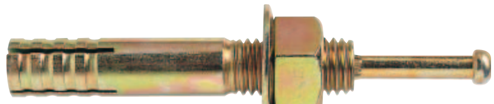
SHA	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Conc. Thickness h_{min} (mm)	Char. Setting Depth $h_{s\ cr}$ (mm)
M6	50	50	70	100	90	30
M8	60	60	80	120	100	35
M10	80	80	90	130	120	40
M12	90	90	110	160	140	45
M16	120	120	130	200	180	65
M20	150	150	160	250	200	85

SHA	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
M6	2.5	0.8	0.2	4.3	2.0	1.7
M8	7.7	2.5	0.2	9.2	4.3	3.6
M10	9.5	3.1	0.2	10.2	4.8	4.0
M12	11.1	3.6	0.2	18.5	8.8	7.3
M16	27.1	8.9	0.2	27.8	13.2	11.0
M20	32.4	10.7	0.2	33.9	16.1	13.4

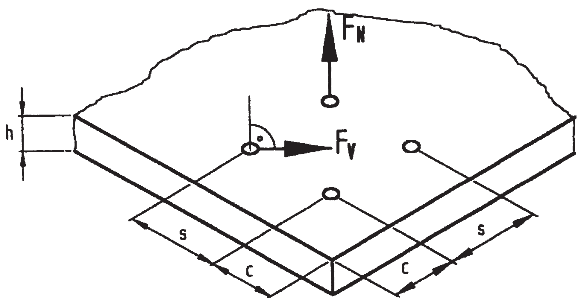
- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- All loads are derived from static load tests on non-cracked concrete of $f_{CU} = 30\ N/mm^2$, apply adjustment factor f_B for other concrete grades.

Type	Reduction Factor Table For Shear – Edge Distance (mm)													
	70	80	90	100	110	120	130	140	150	160	180	200	220	250
M6	0.76	0.84	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M8	-	0.73	0.80	0.87	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	-	0.75	0.82	0.88	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	-	-	-	0.75	0.80	0.85	0.90	0.95	1.00	1.00	1.00	1.00	1.00
M16	-	-	-	-	-	-	0.72	0.76	0.80	0.84	0.92	1.00	1.00	1.00
M20	-	-	-	-	-	-	-	-	-	0.71	0.78	0.84	0.90	1.00

Superfix Recommendations For SHA (Anchor Design Concept)



- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances $< C_{cr}$, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 1$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 1$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = 0.8 (C / C_{cr}) + 0.2$

Formula no. 4: Influence of concrete strength:

$f_B = 0.015 (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\,cr})$

Where $h_{s\,min} \geq 0.75\, h_{s\,cr}$

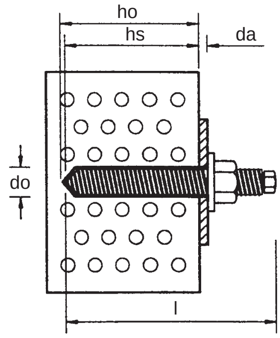
Concrete grade range:

$20 \leq f_{CU} \leq 45$

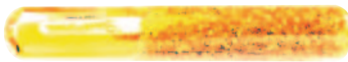
- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

18. Superfix Chemical-Capsule Anchor – SVA

Features:
Very high load, adhesive anchor.
Installation does not increase the stress within existing structures.
Fast cure in both dry and moist base material.
Vibration resistant.
Close anchor spacing and edge distances.
Approved by the German fire prevention service.
Ideal for most building materials and structural fixings.
Galvanised steel, or stainless steel A4/316, or stainless steel A2/304.



Product Range And Installation Data

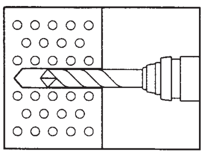


SVA	Description	Fixture Thickness d_a (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole $d_0 \times h_0$ (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Tighten Torque (Nm)
M8	M 8 x 110	20	110	9	10 x 83	80	10
M10	M 10 x 130	30	130	11	12 x 94	90	20
M10	M 10 x 165	65	165	11	12 x 94	90	20
M12	M 12 x 160	35	160	14	14 x 114	110	40
M12	M 12 x 180	55	180	14	14 x 114	110	40
M16	M 16 x 165	20	165	18	18 x 130	125	80
M16	M 16 x 190	45	190	18	18 x 130	125	80
M20	M 20 x 220	25	220	22	25 x 176	170	150
M20	M 20 x 260	65	260	22	25 x 176	170	150
M24	M 24 x 260	20	260	27	28 x 216	210	200
M24	M 24 x 300	60	300	27	28 x 216	210	200

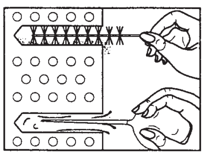
SVA	Description	Chemical Capsule	Drill Hole $d_0 \times h_0$ (mm)	Characteristic Setting Depth $h_{s\,cr}$ (mm)
T10	T10 Rebar	VA-P 10	13 x 94	90
T13	T13 Rebar	VA-P 12	16 x 114	110
T16	T16 Rebar	VA-P 16	20 x 130	125
T20	T20 Rebar	VA-P 20	25 x 176	170
T25	T25 Rebar	VA-P 24	30 x 216	210

Cure Time	Indoor — 27°C (Dry)	Outdoor – ≥ 30°C (Dry)	Indoor — 27°C (In Standing Water)	Outdoor – ≥ 30°C (In Standing Water)
VA-P	60 mins	45 mins	120 mins	90 mins

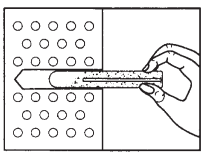
Installation



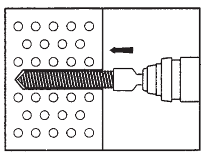
Drill to specified diameter and depth.



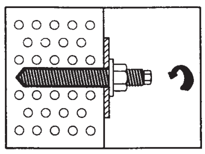
Clean the hole with nylon brush and blowout pump.



Insert chemical capsule into the hole.

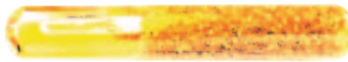


Drive anchor into the hole using setting tool and drilling machine.



After the specified cure time, install fixture and tighten to the specified torque.

Technical Specifications (Anchor Design Concept)



SVA	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Concrete Thickness h_{min} (mm)	Min. Reinforced Concrete Thickness h_{min} (mm)
M8	40	140	40	105	120	105
M10/T10	45	160	45	135	130	115
M12/T13	50	195	50	165	150	135
M16/T16	60	230	60	195	165	155
M20/T20	80	300	80	255	210	200
M24/T25	100	370	100	290	250	250

SVA (Steel Grade 5.6)	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
M8	18.2	6.0	0.1	10.8	5.1	4.2
M10	28.7	9.5	0.1	16.0	7.6	6.3
M12	42.0	13.9	0.15	23.4	11.1	9.2
M16	58.1	19.2	0.2	37.8	18.0	15.0
M20	116.5	38.5	0.25	68.0	32.3	26.9
M24	166.6	55.1	0.3	93.2	44.3	36.9

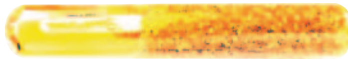
- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- For installation in standing water conditions, multiply a reduction factor of 0.8 for all tensile loads.
- All loads are derived from static load tests on non-cracked concrete of $f_{CU} = 30$ N/mm², apply adjustment factor f_B for other concrete grades.

★ **Safe loads are for bolts of Steel Grade 5.6 and will differ for other steel grade values.**

SVA (Steel Grade 8.8)	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
M8	20.3	6.7	0.1	14.2	6.7	5.6
M10	37.1	12.2	0.1	23.1	11.0	9.1
M12	46.3	15.3	0.15	24.6	11.7	9.7
M16	76.5	25.3	0.2	56.1	26.7	22.2
M20	121.4	40.1	0.25	94.1	44.8	37.3
M24	166.6	55.1	0.3	138.9	66.1	55.1

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- For installation in standing water conditions, multiply a reduction factor of 0.8 for all tensile loads.
- All loads are derived from static load tests on non-cracked concrete of $f_{CU} = 30$ N/mm², apply adjustment factor f_B for other concrete grades.

★ **Safe loads are for bolts of Steel Grade 8.8 and will differ for other steel grade values.**



SVA (Rebar 460 N/mm^2)	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For C ≥ C_{cr} F_v (kN)	Nominal Safe Shear Resistance For C < C_{cr} F_v (kN)
T10	36.1	11.9	0.1	36.1	17.1	14.3
T13	59.2	19.6	0.15	54.7	*21.7	21.7
T16	76.5	25.3	0.2	75.0	*29.7	29.7
T20	121.4	40.1	0.25	130.8	*51.9	51.9
T25	166.6	55.1	0.3	176.3	*69.9	69.9

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- For installation in standing water conditions, multiply a reduction factor of 0.8 for all tensile loads.
- All loads are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2, apply adjustment factor f_B for other concrete grades.
- Safe loads are for rebars of characteristic strength 460 N/mm^2.

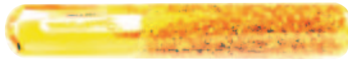
* **Considering rebars as anchors, the mode of failure at the specified edge distances under shear load is governed by the limiting concrete strength. Hence, the factor of safety remains at 2.52.**

Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	40	50	60	70	80	100	120	140	180	220	260	300	340	370
M8	0.64	0.68	0.71	0.75	0.79	0.86	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	0.66	0.69	0.72	0.75	0.81	0.88	0.94	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	0.63	0.65	0.68	0.71	0.76	0.81	0.86	0.96	1.00	1.00	1.00	1.00	1.00
M16	-	-	0.63	0.65	0.67	0.72	0.76	0.80	0.89	0.98	1.00	1.00	1.00	1.00
M20	-	-	-	-	0.63	0.67	0.70	0.73	0.80	0.87	0.93	1.00	1.00	1.00
M24	-	-	-	-	-	0.64	0.66	0.69	0.74	0.80	0.85	0.91	0.96	1.00

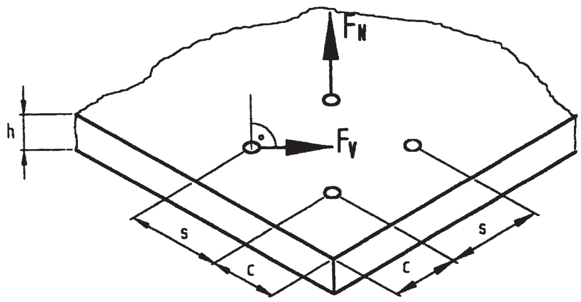
Type	Reduction Factor Table For Tension – Edge Distance (mm)													
	40	50	60	70	80	100	120	140	160	180	200	230	260	290
M8	0.69	0.74	0.79	0.83	0.88	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	0.69	0.72	0.76	0.80	0.87	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	0.65	0.68	0.71	0.74	0.80	0.86	0.92	0.98	1.00	1.00	1.00	1.00	1.00
M16	-	-	0.65	0.68	0.71	0.76	0.81	0.86	0.91	0.96	1.00	1.00	1.00	1.00
M20	-	-	-	-	0.66	0.70	0.74	0.77	0.81	0.85	0.89	0.95	1.00	1.00
M24	-	-	-	-	-	0.67	0.71	0.74	0.78	0.81	0.84	0.90	0.95	1.00

Type	Reduction Factor Table For Shear – Edge Distance (mm)													
	40	50	60	70	80	100	120	140	160	180	200	230	260	290
M8	0.38	0.48	0.57	0.67	0.76	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	0.37	0.44	0.52	0.59	0.74	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	0.30	0.36	0.42	0.48	0.61	0.73	0.85	0.97	1.00	1.00	1.00	1.00	1.00
M16	-	-	0.31	0.36	0.41	0.51	0.62	0.72	0.82	0.92	1.00	1.00	1.00	1.00
M20	-	-	-	-	0.31	0.39	0.47	0.55	0.63	0.71	0.78	0.90	1.00	1.00
M24	-	-	-	-	-	0.34	0.41	0.48	0.55	0.62	0.69	0.79	0.90	1.00

Superfix Recommendations For SVA (Anchor Design Concept)



- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances $< C_{cr}$, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.5 (S / S_{cr}) + 0.5$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 0.5 (C / C_{cr}) + 0.5$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = C / C_{cr}$

Formula no. 4: Influence of concrete strength:

$f_B = 0.02 (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = 1$
($h_{s\,min} = h_{s\,cr}$)

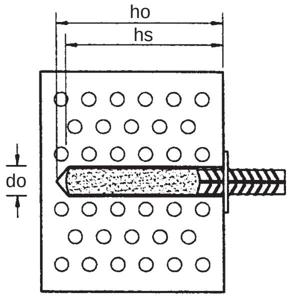
Concrete grade range:

$15 \leq f_{CU} \leq 60$

- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

19. Superfix Hammer-In Capsule – SHC

Features:
High load, adhesive for rebar fastening.
Installation does not increase the stress within existing structures.
Fast cure in both dry and moist base material.
Ideal for starter bar installation.

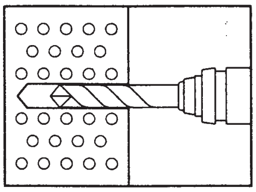


Product Range And Installation Data

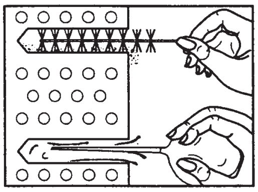
SHC	Description	Chemical Capsule	Drill Hole $d_0 \times h_0$ (mm)	Characteristic Setting Depth $h_{s\,cr}$ (mm)
T10	T10 Rebar	VE-P 10	13 x 94	90
T13	T13 Rebar	VE-P 12	16 x 104	100
T16	T16 Rebar	VE-P 16	20 x 140	135
T20	T20 Rebar	VE-P 20	25 x 183	177

Cure Time	Indoor — 27°C (Dry)	Outdoor – ≥ 30°C (Dry)	Indoor — 27°C (In Standing Water)	Outdoor – ≥ 30°C (In Standing Water)
VE-P	60 mins	45 mins	120 mins	90 mins

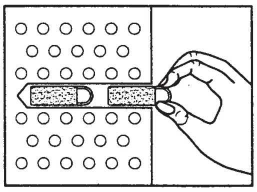
Installation



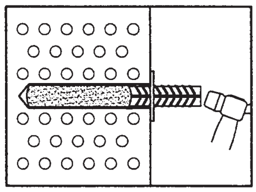
Drill to specified diameter and depth.



Clean the hole with nylon brush and blowout pump.



Insert chemical capsule into the hole.



Hammer rebar into the hole.

Technical Specifications (Anchor Design Concept)

SHC	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Conc Thickness h_{min} (mm)
T10	45	130	45	130	130
T13	50	160	50	160	150
T16	60	180	60	180	175
T20	80	235	80	235	220

SHC (Rebar 460 N/mm²)	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
T10	19.4	6.4	0.1	34.6	*13.7	13.7
T13	25.9	8.5	0.1	49.8	*19.7	19.7
T16	42.3	14.0	0.2	69.1	*27.4	27.4
T20	64.8	21.4	0.3	118.1	*46.8	46.8

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- For installation in standing water conditions, multiply a reduction factor of 0.8 for all tensile loads.
- All loads are derived from static load tests on non-cracked concrete of $f_{CU} = 30$ N/mm², apply adjustment factor f_B for other concrete grades.
- Safe loads are for rebars of characteristic strength 460 N/mm².

* **Considering rebars as anchors, the mode of failure at the specified edge distances under shear load is governed by the limiting concrete strength. Hence, the factor of safety remains at 2.52.**

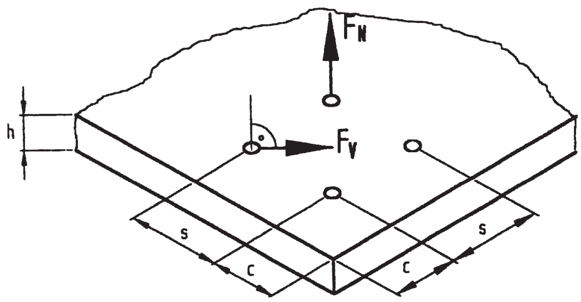
Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	50	60	70	80	90	100	110	120	140	160	180	200	220	240
T10	0.69	0.73	0.77	0.81	0.85	0.88	0.92	0.96	1.00	1.00	1.00	1.00	1.00	1.00
T13	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.88	0.94	1.00	1.00	1.00	1.00	1.00
T16	-	0.67	0.69	0.72	0.75	0.78	0.81	0.83	0.89	0.94	1.00	1.00	1.00	1.00
T20	-	-	-	0.67	0.69	0.71	0.73	0.76	0.80	0.84	0.88	0.93	0.97	1.00

Type	Reduction Factor Table For Tension – Edge Distance (mm)													
	50	60	70	80	90	100	110	120	140	160	180	200	220	240
T10	0.69	0.73	0.77	0.81	0.85	0.88	0.92	0.96	1.00	1.00	1.00	1.00	1.00	1.00
T13	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.88	0.94	1.00	1.00	1.00	1.00	1.00
T16	-	0.67	0.69	0.72	0.75	0.78	0.81	0.83	0.89	0.94	1.00	1.00	1.00	1.00
T20	-	-	-	0.67	0.69	0.71	0.73	0.76	0.80	0.84	0.88	0.93	0.97	1.00

Type	Reduction Factor Table For Shear – Edge Distance (mm)													
	50	60	70	80	90	100	110	120	140	160	180	200	220	240
T10	0.38	0.46	0.54	0.62	0.69	0.77	0.85	0.92	1.00	1.00	1.00	1.00	1.00	1.00
T13	0.31	0.38	0.44	0.50	0.56	0.63	0.69	0.75	0.88	1.00	1.00	1.00	1.00	1.00
T16	-	0.33	0.39	0.44	0.50	0.56	0.61	0.67	0.78	0.89	1.00	1.00	1.00	1.00
T20	-	-	-	0.34	0.38	0.43	0.47	0.51	0.60	0.68	0.77	0.85	0.94	1.00

Superfix Recommendations For SHC (Anchor Design Concept)

- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances < C_{cr}, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.5 (S / S_{cr}) + 0.5$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 0.5 (C / C_{cr}) + 0.5$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = C / C_{cr}$

Formula no. 4: Influence of concrete strength:

$f_B = 0.015 (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\,cr})^2$

Where $h_{s\,min} \geq 0.5\, h_{s\,cr}$

Concrete grade range:

$15 \leq f_{CU} \leq 60$

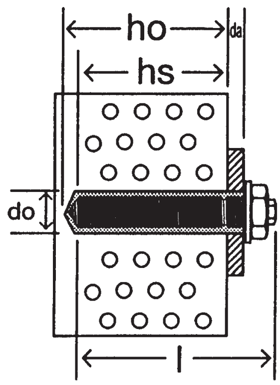
- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

20. Superfix Polyester System – SIS

The system consists of an unsaturated polyester resin, and a hardener contained within a twin-compartment cartridge. Fast curing and of low odour, fastening systems installed using the SIS do not increase the stress within the existing concrete structures. The specially designed nozzle ensures full mixing of the chemicals – when properly mixed, the SIS should be uniform medium grey colour.

Resin – cream white. Hardener – black.
Shelf life – one year from date of manufacture for unopened cartridge.
Recommended storage – dry, air-conditioned room (20°C – 27°C).

Features:
Medium to high load, adhesive anchor.
Installation does not increase the stress within existing structures.
Fast cure in both dry and moist base material.
Close anchor spacing and edge distances.
Ideal for general medium load applications.
Galvanised steel, or stainless steel A4/316, or stainless steel A2/304

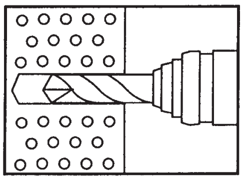


Product Range And Installation Data

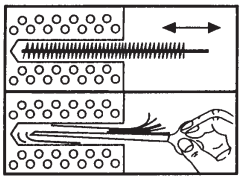
SIS	Description	Minimum Chemical Volume (ml)	Fixture Thickness d_a (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole d_0 x h_0 (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Tighten Torque (Nm)
M8	M 8 x 110	5	20	110	9	10 x 83	80	10
M10	M 10 x 130	7	30	130	11	12 x 94	90	20
M10	M 10 x 165	7	65	165	11	12 x 94	90	20
M12	M 12 x 160	12	35	160	14	14 x 114	110	40
M12	M 12 x 180	12	55	180	14	14 x 114	110	40
M16	M 16 x 165	22	20	165	18	18 x 130	125	80
M16	M 16 x 190	22	45	190	18	18 x 130	125	80
M20	M 20 x 220	56	25	220	22	24 x 176	170	150
M20	M 20 x 260	56	65	260	22	24 x 176	170	150
M24	M 24 x 260	87	20	260	27	28 x 216	210	200
M24	M 24 x 300	87	60	300	27	28 x 216	210	200

SIS	Description	Minimum Chemical Volume (ml)	Drill Hole d_0 x h_0 (mm)	Characteristic Setting Depth $h_{s\,cr}$ (mm)
T10	T10 Rebar	8.3	13 x 94	90
T13	T13 Rebar	15.3	16 x 114	110
T16	T16 Rebar	27.3	20 x 130	125
T20	T20 Rebar	57.6	25 x 176	170
T25	T25 Rebar	101.8	30 x 216	210

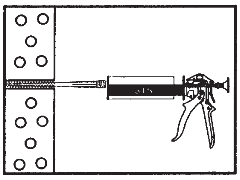
Cure Time	Indoor — 27°C (Dry)	Outdoor – ≥ 30°C (Dry)	Indoor — 27°C (In Standing Water)	Outdoor – ≥ 30°C (In Standing Water)
SIS	60 mins	45 mins	120 mins	90 mins



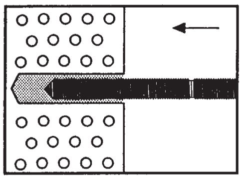
Drill to specified diameter and depth.



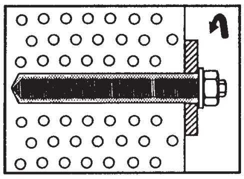
Clean the hole with nylon brush and blowout pump.



Inject chemical from the base of the hole towards the surface.



Insert anchor into the hole using a twisting motion.



After the specified cure time, install fixture and tighten to the specified torque.

Technical Specifications (Anchor Design Concept)

SIS	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Concrete Thickness h_{min} (mm)	Min. Reinforced Concrete Thickness h_{min} (mm)
M8	40	140	40	105	120	105
M10/T10	45	160	45	135	130	115
M12/T13	50	190	50	165	150	135
M16/T16	60	230	60	195	165	155
M20/T20	80	300	80	255	210	200
M24/T25	100	370	100	290	250	250

SIS (Steel Grade 5.6)	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
M8	7.9	2.6	0.1	10.8	5.1	4.2
M10	12.3	4.0	0.1	16.0	7.6	6.3
M12	15.5	5.1	0.15	23.4	11.1	9.2
M16	22.2	7.3	0.2	37.8	18.0	15.0
M20	46.3	15.3	0.25	68.0	32.3	26.9
M24	61.7	20.4	0.3	93.2	44.3	36.9

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- For installation in standing water conditions, multiply a reduction factor of 0.8 for all tensile loads.
- All loads are derived from static load tests on non-cracked concrete of $f_{CU} = 30$ N/mm², apply adjustment factor f_B for other concrete grades.

* **Safe loads are for bolts of Steel Grade 5.6 and will differ for other steel grade values.**

SIS (Rebar 460 N/mm²)	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
T10	18.5	6.1	0.1	36.1	17.1	14.3
T13	33.9	11.2	0.15	54.7	*21.7	21.7
T16	46.3	15.3	0.2	75.0	*29.7	29.7
T20	61.7	20.4	0.25	119.4	*47.3	47.3
T25	92.6	30.6	0.3	167.3	*66.3	66.3

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- For installation in standing water conditions, multiply a reduction factor of 0.8 for all tensile loads.
- All loads are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm², apply adjustment factor f_B for other concrete grades.
- Safe loads are for rebars of characteristic strength 460 N/mm².

★ **Considering rebars as anchors, the mode of failure at the specified edge distances under shear load is governed by the limiting concrete strength. Hence, the factor of safety remains at 2.52.**

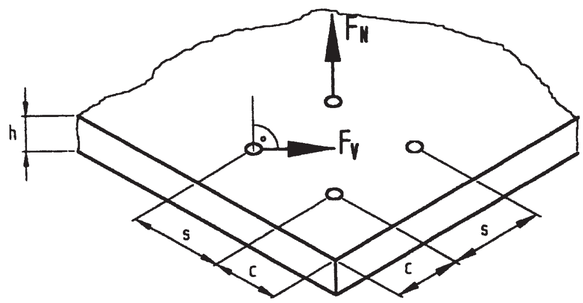
Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	40	50	60	70	80	100	120	140	180	220	260	300	340	370
M8	0.68	0.71	0.74	0.78	0.81	0.87	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	0.69	0.72	0.75	0.78	0.83	0.89	0.94	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	0.67	0.69	0.72	0.74	0.79	0.83	0.88	0.98	1.00	1.00	1.00	1.00	1.00
M16	-	-	0.67	0.69	0.71	0.75	0.78	0.82	0.90	0.98	1.00	1.00	1.00	1.00
M20	-	-	-	-	0.67	0.70	0.73	0.76	0.82	0.88	0.94	1.00	1.00	1.00
M24	-	-	-	-	-	0.67	0.70	0.72	0.77	0.82	0.87	0.91	0.96	1.00

Type	Reduction Factor Table For Tension – Edge Distance (mm)													
	40	50	60	70	80	100	120	140	160	180	200	230	260	290
M8	0.69	0.74	0.79	0.83	0.88	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	0.69	0.72	0.76	0.80	0.87	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	0.65	0.68	0.71	0.74	0.80	0.86	0.92	0.98	1.00	1.00	1.00	1.00	1.00
M16	-	-	0.65	0.68	0.71	0.76	0.81	0.86	0.91	0.96	1.00	1.00	1.00	1.00
M20	-	-	-	-	0.66	0.70	0.74	0.77	0.81	0.85	0.89	0.95	1.00	1.00
M24	-	-	-	-	-	0.67	0.71	0.74	0.78	0.81	0.84	0.90	0.95	1.00

Type	Reduction Factor Table For Shear – Edge Distance (mm)													
	40	50	60	70	80	100	120	140	160	180	200	230	260	290
M8	0.35	0.45	0.55	0.65	0.75	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	0.34	0.42	0.49	0.57	0.73	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	0.27	0.33	0.40	0.46	0.59	0.71	0.84	0.97	1.00	1.00	1.00	1.00	1.00
M16	-	-	0.27	0.33	0.38	0.49	0.60	0.70	0.81	0.92	1.00	1.00	1.00	1.00
M20	-	-	-	-	0.28	0.36	0.44	0.53	0.61	0.69	0.77	0.90	1.00	1.00
M24	-	-	-	-	-	0.31	0.38	0.46	0.53	0.60	0.67	0.78	0.89	1.00

Superfix Recommendations For SIS (Anchor Design Concept)

- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances $< C_{cr}$, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.45\ (S / S_{cr}) + 0.55$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 0.5\ (C / C_{cr}) + 0.5$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = 1.05\ (C / C_{cr}) - 0.05$

Formula no. 4: Influence of concrete strength:

$f_B = 0.02\ (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\ cr})^2$

Where $h_{s\ min} \geq 0.5\ h_{s\ cr}$

Concrete grade range:

$15 \leq f_{CU} \leq 60$

- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

Rebar Design Concept

For details, see **Partial Factors of Safety** on **Page 19** and **Rebar Design Principles** on **Page 22**.

SIS	Nominal Bar Diameter d (mm)	Drill Hole Diameter d_0 (mm)	Minimum Spacing S_{min} (mm)	Char. Spacing $S_{cr,N}$ (mm)	Minimum Edge Dist. C_{min} (mm)	Char. Edge. Dist. $C_{cr,N}$ (mm)	Char. Bond Strength f_{Bond} (N/mm^2)	Char. Steel Strength f_y (N/mm^2)
M10	10	12	45	180	45	90	8.5	≥ 460
T10	10	13	45	180	45	90		
M12	12	14	55	220	55	110		
T13	13	16	55	220	55	110		
M16	16	18	65	260	65	130		
T16	16	20	65	260	65	130		
M20	20	24	85	340	85	170		
T20	20	25	85	340	85	170		
M24	24	28	105	420	105	210		
T25	25	30	105	420	105	210		
T28	28	35	135	540	135	270		
T32	32	40	150	600	150	300		

Design Approach #1: Ultimate Limit State (ULS) Design

#1.1 $F_{N,Bond} = \pi.\, d.\, h_s.\, f_{Bond} \,/\, 1000$ [kN]

#1.2 $F_{N,Concrete} = (7.2).\, (f_{CU})^{0.5}.\, (h_s)^{1.5}.f_{Crack}.\, f_{AN}.f_{RN} \,/\, 1000$ [kN]

#1.3 $F_{N,Steel} = \pi.\, (d^2/4).f_y \,/1000$ [kN]

Ensure that: $F_{N,Bond}/1.2 > F_{N,Steel}$

$F_{N,Concrete} > F_{N,Steel}$

The design embedment depth shall be the greater value of $\mathbf{h_s}$ from #1.1 and #1.2. Superfix recommends the use of software or spreadsheet for such iterative analysis.

With no spacing and edge distance constraints, installation in f_{CU} = 30 N/mm^2 concrete:

SIS	Min. Embedment Due To Limiting Bond Strength (mm) $F_{N,Bond}/1.2 > F_{N,Steel}$	Min. Embedment In Cracked Concrete Due To Limiting Concrete Strength (mm) $F_{N,Concrete} > F_{N,Steel}$	Min. Embedment In Non-Cracked Concrete Due to Limiting Concrete Strength (mm) $F_{N,Concrete} > F_{N,Steel}$	Design Embedment For Cracked Concrete (mm)	Design Embedment For Non-Cracked Concrete (mm)
M10	165	95	80	165	165
T10	165	95	80	165	165
M12	195	125	100	195	195
T13	215	135	110	215	215
M16	260	180	145	260	260
T16	260	180	145	260	260
M20	325	240	190	325	325
T20	325	240	190	325	325
M24	390	305	245	390	390
T25	410	325	260	410	410
T28	455	375	300	455	455
T32	520	445	360	520	520

If there are close spacing or edge distances, reduction factors must be applied to the limiting concrete strength. These may cause the required embedment depth to increase.

For reduced spacing, multiply a reduction factor f_{AN} for each reduced spacing:

Type	Influence of Spacing (mm), where $f_{AN} = 0.5 (S/S_{cr,N}) + 0.5$													
	50	60	70	80	90	100	120	140	160	180	200	220	240	260
M10/T10	0.64	0.67	0.69	0.72	0.75	0.78	0.83	0.89	0.94	1.00	1.00	1.00	1.00	1.00
M12/T13	-	0.64	0.66	0.68	0.70	0.73	0.77	0.82	0.86	0.91	0.95	1.00	1.00	1.00
M16/T16	-	-	0.63	0.65	0.67	0.69	0.73	0.77	0.81	0.85	0.88	0.92	0.96	1.00
M20/T20	-	-	-	-	0.63	0.65	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.88
M24/T25	-	-	-	-	-	-	0.64	0.67	0.69	0.71	0.74	0.76	0.79	0.81
T28	-	-	-	-	-	-	-	0.63	0.65	0.67	0.69	0.70	0.72	0.74
T32	-	-	-	-	-	-	-	-	0.63	0.65	0.67	0.68	0.70	0.72

Type	Influence of Spacing (mm), where $f_{AN} = 0.5 (S/S_{cr,N}) + 0.5$													
	280	300	320	340	360	380	400	420	440	460	480	520	560	600
M10/T10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12/T13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M16/T16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M20/T20	0.91	0.94	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M24/T25	0.83	0.86	0.88	0.90	0.93	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
T28	0.76	0.78	0.80	0.81	0.83	0.85	0.87	0.89	0.91	0.93	0.94	0.98	1.00	1.00
T32	0.73	0.75	0.77	0.78	0.80	0.82	0.83	0.85	0.87	0.88	0.90	0.93	0.97	1.00

For reduced edge distance, multiply a reduction factor f_{RN} for each free edge:

Type	Influence of Edge Distance (mm), where $f_{RN} = 0.75 (C/C_{cr,N}) + 0.25$													
	50	60	70	80	90	100	120	140	160	180	200	220	260	300
M10/T10	0.67	0.75	0.83	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12/T13	-	0.66	0.73	0.80	0.86	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M16/T16	-	-	0.65	0.71	0.77	0.83	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M20/T20	-	-	-	-	0.65	0.69	0.78	0.87	0.96	1.00	1.00	1.00	1.00	1.00
M24/T25	-	-	-	-	-	-	0.68	0.75	0.82	0.89	0.96	1.00	1.00	1.00
T28	-	-	-	-	-	-	-	0.64	0.69	0.75	0.81	0.86	1.00	1.00
T32	-	-	-	-	-	-	-	-	0.65	0.70	0.75	0.80	0.90	1.00

Influence of application location in cracked or non-cracked concrete:

Application Type	f_{Crack}
Cracked Concrete	1.0
Non-Cracked Concrete	1.4

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

Design Approach #2: Design Resistance For Ultimate Loads

#2.1 Calculate the ultimate applied tensile and shear forces from the end-moments and effective lever arm.

#2.2 Obtain the design resistance forces due to limiting bond strength, concrete strength, and steel strength.

#2.3 Perform the necessary checks to ensure adequate safety.

Superfix recommends the use of software or spreadsheet for such iterative analysis.

Tension Analysis

$F_{N,Bond} = \{n.\ \pi.\ h_s.\ f_{Bond}\} \ / \ \{(1000).\ (1.2).\ (1.4)\}$ [kN]
where **n** is the number of rebars resisting tensile loads

$F_{N,Concrete} = \{n.\ (7.2).\ (f_{CU})^{0.5}.\ (h_s)^{1.5}.\ f_{Crack}.\ f_{AN}.\ f_{RN}\} \ / \ \{(1000).\ (1.2).\ (1.5)\}$ [kN]
where **n** is the number of rebars resisting tensile loads

Note: For a group of rebars subjected to tensile load (usually the top row of rebars), the lowest value of $\mathbf{F_{N,Concrete}}$ applies after accounting for the various factors due to site constraints.

For reduced spacing, multiply a reduction factor f_{AN} for each reduced spacing:

Type	Influence of Spacing (mm), where $f_{AN} = 0.5\ (S/S_{cr,N}) + 0.5$													
	50	60	70	80	90	100	120	140	160	180	200	220	240	260
M10/T10	0.64	0.67	0.69	0.72	0.75	0.78	0.83	0.89	0.94	1.00	1.00	1.00	1.00	1.00
M12/T13	-	0.64	0.66	0.68	0.70	0.73	0.77	0.82	0.86	0.91	0.95	1.00	1.00	1.00
M16/T16	-	-	0.63	0.65	0.67	0.69	0.73	0.77	0.81	0.85	0.88	0.92	0.96	1.00
M20/T20	-	-	-	-	0.63	0.65	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.88
M24/T25	-	-	-	-	-	-	0.64	0.67	0.69	0.71	0.74	0.76	0.79	0.81
T28	-	-	-	-	-	-	-	0.63	0.65	0.67	0.69	0.70	0.72	0.74
T32	-	-	-	-	-	-	-	-	0.63	0.65	0.67	0.68	0.70	0.72

Type	Influence of Spacing (mm), where $f_{AN} = 0.5\ (S/S_{cr,N}) + 0.5$													
	280	300	320	340	360	380	400	420	440	460	480	520	560	600
M10/T10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12/T13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M16/T16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M20/T20	0.91	0.94	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M24/T25	0.83	0.86	0.88	0.90	0.93	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
T28	0.76	0.78	0.80	0.81	0.83	0.85	0.87	0.89	0.91	0.93	0.94	0.98	1.00	1.00
T32	0.73	0.75	0.77	0.78	0.80	0.82	0.83	0.85	0.87	0.88	0.90	0.93	0.97	1.00

For reduced edge distance, multiply a reduction factor f_{RN} for each free edge:

Type	Influence of Edge Distance (mm), where $f_{RN} = 0.75\ (C/C_{cr,N}) + 0.25$													
	50	60	70	80	90	100	120	140	160	180	200	220	260	300
M10/T10	0.67	0.75	0.83	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12/T13	-	0.66	0.73	0.80	0.86	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M16/T16	-	-	0.65	0.71	0.77	0.83	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M20/T20	-	-	-	-	0.65	0.69	0.78	0.87	0.96	1.00	1.00	1.00	1.00	1.00
M24/T25	-	-	-	-	-	-	0.68	0.75	0.82	0.89	0.96	1.00	1.00	1.00
T28	-	-	-	-	-	-	-	0.64	0.69	0.75	0.81	0.86	1.00	1.00
T32	-	-	-	-	-	-	-	-	0.65	0.70	0.75	0.80	0.90	1.00

Influence of application location in cracked or non-cracked concrete:

Application Type	f_{Crack}
Cracked Concrete	1.0
Non-Cracked Concrete	1.4

$F_{N,Steel} = \{n. \pi. (d^2/4). f_y\} \ / \ \{(1000). (1.15)\}$ [kN]

where **n** is the number of rebars resisting tensile loads

The design tensile resistance shall be:

$\mathbf{F_{N,Design} = minimum\ (F_{N,Bond}, F_{N,Concrete}, F_{N,Steel})}$

Shear Analysis

$F_{V,Bond} = \{n. (0.6). (\tan \alpha_f). \pi. d. h_s. f_{Bond}\} \ / \ \{(1000). (1.4)\}$ [kN]

Where **n** is the number of rebars resisting shear loads

Influence of type of concrete connection:

Connection Type	$\tan \alpha_f$
Smooth interface, as in untreated concrete	0.7
Roughened or castellated joint	1.4

$F_{V,Concrete} = \{0.45. d^{0.5}. (h_s/d)^{0.2}. f_{CU}^{0.5}. c_1^{1.5}. f_\alpha. f_{ER}.(A_c/A_0)\} \ / \ \{(1000).(1.2).(1.5)\}$ [kN]

Where $\mathbf{c_1}$ is the reduced edge distance of the post-installed rebars

$\mathbf{f_\alpha}$ accounts for the applied load direction in relation to the reduced free edge

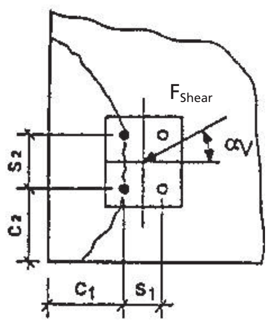
$\mathbf{f_{ER}}$ accounts for the installation position in cracked or non-cracked concrete, and the type of edge reinforcement used

$\mathbf{A_0}$ is the area of concrete cone of an individual rebar at the lateral concrete surface not affected by edges parallel to the assumed loading direction

$\mathbf{A_C}$ is the actual area of concrete cone of the rebars at the lateral concrete surface

Influence of shear load direction:

Shear Load Direction	f_α
For $0° \le \alpha_v \le 55°$	1.0
For $55° \le \alpha_v \le 90°$	$1 / (\cos \alpha_v + 0.5 \sin \alpha_v)$
For $90° \le \alpha_v \le 180°$	2.0

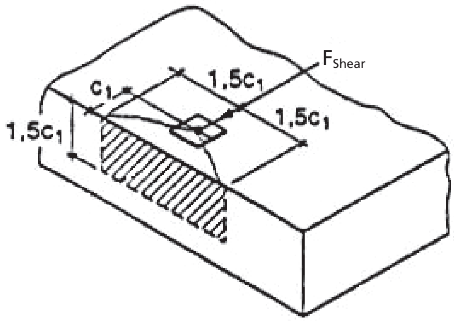


Influence of type of reinforcement and application in cracked or non-cracked concrete:

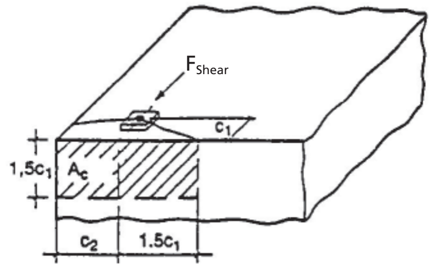
Application Type	f_{ER}
Anchorage in cracked concrete without edge reinforcement or stirrups	1.0
Anchorage in cracked concrete with straight edge reinforcement (≥ ∅ 12 mm)	1.2
Anchorage in cracked concrete with edge reinforcement and closely spaced stirrups (≤ 100 mm), anchorage in non-cracked concrete	1.4

The following are examples to calculate A_0 and A_c:

$A_0 = 4.5\ c_1^2$

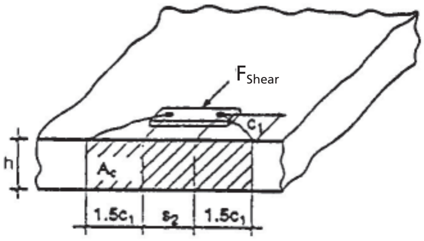


Example: $A_c = (1.5\ c_1).(1.5\ c_1 + c_2)$



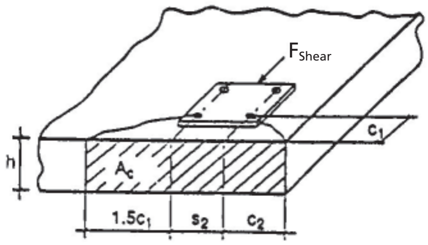
Provided
$h > 1.5\ c_1$
$c_2 \leq 1.5\ c_1$

Example: $A_c = (3c_1 + s_2).(h)$



Provided
$h \leq 1.5\ c_1$
$s_2 \leq 3\ c_1$

Example: $A_c = (1.5\ c_1 + s_1 + c_2)$



Provided
$h \leq 1.5\ c_1$
$s_2 \leq 3\ c_1$
$c_2 \leq 1.5\ c_1$

Note that the concrete shear capacity of the row of rebars nearest the free edge governs. The contribution of the inner rows of rebars must not be included.

$F_{V,Steel} = \{n. (0.6). (\tan \alpha_f). \pi. (d^2/4). f_y\} \ / \ \{(1000). (1.15)\}$ [kN]

Where **n** is the number of rebars resisting shear loads

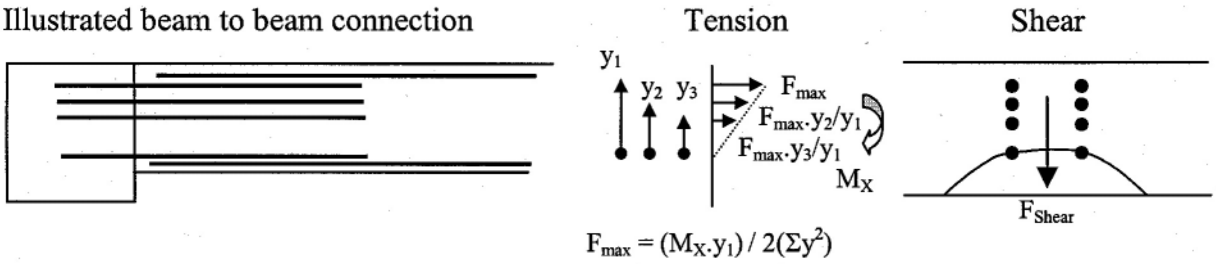
Influence of type of concrete connection:

Connection Type	tan α_f
Smooth interface, as in untreated concrete	0.7
Roughened or castellated joint	1.4

The design shear resistance shall be:

$F_{V,Design}$ = minimum ($F_{V,Bond}$, $F_{V,Concrete}$, $F_{V,Steel}$)

Checks to ensure adequate safety



Check worst-case tensile load (top row, single rebar):

$F_{max} / (F_{N,Design}/n) \leq 1$, where **n** is the number of rebars resisting tensile forces

Check worst-case shear load (bottom row rebars):

$F_{Shear} / F_{V,Design} \leq 1$

Check for safety of combined-load interaction for the whole group:

$$\left(\frac{F_z}{F_{N,Design}}\right)^N + \left(\frac{F_{Shear}}{F_{V,Design}}\right)^N \leq 1,$$

where **N** = 1.5 for all modes of failure

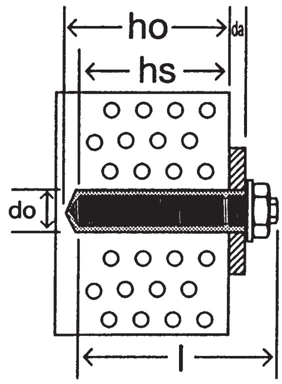
Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

21. Superfix Epoxy-Acrylate System – SEA

The system consists of a blended epoxy acrylate resin, and a hardener contained within a twin-compartment cartridge. Fast curing and of low odour, fastening systems installed using the SEA do not increase the stress within the existing concrete structures. The specially designed nozzle ensures full mixing of the chemicals – when properly mixed, the SEA should be uniform grey or cream colour.

Resin – cream white. Hardener – black or cream.
Shelf life – one year from date of manufacture for unopened cartridge.
Recommended storage – dry, air-conditioned room (20°C – 27°C).

Features:
Medium to high load, adhesive anchor.
Installation does not increase the stress within existing structures.
Fast cure in both dry and moist base material.
Close anchor spacing and edge distances.
Ideal for general medium load applications.
Galvanised steel, or stainless steel A4/316, or stainless steel A2/304.

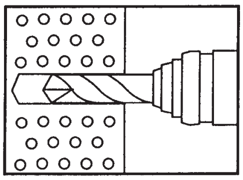


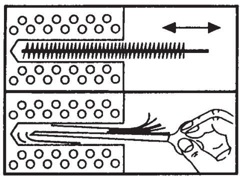
Product Range And Installation Data

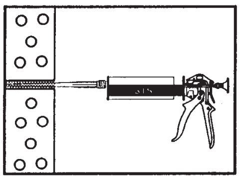
SEA	Description	Minimum Chemical Volume (ml)	Fixture Thickness d_a (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole d_0 x h_0 (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Tighten Torque (Nm)
M8	M 8 x 110	5	20	110	9	10 x 83	80	10
M10	M 10 x 130	7	30	130	11	12 x 94	90	20
M10	M 10 x 165	7	65	165	11	12 x 94	90	20
M12	M 12 x 160	12	35	160	14	14 x 114	110	40
M12	M 12 x 180	12	55	180	14	14 x 114	110	40
M16	M 16 x 165	22	20	165	18	18 x 130	125	80
M16	M 16 x 190	22	45	190	18	18 x 130	125	80
M20	M 20 x 220	56	25	220	22	24 x 176	170	150
M20	M 20 x 260	56	65	260	22	24 x 176	170	150
M24	M 24 x 260	87	20	260	27	28 x 216	210	200
M24	M 24 x 300	87	60	300	27	28 x 216	210	200

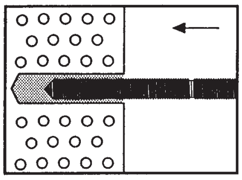
SEA	Description	Minimum Chemical Volume (ml)	Drill Hole d_0 x h_0 (mm)	Characteristic Setting Depth $h_{s\,cr}$ (mm)
T10	T10 Rebar	8.3	13 x 94	90
T13	T13 Rebar	15.3	16 x 114	110
T16	T16 Rebar	27.3	20 x 130	125
T20	T20 Rebar	57.6	25 x 176	170
T25	T25 Rebar	101.8	30 x 216	210

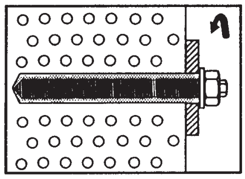
Cure Time	Indoor — 27°C (Dry)	Outdoor – ≥ 30°C (Dry)	Indoor — 27°C (In Standing Water)	Outdoor – ≥ 30°C (In Standing Water)
SEA	90 mins	60 mins	300 mins	180 mins


Drill to specified diameter and depth.


Clean the hole with nylon brush and blowout pump.


Inject chemical from the base of the hole towards the surface.


Insert anchor into the hole using a twisting motion.


After the specified cure time, install fixture and tighten to the specified torque.

Technical Specifications (Anchor Design Concept)

SEA	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Concrete Thickness h_{min} (mm)	Min. Reinforced Concrete Thickness h_{min} (mm)
M8	40	140	40	105	120	105
M10/T10	45	160	45	135	130	115
M12/T13	50	190	50	165	150	135
M16/T16	60	230	60	195	165	155
M20/T20	80	300	80	255	210	200
M24/T25	100	370	100	290	250	250

SEA (Steel Grade 5.6)	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
M8	12.9	4.2	0.1	10.8	5.1	4.2
M10	21.6	7.1	0.1	16.0	7.6	6.3
M12	33.9	11.2	0.15	23.4	11.1	9.2
M16	46.3	15.3	0.2	37.8	18.0	15.0
M20	74.0	24.5	0.25	68.0	32.3	26.9
M24	101.8	33.7	0.3	93.2	44.3	36.9

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- For installation in standing water conditions, multiply a reduction factor of 0.8 for all tensile loads.
- All loads are derived from static load tests on non-cracked concrete of $f_{CU} = 30$ N/mm^2, apply adjustment factor f_B for other concrete grades.

* **Safe loads are for bolts of Steel Grade 5.6 and will differ for other steel grade values.**

SEA (Rebar 460 N/mm^2)	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
T10	26.8	8.8	0.1	36.1	17.1	14.3
T13	42.6	14.1	0.15	54.7	*21.7	21.7
T16	59.6	19.7	0.2	75.0	*29.7	29.7
T20	101.5	33.6	0.25	130.8	*51.9	51.9
T25	156.5	51.8	0.3	176.3	*69.9	69.9

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- For installation in standing water conditions, multiply a reduction factor of 0.8 for all tensile loads.
- All loads are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2, apply adjustment factor f_B for other concrete grades.
- Safe loads are for rebars of characteristic strength 460 N/mm^2.

* **Considering rebars as anchors, the mode of failure at the specified edge distances under shear load is governed by the limiting concrete strength. Hence, the factor of safety remains at 2.52.**

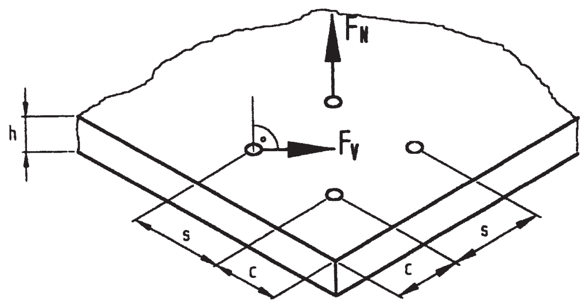
Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	40	50	60	70	80	100	120	140	180	220	260	300	340	370
M8	0.68	0.71	0.74	0.78	0.81	0.87	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	0.69	0.72	0.75	0.78	0.83	0.89	0.94	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	0.67	0.69	0.72	0.74	0.79	0.83	0.88	0.98	1.00	1.00	1.00	1.00	1.00
M16	-	-	0.67	0.69	0.71	0.75	0.78	0.82	0.90	0.98	1.00	1.00	1.00	1.00
M20	-	-	-	-	0.67	0.70	0.73	0.76	0.82	0.88	0.94	1.00	1.00	1.00
M24	-	-	-	-	-	0.67	0.70	0.72	0.77	0.82	0.87	0.91	0.96	1.00

Type	Reduction Factor Table For Tension – Edge Distance (mm)													
	40	50	60	70	80	100	120	140	160	180	200	230	260	290
M8	0.69	0.74	0.79	0.83	0.88	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	0.69	0.72	0.76	0.80	0.87	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	0.65	0.68	0.71	0.74	0.80	0.86	0.92	0.98	1.00	1.00	1.00	1.00	1.00
M16	-	-	0.65	0.68	0.71	0.76	0.81	0.86	0.91	0.96	1.00	1.00	1.00	1.00
M20	-	-	-	-	0.66	0.70	0.74	0.77	0.81	0.85	0.89	0.95	1.00	1.00
M24	-	-	-	-	-	0.67	0.71	0.74	0.78	0.81	0.84	0.90	0.95	1.00

Type	Reduction Factor Table For Shear – Edge Distance (mm)													
	40	50	60	70	80	100	120	140	160	180	200	230	260	290
M8	0.35	0.45	0.55	0.65	0.75	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	0.34	0.42	0.49	0.57	0.73	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	0.27	0.33	0.40	0.46	0.59	0.71	0.84	0.97	1.00	1.00	1.00	1.00	1.00
M16	-	-	0.27	0.33	0.38	0.49	0.60	0.70	0.81	0.92	1.00	1.00	1.00	1.00
M20	-	-	-	-	0.28	0.36	0.44	0.53	0.61	0.69	0.77	0.90	1.00	1.00
M24	-	-	-	-	-	0.31	0.38	0.46	0.53	0.60	0.67	0.78	0.89	1.00

Superfix Recommendations For SEA (Anchor Design Concept)

- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances $< C_{cr}$, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.45 (S / S_{cr}) + 0.55$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 0.5 (C / C_{cr}) + 0.5$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = 1.05 (C / C_{cr}) - 0.05$

Formula no. 4: Influence of concrete strength:

$f_B = 0.02 (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\,cr})^2$

Where $h_{s\,min} \geq 0.5\, h_{s\,cr}$

Concrete grade range:

$15 \leq f_{CU} \leq 60$

- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

Rebar Design Concept

For details, see **Partial Factors of Safety** on **Page 19** and **Rebar Design Principles** on **Page 22**.

SEA	Nominal Bar Diameter d (mm)	Drill Hole Diameter d_0 (mm)	Minimum Spacing S_{min} (mm)	Char. Spacing $S_{cr,N}$ (mm)	Minimum Edge Dist. C_{min} (mm)	Char. Edge. Dist. $C_{cr,N}$ (mm)	Char. Bond Strength f_{Bond} (N/mm^2)	Char. Steel Strength f_y (N/mm^2)
M10	10	12	45	180	45	90	9.5	≥ 460
T10	10	13	45	180	45	90		
M12	12	14	55	220	55	110		
T13	13	16	55	220	55	110		
M16	16	18	65	260	65	130		
T16	16	20	65	260	65	130		
M20	20	24	85	340	85	170		
T20	20	25	85	340	85	170		
M24	24	28	105	420	105	210		
T25	25	30	105	420	105	210		
T28	28	35	135	540	135	270		
T32	32	40	150	600	150	300		

Design Approach #1: Ultimate Limit State (ULS) Design

#1.1 $F_{N,Bond} = \pi.\ d.\ h_s.\ f_{Bond}\ /\ 1000$ [kN]

#1.2 $F_{N,Concrete} = (7.2).\ (f_{CU})^{0.5}.\ (h_s)^{1.5}.f_{Crack}.\ f_{AN}.f_{RN}\ /\ 1000$ [kN]

#1.3 $F_{N,Steel} = \pi.\ (d^2/4).f_y\ /1000$ [kN]

Ensure that: $F_{N,Bond}/1.2 > F_{N,Steel}$

$F_{N,Concrete} > F_{N,Steel}$

The design embedment depth shall be the greater value of $\mathbf{h_s}$ from #1.1 and #1.2. Superfix recommends the use of software or spreadsheet for such iterative analysis.

With no spacing and edge distance constraints, installation in f_{CU} = 30 N/mm^2 concrete:

SEA	Min. Embedment Due To Limiting Bond Strength (mm) $F_{N,Bond}/1.2 > F_{N,Steel}$	Min. Embedment In Cracked Concrete Due To Limiting Concrete Strength (mm) $F_{N,Concrete} > F_{N,Steel}$	Min. Embedment In Non-Cracked Concrete Due to Limiting Concrete Strength (mm) $F_{N,Concrete} > F_{N,Steel}$	Design Embedment For Cracked Concrete (mm)	Design Embedment For Non-Cracked Concrete (mm)
M10	150	95	80	150	150
T10	150	95	80	150	150
M12	165	125	100	165	165
T13	190	135	110	190	190
M16	235	180	145	235	235
T16	235	180	145	235	235
M20	295	240	190	295	295
T20	295	240	190	295	295
M24	335	305	245	335	335
T25	365	325	260	365	365
T28	410	375	300	410	410
T32	465	445	360	465	465

If there are close spacing or edge distances, reduction factors must be applied to the limiting concrete strength. These may cause the required embedment depth to increase.

For reduced spacing, multiply a reduction factor f_{AN} for each reduced spacing:

Type	Influence of Spacing (mm), where $f_{AN} = 0.5 (S/S_{cr,N}) + 0.5$													
	50	60	70	80	90	100	120	140	160	180	200	220	240	260
M10/T10	0.64	0.67	0.69	0.72	0.75	0.78	0.83	0.89	0.94	1.00	1.00	1.00	1.00	1.00
M12/T13	-	0.64	0.66	0.68	0.70	0.73	0.77	0.82	0.86	0.91	0.95	1.00	1.00	1.00
M16/T16	-	-	0.63	0.65	0.67	0.69	0.73	0.77	0.81	0.85	0.88	0.92	0.96	1.00
M20/T20	-	-	-	-	0.63	0.65	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.88
M24/T25	-	-	-	-	-	-	0.64	0.67	0.69	0.71	0.74	0.76	0.79	0.81
T28	-	-	-	-	-	-	-	0.63	0.65	0.67	0.69	0.70	0.72	0.74
T32	-	-	-	-	-	-	-	-	0.63	0.65	0.67	0.68	0.70	0.72

Type	Influence of Spacing (mm), where $f_{AN} = 0.5 (S/S_{cr,N}) + 0.5$													
	280	300	320	340	360	380	400	420	440	460	480	520	560	600
M10/T10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12/T13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M16/T16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M20/T20	0.91	0.94	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M24/T25	0.83	0.86	0.88	0.90	0.93	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
T28	0.76	0.78	0.80	0.81	0.83	0.85	0.87	0.89	0.91	0.93	0.94	0.98	1.00	1.00
T32	0.73	0.75	0.77	0.78	0.80	0.82	0.83	0.85	0.87	0.88	0.90	0.93	0.97	1.00

For reduced edge distance, multiply a reduction factor f_{RN} for each free edge:

Type	Influence of Edge Distance (mm), where $f_{RN} = 0.75 (C/C_{cr,N}) + 0.25$													
	50	60	70	80	90	100	120	140	160	180	200	220	260	300
M10/T10	0.67	0.75	0.83	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12/T13	-	0.66	0.73	0.80	0.86	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M16/T16	-	-	0.65	0.71	0.77	0.83	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M20/T20	-	-	-	-	0.65	0.69	0.78	0.87	0.96	1.00	1.00	1.00	1.00	1.00
M24/T25	-	-	-	-	-	-	0.68	0.75	0.82	0.89	0.96	1.00	1.00	1.00
T28	-	-	-	-	-	-	-	0.64	0.69	0.75	0.81	0.86	1.00	1.00
T32	-	-	-	-	-	-	-	-	0.65	0.70	0.75	0.80	0.90	1.00

Influence of application location in cracked or non-cracked concrete:

Application Type	f_{Crack}
Cracked Concrete	1.0
Non-Cracked Concrete	1.4

Design Approach #2: Design Resistance For Ultimate Loads

#2.1 Calculate the ultimate applied tensile and shear forces from the end-moments and effective lever arm.

#2.2 Obtain the design resistance forces due to limiting bond strength, concrete strength, and steel strength.

#2.3 Perform the necessary checks to ensure adequate safety.

Superfix recommends the use of software or spreadsheet for such iterative analysis.

Tension Analysis

$F_{N,Bond} = \{n.\ \pi.\ h_s.\ f_{Bond}\} \ / \ \{(1000).\ (1.2).\ (1.4)\}$ [kN]

where **n** is the number of rebars resisting tensile loads

$F_{N,Concrete} = \{n.\ (7.2).\ (f_{CU})^{0.5}.\ (h_s)^{1.5}.\ f_{Crack}.\ f_{AN}.\ f_{RN}\} \ / \ \{(1000).\ (1.2).\ (1.5)\}$ [kN]

where **n** is the number of rebars resisting tensile loads

Note: For a group of rebars subjected to tensile load (usually the top row of rebars), the lowest value of $\mathbf{F_{N,Concrete}}$ applies after accounting for the various factors due to site constraints.

For reduced spacing, multiply a reduction factor f_{AN} for each reduced spacing:

Type	Influence of Spacing (mm), where $f_{AN} = 0.5\ (S/S_{cr,N}) + 0.5$													
	50	60	70	80	90	100	120	140	160	180	200	220	240	260
M10/T10	0.64	0.67	0.69	0.72	0.75	0.78	0.83	0.89	0.94	1.00	1.00	1.00	1.00	1.00
M12/T13	-	0.64	0.66	0.68	0.70	0.73	0.77	0.82	0.86	0.91	0.95	1.00	1.00	1.00
M16/T16	-	-	0.63	0.65	0.67	0.69	0.73	0.77	0.81	0.85	0.88	0.92	0.96	1.00
M20/T20	-	-	-	-	0.63	0.65	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.88
M24/T25	-	-	-	-	-	-	0.64	0.67	0.69	0.71	0.74	0.76	0.79	0.81
T28	-	-	-	-	-	-	-	0.63	0.65	0.67	0.69	0.70	0.72	0.74
T32	-	-	-	-	-	-	-	-	0.63	0.65	0.67	0.68	0.70	0.72

Type	Influence of Spacing (mm), where $f_{AN} = 0.5\ (S/S_{cr,N}) + 0.5$													
	280	300	320	340	360	380	400	420	440	460	480	520	560	600
M10/T10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12/T13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M16/T16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M20/T20	0.91	0.94	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M24/T25	0.83	0.86	0.88	0.90	0.93	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
T28	0.76	0.78	0.80	0.81	0.83	0.85	0.87	0.89	0.91	0.93	0.94	0.98	1.00	1.00
T32	0.73	0.75	0.77	0.78	0.80	0.82	0.83	0.85	0.87	0.88	0.90	0.93	0.97	1.00

For reduced edge distance, multiply a reduction factor f_{RN} for each free edge:

Type	Influence of Edge Distance (mm), where $f_{RN} = 0.75\ (C/C_{cr,N}) + 0.25$													
	50	60	70	80	90	100	120	140	160	180	200	220	260	300
M10/T10	0.67	0.75	0.83	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12/T13	-	0.66	0.73	0.80	0.86	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M16/T16	-	-	0.65	0.71	0.77	0.83	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M20/T20	-	-	-	-	0.65	0.69	0.78	0.87	0.96	1.00	1.00	1.00	1.00	1.00
M24/T25	-	-	-	-	-	-	0.68	0.75	0.82	0.89	0.96	1.00	1.00	1.00
T28	-	-	-	-	-	-	-	0.64	0.69	0.75	0.81	0.86	1.00	1.00
T32	-	-	-	-	-	-	-	-	0.65	0.70	0.75	0.80	0.90	1.00

Influence of application location in cracked or non-cracked concrete:

Application Type	f_{Crack}
Cracked Concrete	1.0
Non-Cracked Concrete	1.4

$F_{N,Steel} = \{n.\pi.(d^2/4).f_y\} / \{(1000).(1.15)\}$ [kN]

where **n** is the number of rebars resisting tensile loads

The design tensile resistance shall be:
$F_{N,Design}$ = minimum ($F_{N,Bond}$, $F_{N,Concrete}$, $F_{N,Steel}$)

Shear Analysis

$F_{V,Bond} = \{n.(0.6).(\tan\alpha_f).\pi.d.h_s.f_{Bond}\} / \{(1000).(1.4)\}$ [kN]

Where **n** is the number of rebars resisting shear loads

Influence of type of concrete connection:

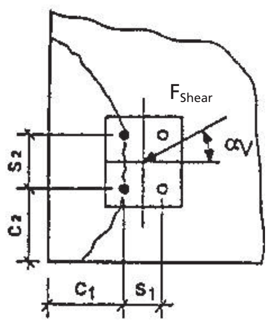
Connection Type	$\tan\alpha_f$
Smooth interface, as in untreated concrete	0.7
Roughened or castellated joint	1.4

$F_{V,Concrete} = \{0.45.d^{0.5}.(h_s/d)^{0.2}.f_{CU}^{0.5}.c_1^{1.5}.f_\alpha.f_{ER}.(A_c/A_0)\} / \{(1000).(1.2).(1.5)\}$ [kN]

Where **c_1** is the reduced edge distance of the post-installed rebars
f_α accounts for the applied load direction in relation to the reduced free edge
f_{ER} accounts for the installation position in cracked or non-cracked concrete, and the type of edge reinforcement used
A_0 is the area of concrete cone of an individual rebar at the lateral concrete surface not affected by edges parallel to the assumed loading direction
A_C is the actual area of concrete cone of the rebars at the lateral concrete surface

Influence of shear load direction:

Shear Load Direction	f_α
For $0° \le \alpha_v \le 55°$	1.0
For $55° \le \alpha_v \le 90°$	$1 / (\cos\alpha_v + 0.5\sin\alpha_v)$
For $90° \le \alpha_v \le 180°$	2.0

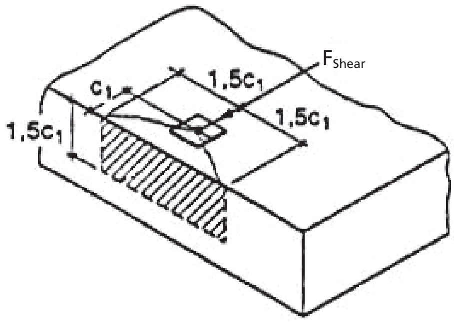


Influence of type of reinforcement and application in cracked or non-cracked concrete:

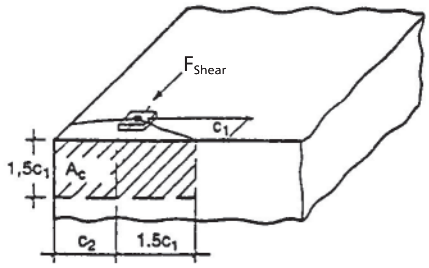
Application Type	f_{ER}
Anchorage in cracked concrete without edge reinforcement or stirrups	1.0
Anchorage in cracked concrete with straight edge reinforcement (≥ ∅ 12 mm)	1.2
Anchorage in cracked concrete with edge reinforcement and closely spaced stirrups (≤ 100 mm), anchorage in non-cracked concrete	1.4

The following are examples to calculate A_0 and A_c:

$A_0 = 4.5\ c_1^2$

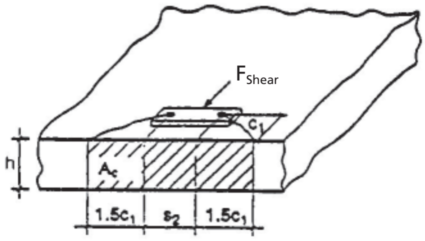


Example: $A_c = (1.5\ c_1).(1.5\ c_1 + c_2)$



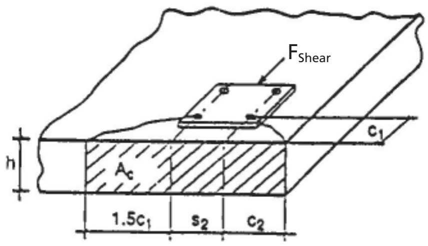
Provided
$h > 1.5\ c_1$
$c_2 \leq 1.5\ c_1$

Example: $A_c = (3c_1 + s_2).(h)$



Provided
$h \leq 1.5\ c_1$
$s_2 \leq 3\ c_1$

Example: $A_c = (1.5\ c_1 + s_2 + c_2)$



Provided
$h \leq 1.5\ c_1$
$s_2 \leq 3\ c_1$
$c_2 \leq 1.5\ c_1$

Note that the concrete shear capacity of the row of rebars nearest the free edge governs. The contribution of the inner rows of rebars must not be included.

$F_{V,Steel} = \{n. (0.6). (\tan \alpha_f). \pi. (d^2/4). f_y\} \,/\, \{(1000). (1.15)\}$ [kN]

Where **n** is the number of rebars resisting shear loads

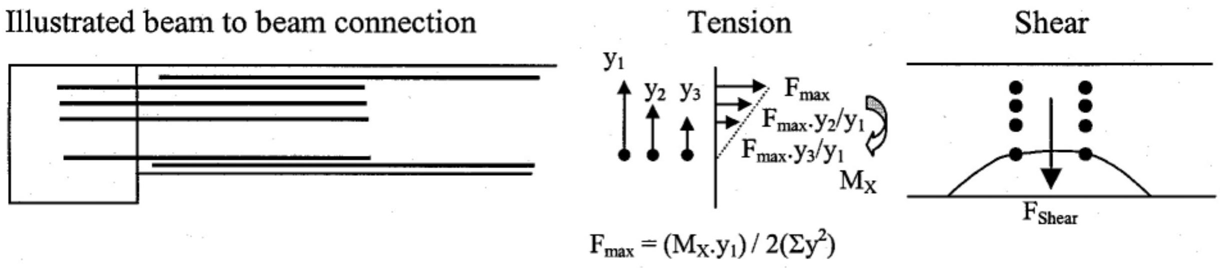
Influence of type of concrete connection:

Connection Type	tan α_f
Smooth interface, as in untreated concrete	0.7
Roughened or castellated joint	1.4

The design shear resistance shall be:

$F_{V,Design}$ = minimum ($F_{V,Bond}$, $F_{V,Concrete}$, $F_{V,Steel}$)

Checks to ensure adequate safety



Check worst-case tensile load (top row, single rebar):

F_{max} / ($F_{N,Design}$/n) ≤ 1, where **n** is the number of rebars resisting tensile forces

Check worst-case shear load (bottom row rebars):

F_{Shear} / $F_{V,Design}$ ≤ 1

Check for safety of combined-load interaction for the whole group:

$$\left(\frac{F_z}{F_{N,Design}}\right)^N + \left(\frac{F_{Shear}}{F_{V,Design}}\right)^N \leq 1,$$

where **N** = 1.5 for all modes of failure

22. Superfix Epoxy System – SES

Epoxy-Tie ET is a two-component, 100% epoxy based adhesive for use as a high strength, non-shrink anchor grouting material. Resin and hardener are dispensed and mixed simultaneously through the mixing nozzle – ET should be uniform medium grey colour when properly mixed. With low odour, fastening systems installed using the ET do not increase the stress within the existing concrete structures. Other applications include anchor grouting, bonding hardened concrete to hardened concrete, pressure injection of crack widths of 3/16" – 3/4".

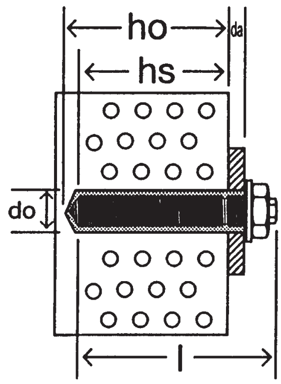
Resin – white. Hardener – black; amine based.
Shelf life – two years from date of manufacture for unopened cartridge.
ET meets the ASTM C-881-90 specification for Type I, II, IV and V Grade 3, Class B, and C.
Recommended storage – dry, air-conditioned room (20°C – 27°C).

Epoxy-Tie ETF is a two-component, 100% epoxy based adhesive for use as a high strength, fast cure, non-shrink anchor grouting material. Resin and hardener are dispensed and mixed simultaneously through the mixing nozzle – ETF should be uniform dark grey colour when properly mixed. Fastening systems installed using the ETF do not increase the stress within the existing concrete structures. Other applications include anchor grouting, bonding hardened concrete to hardened concrete.

Resin – white. Hardener – black; mercaptan based.
Shelf life – two years from date of manufacture for unopened cartridge.
ETF meets the ASTM C-881-90* specification for Type I, II, IV and V Grade 3, Class B, and C.
Recommended storage – dry, air-conditioned room (20°C – 27°C).

***Modified for viscosity and gel time.**

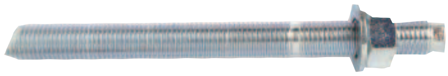
Features:
Very high load, adhesive anchor.
Installation does not increase the stress within existing structures.
Specific cure time in both dry and moist base material.
Close anchor spacing and edge distances.
Ideal for general very high load applications, critical structural fixings.
Galvanised steel, or stainless steel A4/316, or stainless steel A2/304.



Product Range And Installation Data

Please note that the ET & ETF use similar epoxy resins, and that the ETF uses a different hardener to speed up the cure time. Although the load performances vary slightly, the values reflected subsequently represent the lower of both the epoxy systems.

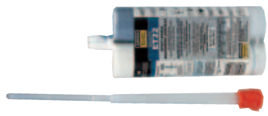
Product Range And Installation Data



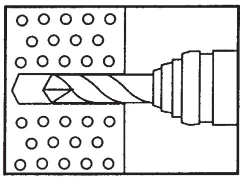
SES-ET SES-ETF	Description	Minimum Chemical Volume (ml)	Fixture Thickness d_a (mm)	Anchor Length l (mm)	Fixture Hole (mm)	Drill Hole $d_0 \times h_0$ (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Tighten Torque (Nm)
M8	M 8 x 110	5	20	110	9	10 x 83	80	10
M10	M 10 x 130	7	30	130	11	12 x 94	90	20
M10	M 10 x 165	7	65	165	11	12 x 94	90	20
M12	M 12 x 160	12	35	160	14	14 x 114	110	40
M12	M 12 x 180	12	55	180	14	14 x 114	110	40
M16	M 16 x 165	22	20	165	18	18 x 130	125	80
M16	M 16 x 190	22	45	190	18	18 x 130	125	80
M20	M 20 x 220	56	25	220	22	24 x 176	170	150
M20	M 20 x 260	56	65	260	22	24 x 176	170	150
M24	M 24 x 260	87	20	260	27	28 x 216	210	200
M24	M 24 x 300	87	60	300	27	28 x 216	210	200

SES-ET SES-ETF	Description	Minimum Chemical Volume (ml)	Drill Hole $d_0 \times h_0$ (mm)	Characteristic Setting Depth $h_{s\,cr}$ (mm)
T10	T10 Rebar	8.3	13 x 94	90
T13	T13 Rebar	15.3	16 x 114	110
T16	T16 Rebar	27.3	20 x 130	125
T20	T20 Rebar	57.6	25 x 176	170
T25	T25 Rebar	101.8	30 x 216	210

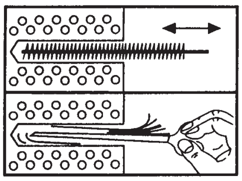
Cure Time	Indoor – 27°C (Dry)	Outdoor – ≥ 30°C (Dry)	Indoor – 27°C (In Standing Water)	Outdoor – ≥ 30°C (In Standing Water)
SES-ET	8 hrs	6 hrs	32 hrs	28 hrs
SES-ETF	1 hr	1 hr	20 hrs	14 hrs



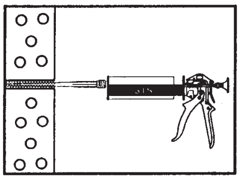
Installation



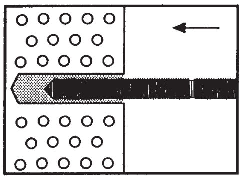
Drill to specified diameter and depth.



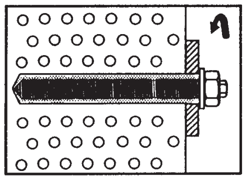
Clean the hole with nylon brush and blowout pump.



Inject chemical from the base of the hole towards the surface.



Insert anchor into the hole using a twisting motion.



After the specified cure time, install fixture and tighten to the specified torque.

Technical Specifications (Anchor Design Concept)

SES-ET SES-ETF	Min. Spacing S_{min} (mm)	Char. Spacing S_{cr} (mm)	Min. Edge Dist C_{min} (mm)	Char. Edge Dist C_{cr} (mm)	Min. Normal Concrete Thickness h_{min} (mm)	Min. Reinforced Concrete Thickness h_{min} (mm)
M8	40	140	40	120	120	105
M10/T10	45	160	45	140	130	115
M12/T13	50	190	50	160	150	135
M16/T16	60	230	60	190	165	155
M20/T20	80	310	80	260	210	200
M24/T25	100	400	100	340	250	250

SES-ET SES-ETF (Steel Grade 5.6)	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
M8	18.2	6.0	0.1	10.8	5.1	4.2
M10	28.7	9.5	0.1	16.0	7.6	6.3
M12	42.0	13.9	0.15	23.4	11.1	9.2
M16	58.1	19.2	0.2	37.8	18.0	15.0
M20	116.5	38.5	0.25	68.0	32.3	26.9
M24	166.6	55.1	0.25	93.2	44.3	36.9

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- For installation in standing water conditions, multiply a reduction factor of 0.8 for all tensile loads.
- All loads are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm², apply adjustment factor f_B for other concrete grades.

★ **Safe loads are for bolts of Steel Grade 5.6 and will differ for other steel grade values.**

SES-ET SES-ETF (Steel Grade 8.8)	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
M8	21.5	7.1	0.1	14.2	6.7	5.6
M10	37.2	12.3	0.1	23.1	11.0	9.1
M12	48.1	15.9	0.15	24.6	11.7	9.7
M16	76.5	25.3	0.2	56.1	26.7	22.2
M20	121.4	40.1	0.25	94.1	44.8	37.3
M24	166.6	55.1	0.25	138.9	66.1	55.1

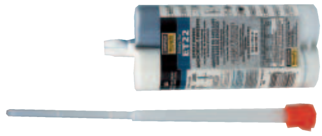
- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- For installation in standing water conditions, multiply a reduction factor of 0.8 for all tensile loads.
- All loads are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm², apply adjustment factor f_B for other concrete grades.

★ **Safe loads are for bolts of Steel Grade 8.8 and will differ for other steel grade values.**

SES-ET SES-ETF (Rebar 460 N/mm²)	Characteristic Tensile Resistance (kN)	Nominal Safe Tensile Resistance F_N (kN)	Acceptable Displacement At Safe Tensile Load δ (mm)	Characteristic Shear Resistance (kN)	Nominal Safe Shear Resistance For $C \geq C_{cr}$ F_v (kN)	Nominal Safe Shear Resistance For $C < C_{cr}$ F_v (kN)
T10	36.1	11.9	0.1	36.1	17.1	14.3
T13	59.2	19.6	0.15	52.3	*20.7	20.7
T16	76.5	25.3	0.2	72.1	*28.6	28.6
T20	121.4	40.1	0.25	134.7	*53.4	53.4
T25	166.6	55.1	0.25	223.9	*88.8	88.8

- Safe loads published are for service conditions. For checks at the Ultimate Limit State, multiply safe loads by a factor of 1.4, and check against the factored applied loads (eg. $1.4G_k + 1.6Q_k$).
- For installation in standing water conditions, multiply a reduction factor of 0.8 for all tensile loads.
- All loads are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm², apply adjustment factor f_B for other concrete grades.
- Safe loads are for rebars of characteristic strength 460 N/mm².

★ **Considering rebars as anchors, the mode of failure at the specified edge distances under shear load is governed by the limiting concrete strength. Hence, the factor of safety remains at 2.52.**



Type	Reduction Factor Table For Tension And Shear – Spacing (mm)													
	40	50	60	70	80	100	120	160	200	240	280	320	360	400
M8	0.70	0.73	0.76	0.79	0.82	0.88	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	0.71	0.74	0.76	0.79	0.84	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	0.69	0.71	0.73	0.76	0.80	0.85	0.93	1.00	1.00	1.00	1.00	1.00	1.00
M16	-	-	0.69	0.71	0.73	0.76	0.80	0.87	0.95	1.00	1.00	1.00	1.00	1.00
M20	-	-	-	-	0.69	0.72	0.74	0.80	0.85	0.91	0.96	1.00	1.00	1.00
M24	-	-	-	-	-	0.69	0.71	0.75	0.79	0.83	0.87	0.92	0.96	1.00

Type	Reduction Factor Table For Tension – Edge Distance (mm)													
	40	50	60	70	80	100	120	140	160	180	220	260	300	340
M8	0.50	0.56	0.63	0.69	0.75	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	0.52	0.57	0.63	0.68	0.79	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	0.48	0.53	0.58	0.63	0.72	0.81	0.91	1.00	1.00	1.00	1.00	1.00	1.00
M16	-	-	0.49	0.53	0.57	0.64	0.72	0.80	0.88	0.96	1.00	1.00	1.00	1.00
M20	-	-	-	-	0.48	0.54	0.60	0.65	0.71	0.77	0.88	1.00	1.00	1.00
M24	-	-	-	-	-	0.47	0.51	0.56	0.60	0.65	0.74	0.82	0.91	1.00

Type	Reduction Factor Table For Shear – Edge Distance (mm)													
	40	50	60	70	80	100	120	140	160	180	220	260	300	340
M8	0.27	0.36	0.45	0.54	0.63	0.82	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M10	-	0.29	0.37	0.45	0.53	0.69	0.84	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12	-	0.24	0.31	0.38	0.45	0.59	0.73	0.86	1.00	1.00	1.00	1.00	1.00	1.00
M16	-	-	0.25	0.31	0.36	0.48	0.59	0.71	0.83	0.94	1.00	1.00	1.00	1.00
M20	-	-	-	-	0.24	0.32	0.41	0.49	0.58	0.66	0.83	1.00	1.00	1.00
M24	-	-	-	-	-	0.22	0.29	0.35	0.42	0.48	0.61	0.74	0.87	1.00

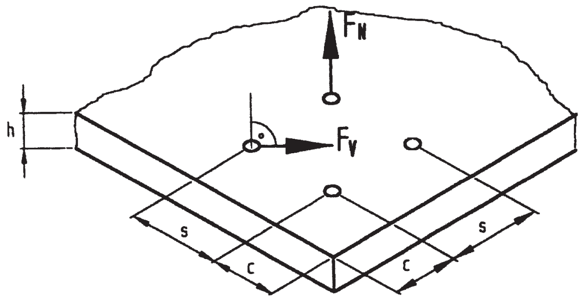
Demonstration Of Bond Strength

SES-ET SES-ETF	Spacing (mm)	Edge Distance (mm)	Embedment Depth (mm)	Ultimate Tensile Load (kN)	Mode Of Failure	Remarks
T32	600	250	320	**498.7**	Rebar	Sample was tested using a small reaction frame (87 mm diameter) to demonstrate the bond strength of SES-ET. In practical situations, anchorage system will fail at about 313 kN to 330 kN because of the limiting strength of concrete (f_{CU} = 30 N/mm^2) at 320 mm embedment.

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

Superfix Recommendations For SES (Anchor Design Concept)

- Anchor groups consist of up to 4 anchors.
- Where there are reduced spacing ($S_{min} \leq S < S_{cr}$) and / or edge distances ($C_{min} \leq C < C_{cr}$), load reduction factors f_A, f_{RN}, f_{RV} have to be determined for each reduced spacing and / or edge distance according to formulae 1 to 3.
- The influence of the concrete strength is calculated according to formula 4.
- The influence of the reduced setting depth is calculated according to formula 5.
- To calculate the safe working load per anchor, F_N or F_V should be multiplied with all the respective reduction factors – example: $F_{N,REC} = F_N \times f_{A1} \times f_{A2} \times f_{RN1} \times f_{RN2} \times f_B \times f_T$.
- The lowest calculated load of an anchor applies for all anchors of the same group for shear, as well as for tension without external applied moments.
- The distance between two anchor groups is $\geq S_{cr}$.
- Where edge distances $< C_{cr}$, there should be nominal concrete reinforcement between the anchor and the edge to enhance the safety against concrete breakout at the edge.



F_N – Nominal safe tensile resistance
F_V – Nominal safe shear resistance
S, S_{min}, S_{cr} – Anchor-to-anchor spacing
C, C_{min}, C_{cr} – Edge distances
h_{min} – Minimum thickness of concrete

Formula no. 1: Reduced spacing, tension & shear:

$f_A = 0.42 (S / S_{cr}) + 0.58$

Formula no. 2: Reduced edge distance, tension:

$f_{RN} = 0.75 (C / C_{cr}) + 0.25$

Formula no. 3: Reduced edge distance, shear:

$f_{RV} = 1.1 (C / C_{cr}) - 0.1$

Formula no. 4: Influence of concrete strength:

$f_B = 0.02 (f_{CU} - 30) + 1$ ≤ 1.1 (Tension)
≤ 1.0 (Shear)

Formula no. 5: Influence of reduced setting depth:

$f_T = (h_s / h_{s\,cr})^2$

Where $h_{s\,min} \geq 0.5\, h_{s\,cr}$

Concrete grade range:

$15 \leq f_{CU} \leq 60$

- For details, see **Partial Factors of Safety** and **Design Principles** on Page 19.

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Rebar Design Concept

For details, see **Partial Factors of Safety** on **Page 19** and **Rebar Design Principles** on **Page 22**.

SES-ET SES-ETF	Nominal Bar Diameter d (mm)	Drill Hole Diameter d_0 (mm)	Minimum Spacing S_{min} (mm)	Char. Spacing $S_{cr,N}$ (mm)	Minimum Edge Dist. C_{min} (mm)	Char. Edge. Dist. $C_{cr,N}$ (mm)	Char. Bond Strength f_{Bond} (N/mm^2)	Char. Steel Strength f_y (N/mm^2)
M10	10	12	45	180	45	90	12.9	≥ 460
T10	10	13	45	180	45	90		
M12	12	14	55	220	55	110		
T13	13	16	55	220	55	110		
M16	16	18	65	260	65	130		
T16	16	20	65	260	65	130		
M20	20	24	85	340	85	170		
T20	20	25	85	340	85	170		
M24	24	28	105	420	105	210		
T25	25	30	105	420	105	210		
T28	28	35	135	540	135	270		
T32	32	40	150	600	150	300		

Design Approach #1: Ultimate Limit State (ULS) Design

#1.1 $F_{N,Bond} = \pi . d . h_s . f_{Bond} / 1000$ [kN]
#1.2 $F_{N,Concrete} = (7.2) . (f_{CU})^{0.5} . (h_s)^{1.5} . f_{Crack} . f_{AN} . f_{RN} / 1000$ [kN]
#1.3 $F_{N,Steel} = \pi . (d^2/4) . f_y / 1000$ [kN]

Ensure that: $F_{N,Bond}/1.2 > F_{N,Steel}$
$F_{N,Concrete} > F_{N,Steel}$

The design embedment depth shall be the greater value of $\mathbf{h_s}$ from #1.1 and #1.2. Superfix recommends the use of software or spreadsheet for such iterative analysis.

With no spacing and edge distance constraints, installation in f_{CU} = 30 N/mm^2 concrete:

SES-ET SES-ETF	Min. Embedment Due To Limiting Bond Strength (mm) $F_{N,Bond}/1.2 > F_{N,Steel}$	Min. Embedment In Cracked Concrete Due To Limiting Concrete Strength (mm) $F_{N,Concrete} > F_{N,Steel}$	Min. Embedment In Non-Cracked Concrete Due to Limiting Concrete Strength (mm) $F_{N,Concrete} > F_{N,Steel}$	Design Embedment For Cracked Concrete (mm)	Design Embedment For Non-Cracked Concrete (mm)
M10	110	95	80	110	110
T10	110	95	80	110	110
M12	120	125	100	125	120
T13	140	135	110	140	140
M16	175	180	145	180	175
T16	175	180	145	180	175
M20	215	240	190	240	215
T20	215	240	190	240	215
M24	250	305	245	305	250
T25	270	325	260	325	270
T28	300	375	300	375	300
T32	345	445	360	445	360

If there are close spacing or edge distances, reduction factors must be applied to the limiting concrete strength. These may cause the required embedment depth to increase.

For reduced spacing, multiply a reduction factor f_{AN} for each reduced spacing:

Type	Influence of Spacing (mm), where $f_{AN} = 0.5 (S/S_{cr,N}) + 0.5$													
	50	60	70	80	90	100	120	140	160	180	200	220	240	260
M10/T10	0.64	0.67	0.69	0.72	0.75	0.78	0.83	0.89	0.94	1.00	1.00	1.00	1.00	1.00
M12/T13	-	0.64	0.66	0.68	0.70	0.73	0.77	0.82	0.86	0.91	0.95	1.00	1.00	1.00
M16/T16	-	-	0.63	0.65	0.67	0.69	0.73	0.77	0.81	0.85	0.88	0.92	0.96	1.00
M20/T20	-	-	-	-	0.63	0.65	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.88
M24/T25	-	-	-	-	-	-	0.64	0.67	0.69	0.71	0.74	0.76	0.79	0.81
T28	-	-	-	-	-	-	-	0.63	0.65	0.67	0.69	0.70	0.72	0.74
T32	-	-	-	-	-	-	-	-	0.63	0.65	0.67	0.68	0.70	0.72

Type	Influence of Spacing (mm), where $f_{AN} = 0.5 (S/S_{cr,N}) + 0.5$													
	280	300	320	340	360	380	400	420	440	460	480	520	560	600
M10/T10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12/T13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M16/T16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M20/T20	0.91	0.94	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M24/T25	0.83	0.86	0.88	0.90	0.93	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
T28	0.76	0.78	0.80	0.81	0.83	0.85	0.87	0.89	0.91	0.93	0.94	0.98	1.00	1.00
T32	0.73	0.75	0.77	0.78	0.80	0.82	0.83	0.85	0.87	0.88	0.90	0.93	0.97	1.00

For reduced edge distance, multiply a reduction factor f_{RN} for each free edge:

Type	Influence of Edge Distance (mm), where $f_{RN} = 0.75 (C/C_{cr,N}) + 0.25$													
	50	60	70	80	90	100	120	140	160	180	200	220	260	300
M10/T10	0.67	0.75	0.83	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12/T13	-	0.66	0.73	0.80	0.86	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M16/T16	-	-	0.65	0.71	0.77	0.83	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M20/T20	-	-	-	-	0.65	0.69	0.78	0.87	0.96	1.00	1.00	1.00	1.00	1.00
M24/T25	-	-	-	-	-	-	0.68	0.75	0.82	0.89	0.96	1.00	1.00	1.00
T28	-	-	-	-	-	-	-	0.64	0.69	0.75	0.81	0.86	1.00	1.00
T32	-	-	-	-	-	-	-	-	0.65	0.70	0.75	0.80	0.90	1.00

Influence of application location in cracked or non-cracked concrete:

Application Type	f_{Crack}
Cracked Concrete	1.0
Non-Cracked Concrete	1.4

Design Approach #2: Design Resistance For Ultimate Loads

#2.1 Calculate the ultimate applied tensile and shear forces from the end-moments and effective lever arm.

#2.2 Obtain the design resistance forces due to limiting bond strength, concrete strength, and steel strength.

#2.3 Perform the necessary checks to ensure adequate safety.

Superfix recommends the use of software or spreadsheet for such iterative analysis.

Tension Analysis

$F_{N,Bond} = \{n. \pi. h_s. f_{Bond}\} / \{(1000). (1.2). (1.4)\}$ [kN]
where **n** is the number of rebars resisting tensile loads

$F_{N,Concrete} = \{n. (7.2). (f_{CU})^{0.5}. (h_s)^{1.5}. f_{Crack}. f_{AN}. f_{RN}\} / \{(1000). (1.2). (1.5)\}$ [kN]
where **n** is the number of rebars resisting tensile loads

Note: For a group of rebars subjected to tensile load (usually the top row of rebars), the lowest value of $\mathbf{F_{N,Concrete}}$ applies after accounting for the various factors due to site constraints.

For reduced spacing, multiply a reduction factor f_{AN} for each reduced spacing:

Type	Influence of Spacing (mm), where $f_{AN} = 0.5 (S/S_{cr,N}) + 0.5$													
	50	60	70	80	90	100	120	140	160	180	200	220	240	260
M10/T10	0.64	0.67	0.69	0.72	0.75	0.78	0.83	0.89	0.94	1.00	1.00	1.00	1.00	1.00
M12/T13	-	0.64	0.66	0.68	0.70	0.73	0.77	0.82	0.86	0.91	0.95	1.00	1.00	1.00
M16/T16	-	-	0.63	0.65	0.67	0.69	0.73	0.77	0.81	0.85	0.88	0.92	0.96	1.00
M20/T20	-	-	-	-	0.63	0.65	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.88
M24/T25	-	-	-	-	-	-	0.64	0.67	0.69	0.71	0.74	0.76	0.79	0.81
T28	-	-	-	-	-	-	-	0.63	0.65	0.67	0.69	0.70	0.72	0.74
T32	-	-	-	-	-	-	-	-	0.63	0.65	0.67	0.68	0.70	0.72

Type	Influence of Spacing (mm), where $f_{AN} = 0.5 (S/S_{cr,N}) + 0.5$													
	280	300	320	340	360	380	400	420	440	460	480	520	560	600
M10/T10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12/T13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M16/T16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M20/T20	0.91	0.94	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M24/T25	0.83	0.86	0.88	0.90	0.93	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
T28	0.76	0.78	0.80	0.81	0.83	0.85	0.87	0.89	0.91	0.93	0.94	0.98	1.00	1.00
T32	0.73	0.75	0.77	0.78	0.80	0.82	0.83	0.85	0.87	0.88	0.90	0.93	0.97	1.00

For reduced edge distance, multiply a reduction factor f_{RN} for each free edge:

Type	Influence of Edge Distance (mm), where $f_{RN} = 0.75 (C/C_{cr,N}) + 0.25$													
	50	60	70	80	90	100	120	140	160	180	200	220	260	300
M10/T10	0.67	0.75	0.83	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M12/T13	-	0.66	0.73	0.80	0.86	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M16/T16	-	-	0.65	0.71	0.77	0.83	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M20/T20	-	-	-	-	0.65	0.69	0.78	0.87	0.96	1.00	1.00	1.00	1.00	1.00
M24/T25	-	-	-	-	-	-	0.68	0.75	0.82	0.89	0.96	1.00	1.00	1.00
T28	-	-	-	-	-	-	-	0.64	0.69	0.75	0.81	0.86	1.00	1.00
T32	-	-	-	-	-	-	-	-	0.65	0.70	0.75	0.80	0.90	1.00

Influence of application location in cracked or non-cracked concrete:

Application Type	f_{Crack}
Cracked Concrete	1.0
Non-Cracked Concrete	1.4

$F_{N,Steel} = \{n.\,\pi.\,(d^2/4).\,f_y\} \,/\, \{(1000).\,(1.15)\}$ [kN]
where **n** is the number of rebars resisting tensile loads

The design tensile resistance shall be:
$\mathbf{F_{N,Design} = minimum\ (F_{N,Bond},\ F_{N,Concrete},\ F_{N,Steel})}$

Shear Analysis

$F_{V,Bond} = \{n.\,(0.6).\,(\tan\alpha_f).\,\pi.\,d.\,h_s.\,f_{Bond}\} \,/\, \{(1000).\,(1.4)\}$ [kN]
Where **n** is the number of rebars resisting shear loads

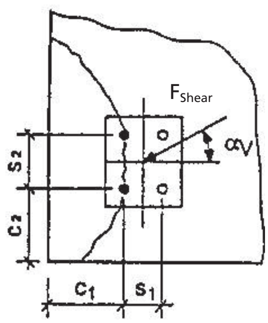
Influence of type of concrete connection:

Connection Type	$\tan\alpha_f$
Smooth interface, as in untreated concrete	0.7
Roughened or castellated joint	1.4

$F_{V,Concrete} = \{0.45.\,d^{0.5}.\,(h_s/d)^{0.2}.\,f_{CU}^{0.5}.\,c_1^{1.5}.\,f_\alpha.\,f_{ER}.(A_c/A_0)\} \,/\, \{(1000).(1.2).(1.5)\}$ [kN]
Where $\mathbf{c_1}$ is the reduced edge distance of the post-installed rebars
$\mathbf{f_\alpha}$ accounts for the applied load direction in relation to the reduced free edge
$\mathbf{f_{ER}}$ accounts for the installation position in cracked or non-cracked concrete, and the type of edge reinforcement used
$\mathbf{A_0}$ is the area of concrete cone of an individual rebar at the lateral concrete surface not affected by edges parallel to the assumed loading direction
$\mathbf{A_C}$ is the actual area of concrete cone of the rebars at the lateral concrete surface

Influence of shear load direction:

Shear Load Direction	f_α
For $0° \leq \alpha_v \leq 55°$	1.0
For $55° \leq \alpha_v \leq 90°$	$1 / (\cos\alpha_v + 0.5 \sin\alpha_v)$
For $90° \leq \alpha_v \leq 180°$	2.0

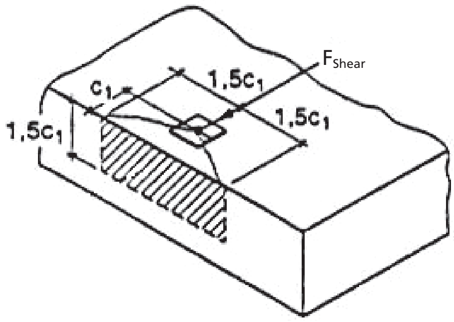


Influence of type of reinforcement and application in cracked or non-cracked concrete:

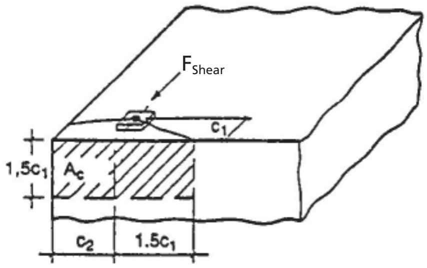
Application Type	f_{ER}
Anchorage in cracked concrete without edge reinforcement or stirrups	1.0
Anchorage in cracked concrete with straight edge reinforcement (≥ ∅ 12 mm)	1.2
Anchorage in cracked concrete with edge reinforcement and closely spaced stirrups (≤ 100 mm), anchorage in non-cracked concrete	1.4

The following are examples to calculate A_0 and A_c:

$A_0 = 4.5\ c_1^2$

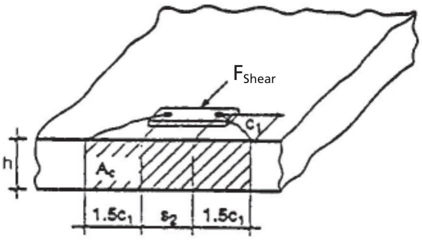


Example: $A_c = (1.5\ c_1).(1.5\ c_1 + c_2)$



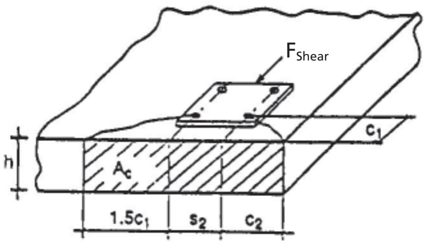
Provided
$h > 1.5\ c_1$
$c_2 \leq 1.5\ c_1$

Example: $A_c = (3c_1 + s_2).(h)$



Provided
$h \leq 1.5\ c_1$
$s_2 \leq 3\ c_1$

Example: $A_c = (1.5\ c_1 + s_1 + c_2)$



Provided
$h \leq 1.5\ c_1$
$s_2 \leq 3\ c_1$
$c_2 \leq 1.5\ c_1$

Note that the concrete shear capacity of the row of rebars nearest the free edge governs. The contribution of the inner rows of rebars must not be included.

$F_{V,Steel} = \{n.\ (0.6).\ (\tan \alpha_f).\ \pi.\ (d^2/4).\ f_y\}\ /\ \{(1000).\ (1.15)\}$ [kN]

Where **n** is the number of rebars resisting shear loads

Influence of type of concrete connection:

Connection Type	tan α_f
Smooth interface, as in untreated concrete	0.7
Roughened or castellated joint	1.4

The design shear resistance shall be:

$\mathbf{F_{V,Design} = minimum\ (F_{V,Bond},\ F_{V,Concrete},\ F_{V,Steel})}$

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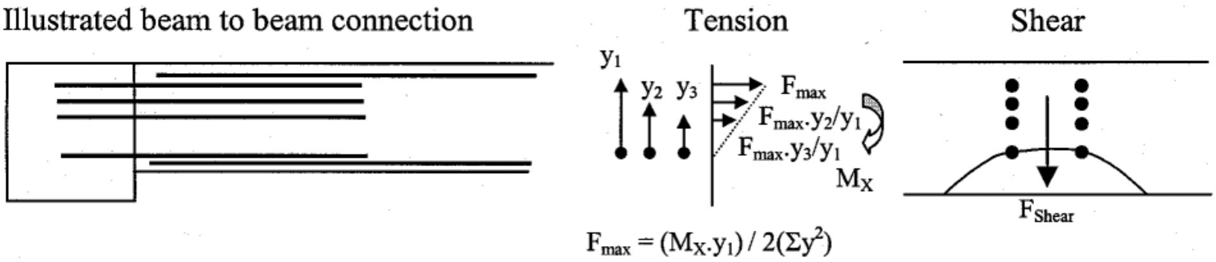
Checks to ensure adequate safety



Check worst-case tensile load (top row, single rebar):

$F_{max} / (F_{N,Design}/n) \leq 1$,   where **n** is the number of rebars resisting tensile forces

Check worst-case shear load (bottom row rebars):

$F_{Shear} / F_{V,Design} \leq 1$

Check for safety of combined-load interaction for the whole group:

$$\left(\frac{F_z}{F_{N,Design}}\right)^N + \left(\frac{F_{Shear}}{F_{V,Design}}\right)^N \leq 1,$$

where **N** = 1.5 for all modes of failure

Accessories For Adhesive Anchors

Superfix Metal Mesh – SMM

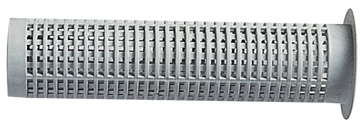
Concrete/Brickwork (borehole filling level approx. 50%)

Description	Hole Diameter (mm)	Hole Depth (mm)	Minimum Volume Required (ml)	Minimum Thread Length (mm)
SMM 6 x 48	8	51	2	6
SMM 8 x 80	12	85	5	8
SMM 10 x 80	14	85	7	10
SMM 12 x 80	16	85	9	12

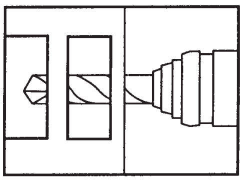
Superfix Plastic Mesh – SPM

Pierced Brick (screen sleeves filling level 100%)

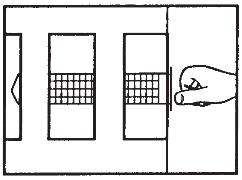
Description	Hole Diameter (mm)	Threaded Rod					Minimum Volume Required (ml)
		M6	M8	M10	M12	M14	
SPM 9 x 50	12	✔	✔				4
SPM 13 x 85	15		✔	✔	✔		13
SPM 13 x 130	15		✔	✔	✔		19
SPM 18 x 85	20					✔	23



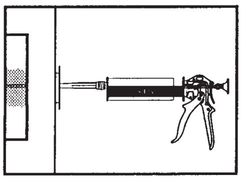
Application in pierced bricks



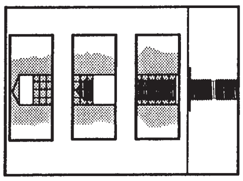
Drill hole



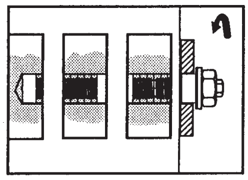
Insert screen sleeve



Inject compound mortar



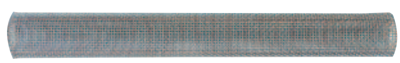
Insert threaded bar using a twisting motion



After the specified cure time, install fixture and tighten

Metal Sleeve – MS

Description	Hole Diameter (mm)	Threaded Rod (mm)	Length (mm)
MS 12	12	8	1000
MS 16	16	12	1000
MS 22	22	16	1000



Square Drive Socket

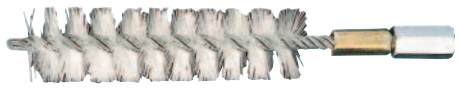
Square Drive	Drill Chuck Head
1/2"	SDS – Plus
3/4"	SDS – Max

Rebar Adapter

Square Drive	Drill Chuck Head
T10	SDS – Plus
T13	SDS – Plus
T16	SDS – Plus
T20	SDS – Max
T25	SDS – Max

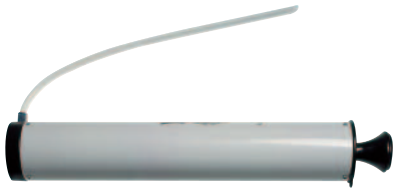
Nylon Brush

Diameter (mm)	Normal Length (mm)	Extended Length
10	250	Customised
12	300	Customised
16	350	Customised
20	450	Customised
25	500	Customised



Blow Out Pump

Cylinder (ml)	Length (mm)
350	415



P.E. Tube Adapter

Diameter (mm)	Length (mm)
9	175

SIS/SEA Dispenser Gun & Static Mixer

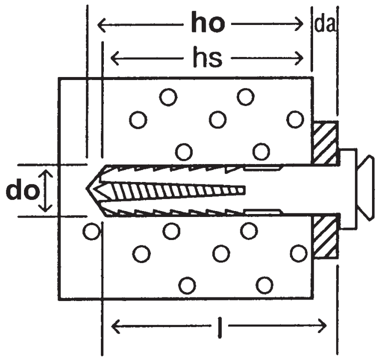
SES Dispenser Gun & Static Mixer

DG-SIS/SEA 150 DG-SIS/SEA 235 DG-SIS/SEA 380 DG-SIS/SEA 380H	 *DG-SIS/SEA 380H looks like DG-SES	DG-SES	
SM-SIS SM-SEA		SM-SES	

23. Superfix Nylon Anchor – SNA

Features:
Quick and easy to use.
Ideal for timber door, window frame, light electrial fittings, signboards and most lightweight fixings.

Material: Polyamide
Galvanised steel, or
stainless steel A4/316, or
stainless steel A2/304.



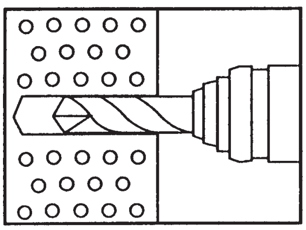
Product Range And Technical Data

Description	Drill Hole d_0 x h_0 (mm)	Anchor Length l (mm)	Fixture Thickness d_a (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)
SNA 5 x 25/5	5 x 25	25	5	20	0.1	0.2
SNA 5 x 33/13	5 x 30	33	13	20	0.1	0.2
SNA 6 x 37/10	6 x 35	37	10	27	0.2	0.35
SNA 6 x 44/14	6 x 35	44	14	30	0.3	0.35
SNA 6 x 55/25	6 x 35	55	25	30	0.3	0.35
SNA 6 x 70/35	6 x 35	70	35	30	0.3	0.35
SNA 8 x 54/20	8 x 40	54	20	34	0.4	0.4
SNA 8 x 72/40	8 x 40	72	40	34	0.4	0.4
SNA 8 x 100/60	8 x 40	100	60	34	0.4	0.4

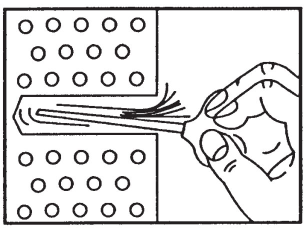
Description	Safe Tensile Resistance (Solid Brick) (kN)	Safe Shear Resistance (Solid Brick) (kN)	Safe Tensile Resistance (Hollow Brick) (kN)	Safe Shear Resistance (Hollow Brick) (kN)
SNA 5 x 25/5	0.05	0.19	0.05	0.19
SNA 5 x 33/13	0.05	0.19	0.05	0.19
SNA 6 x 37/10	0.15	0.2	0.13	0.2
SNA 6 x 44/14	0.15	0.2	0.13	0.2
SNA 6 x 55/25	0.15	0.2	0.13	0.2
SNA 6 x 70/35	0.15	0.2	0.13	0.2
SNA 8 x 54/20	0.35	0.25	0.25	0.25
SNA 8 x 72/40	0.35	0.25	0.25	0.25
SNA 8 x 100/60	0.35	0.25	0.25	0.25

- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance, concrete grade influences.

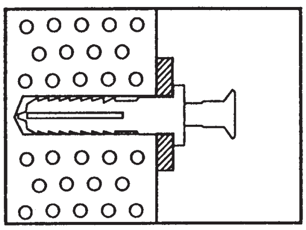
Installation



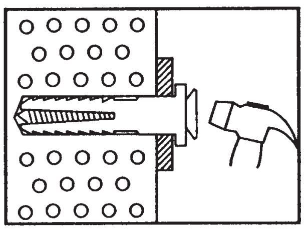
Drill to specified diameter and depth.



Clean the hole.



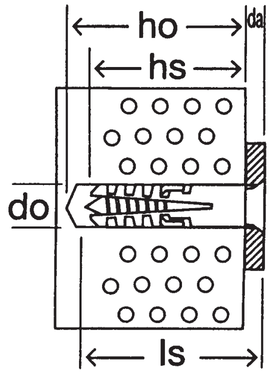
Push SNA into the base material with fixture.



Hammer SNA into position.

24. Superfix Nylon Plug – SNP

Features:
Quick installation with self-tapping screws and chipboard screws.
SNP is resistant to weathering and rust for a temperature range of -40°C to 80°C.
Ideal for light electrical pipes, brackets, woodwork, bathroom fittings, kitchen fittings and light wall mountings.



Product Range And Technical Data

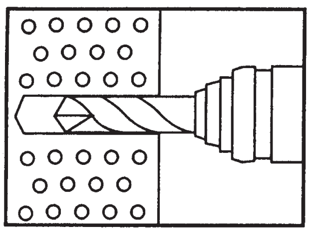
Description	Drill Hole d_0 x h_0 (mm)	Anchor Length l (mm)	Fixture Thickness d_a (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Screw (Not Provided) d_s x l_s (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)
SNP 5 x 25	5 x 28	25	5	25	(3 ~ 4) x 30	0.2	0.4
SNP 6 x 30	6 x 35	30	10	30	(4 ~ 5) x 40	0.2	0.4
SNP 8 x 40	8 x 45	40	10	40	(4.5 ~ 6) x 50	0.3	0.8
SNP 10 x 50	10 x 55	50	25	50	(6 ~ 8) x 75	0.8	1.8
SNP 12 x 60	12 x 65	60	25	60	(8 ~ 10) x 85	1.0	2.2

Description	Safe Tensile Resistance (Lightweight Concrete) (kN)	Safe Shear Resistance (Lightweight Concrete) (kN)	Safe Tensile Resistance (Solid Brick) (kN)	Safe Shear Resistance (Solid Brick) (kN)
SNP 5 x 25	0.08	0.1	0.2	0.18
SNP 6 x 30	0.1	0.15	0.2	0.25
SNP 8 x 40	0.25	0.2	0.25	0.25
SNP 10 x 50	0.35	0.44	*0.3	*0.25
SNP 12 x 60	0.4	0.44	*0.3	*0.25

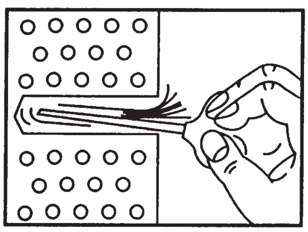
- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26**.
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance, concrete grade influences.

*** Use 4.5mm ~ 6mm diameter screws because larger screws will cause the brick to fracture during installation.**

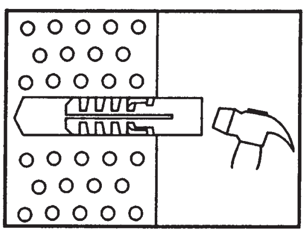
Installation



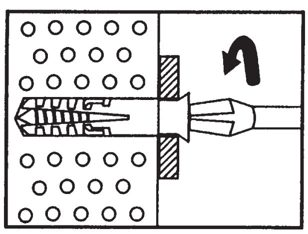
Drill to specified diameter and depth.



Clean the hole.



Tap SNP with hammer until it is flush with the surface.

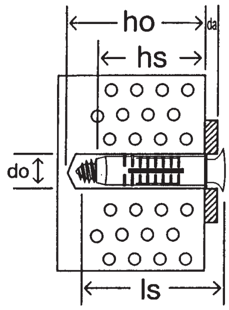


Position the fixture, insert screw and tighten.

25. Superfix Universal Plug – SUP

Features:
Suitable for concrete, solid bricks, gypsum board, and most other building materials.
SUP is resistant to weathering and rust for a temperature range of -40°C to 80°C.
When fixing in hollow walls, the fixing collapses laterally and forms a lock in the cavity.
Ideal for ceiling fixtures, wall shelves, curtain rails, electrical switches, cable clips, bathroom and kitchen fittings.

Material: Polyamide, polypropylene.



Product Range And Technical Data

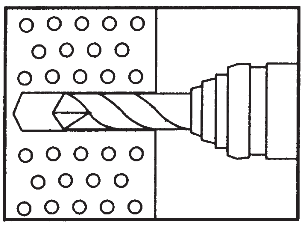
Description	Drill Hole d_0 x h_0 (mm)	Anchor Length l (mm)	Fixture Thickness d_a (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Screw (Not Provided) d_s x l_s (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)
SUP 5 x 30	5 x 35	30	5	30	(3 ~ 4) x 38	0.1	0.15
SUP 6 x 35	6 x 42	35	10	35	(4 ~ 5) x 48	0.1	0.25
SUP 8 x 50	8 x 58	50	10	50	(5 ~ 6) x 65	0.15	0.6
SUP 10 x 60	10 x 68	60	15	60	(7 ~ 8) x 80	0.3	1.8
SUP 12 x 70	12 x 78	70	20	70	(8 ~ 10) x 95	0.4	2.2

Description	Safe Tensile Resistance (Lightweight Concrete)	Safe Shear Resistance (Lightweight Concrete)	Safe Tensile Resistance (Solid Brick) (kN)	Safe Shear Resistance (Solid Brick) (kN)	Safe Tensile Resistance (Hollow Brick) (kN)	Safe Shear Resistance (Hollow Brick) (kN)
SUP 5 x 30	0.07	0.07	0.05	0.15	0.05	0.15
SUP 6 x 35	0.1	0.15	0.08	0.25	0.05	0.25
SUP 8 x 50	0.1	0.3	0.12	0.35	0.06	0.35
SUP 10 x 60	0.3	0.44	0.3	0.4	0.1	0.4
SUP 12 x 70	0.4	0.44	0.4	0.4	0.2	0.4

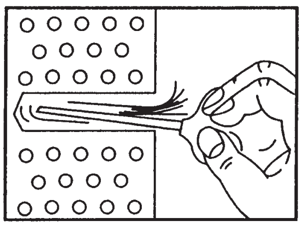
Description	Board Thickness h_b (mm)	Screw For Plywood (Not Provided) d_s x l_s (mm)	Safe Tensile Resistance (Plywood) (kN)	Safe Shear Resistance (Plywood) (kN)	Screw For Gypsum Board (Not Provided) d_s x l_s (mm)	Safe Tensile Resistance (Gypsum Board) (kN)	Safe Shear Resistance (Gypsum Board) (kN)
SUP 5 x 30	9 ~ 11	3.5 x 40	0.05	0.25	3.5 x 40	0.05	0.08
SUP 6 x 35	12 ~ 14	(3.5 ~ 3.8) x 50	0.05	0.35	(4 ~ 4.2) x 50	0.1	0.13
SUP 8 x 50	14 ~ 18	4.2 x 65	0.12	0.4	(4.2 ~ 4.8) x 65	0.1	0.18
SUP 10 x 60	17 ~ 21	(4.8 ~ 5.5) x 80	0.15	0.6	(4.8 ~ 5.5) x 80	0.1	0.2
SUP 12 x 70	20 ~ 25	(5.5 ~ 6.3) x 100	0.16	0.7	(5.5 ~ 6.3) x 100	0.17	0.22

- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance, concrete grade influences.

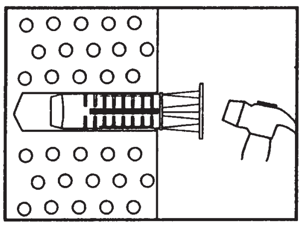
Installation



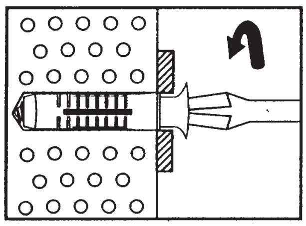
Drill to specified diameter and depth.



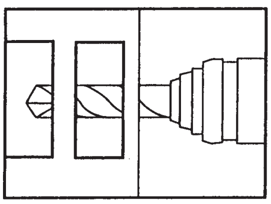
Clean the hole.

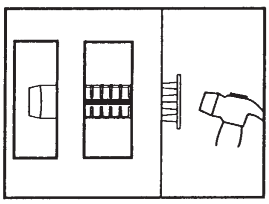


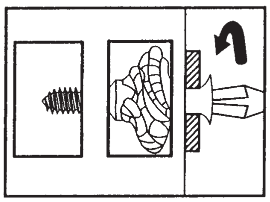
Tap SUP with hammer until it is flush with the surface.

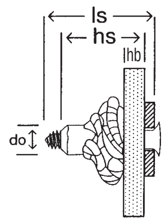


Position the fixture, insert screw and tighten.





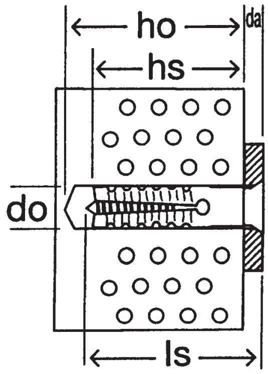




26. Superfix Thread Plug – STP

Features:
Designed specially for use in lightweight concrete.
Ideal for gas pipes, pipe clips, bathroom and kitchen fittings.

Material: Galvanised steel



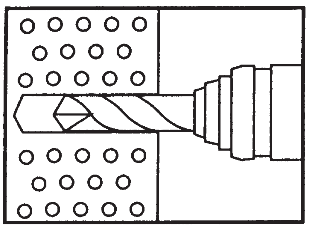
Product Range And Technical Data

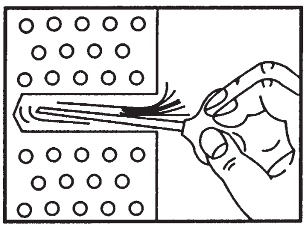
Description	Drill Hole For Concrete Or Brick d_0 x h_0 (mm)	Drill Hole For Lightweight Concrete d_0 x h_0 (mm)	Anchor Length l (mm)	Fixture Thickness d_a (mm)	Char. Setting Depth $h_{s\ cr}$ (mm)	Screw (Not Provided) d_s x l_s (mm)
STP 6 x 32	8 x 35	6 x 35	32	5	32	(5 ~ 6) x 37
STP 8 x 38	10 x 43	10 x 43	38	10	38	(6 ~ 8) x 48
STP 10 x 60	12 x 68	12 x 68	60	25	60	(8 ~ 10) x 85

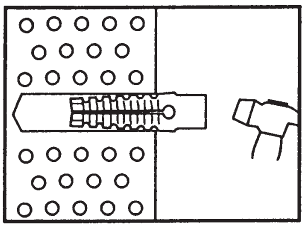
Description	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)	Safe Tensile Resistance (Lightweight Concrete) (kN)	Safe Shear Resistance (Lightweight Concrete) (kN)
STP 6 x 32	0.25	1.0	0.05	0.25
STP 8 x 38	0.8	1.8	0.4	0.4
STP 10 x 60	2.0	2.2	0.4	0.4

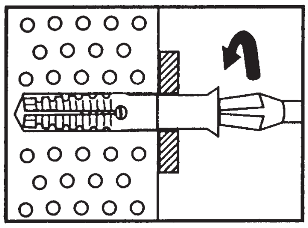
- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance, concrete grade influences.

Installation


Drill to specified diameter and depth.


Clean the hole.

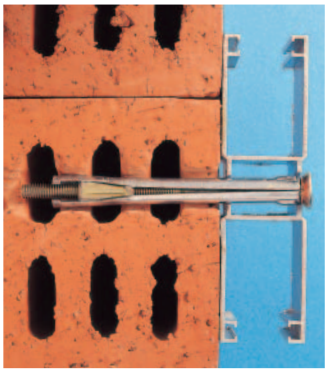

Tap STP with hammer until it is flush with the surface.

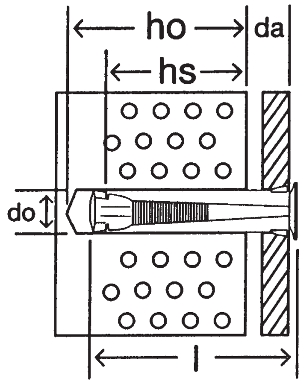

Position the fixture, insert screw and tighten.

27. Superfix Metal Frame – SMF

Features:
When tightening the screw, the wedge is formed without drawing the fixture against the base material. Good corrosion protection through zinc coating. Ideal for fixing door frames, wall partitions with aluminium profiles and plastic material.

Material: Galvanised iron.





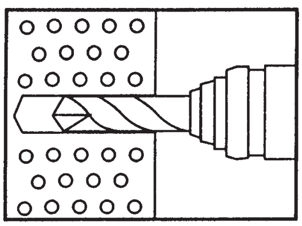
Product Range And Technical Data

Description	Drill Hole d_0 x h_0 (mm)	Anchor Length l (mm)	Fixture Thickness d_a (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)
SMF 8 x 112	8 x 33	112	82	30	1.3	0.82
SMF 8 x 132	8 x 33	132	102	30	1.3	0.82
SMF 8 x 152	8 x 33	152	122	30	1.3	0.82
SMF 8 x 182	8 x 33	182	152	30	1.3	0.82
SMF 10 x 72	10 x 33	72	42	30	2.05	2.05
SMF 10 x 92	10 x 33	92	62	30	2.05	2.05
SMF 10 x 112	10 x 33	112	82	30	2.05	2.05
SMF 10 x 132	10 x 33	132	102	30	2.05	2.05
SMF 10 x 152	10 x 33	152	122	30	2.05	2.05
SMF 10 x 182	10 x 33	182	152	30	2.05	2.05
SMF 10 x 202	10 x 33	202	172	30	2.05	2.05

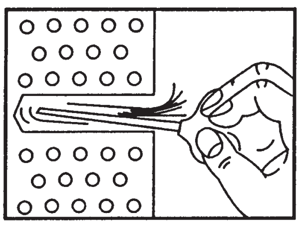
Description	Safe Tensile Resistance (Solid Brick) (kN)	Safe Shear Resistance (Solid Brick) (kN)	Safe Tensile Resistance (Hollow Brick) (kN)	Safe Shear Resistance (Hollow Brick) (kN)
SMF 8 x 112	0.2	0.43	0.15	0.46
SMF 8 x 132	0.2	0.43	0.15	0.46
SMF 8 x 152	0.2	0.43	0.15	0.46
SMF 8 x 182	0.2	0.43	0.15	0.46
SMF 10 x 72	0.2	0.48	0.15	0.46
SMF 10 x 92	0.2	0.48	0.15	0.46
SMF 10 x 112	0.2	0.48	0.15	0.46
SMF 10 x 132	0.2	0.48	0.15	0.46
SMF 10 x 152	0.2	0.48	0.15	0.46
SMF 10 x 182	0.2	0.48	0.15	0.46
SMF 10 x 202	0.2	0.48	0.15	0.46

- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance, concrete grade influences.

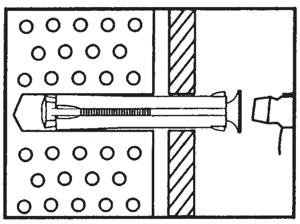
Installation



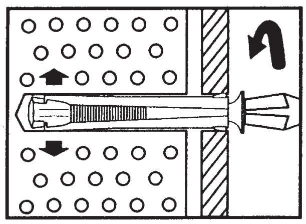
Drill to specified diameter and depth.



Clean the hole.



Tap SMF through the fixture until it is flush with the surface of the fixture.



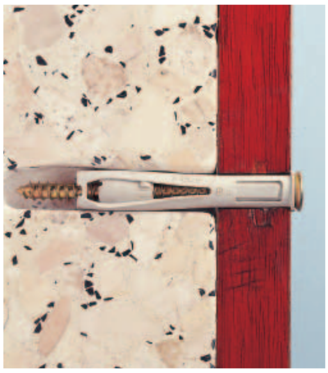
Tighten the screw.

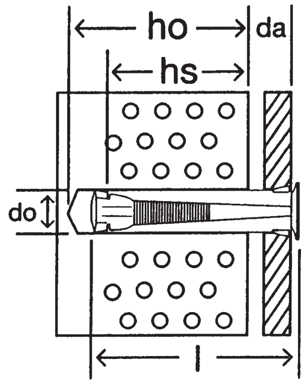
Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

28. Superfix Plastic Frame – SPF

Features:
When tightening the screw, the wedge is formed without drawing the fixture against the base material.
Good corrosion protection.
Ideal for fixing door frames, wall partitions with aluminium profiles and plastic material.

Material: Polyamide, polypropylene galvanised steel, or stainless steel A4/316, or stainless steel A2304.





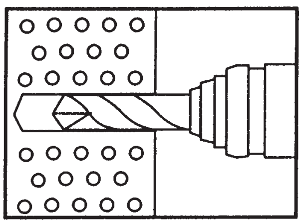
Product Range And Technical Data

Description	Drill Hole $d_0 \times h_0$ (mm)	Anchor Length l (mm)	Fixture Thickness d_a (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)
SPF 8 x 110	8 x 53	100	60	50	0.03	0.53
SPF 8 x 140	8 x 53	140	90	50	0.03	0.53
SPF 10 x 75	10 x 63	75	15	60	0.03	0.7
SPF 10 x 100	10 x 63	100	40	60	0.03	0.7
SPF 10 x 120	10 x 63	120	60	60	0.03	0.7
SPF 10 x 140	10 x 63	140	80	60	0.03	0.7
SPF 10 x 165	10 x 63	165	105	60	0.03	0.7

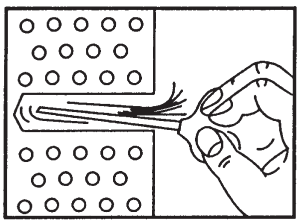
Description	Safe Tensile Resistance (Solid Brick) (kN)	Safe Shear Resistance (Solid Brick) (kN)	Safe Tensile Resistance (Hollow Brick) (kN)	Safe Shear Resistance (Hollow Brick) (kN)
SPF 8 x 100	0.02	0.37	0.04	0.39
SPF 8 x 140	0.02	0.37	0.04	0.39
SPF 10 x 75	0.05	0.37	0.34	0.39
SPF 10 x 100	0.05	0.37	0.34	0.39
SPF 10 x 120	0.05	0.37	0.34	0.39
SPF 10 x 140	0.05	0.37	0.34	0.39
SPF 10 x 165	0.05	0.37	0.34	0.39

- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance, concrete grade influences.

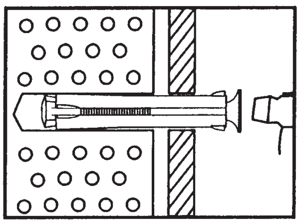
Installation



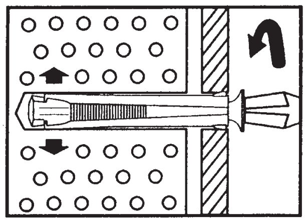
Drill to specified diameter and depth.



Clean the hole.



Tap SPF through the fixture until it is flush with the surface of the fixture.

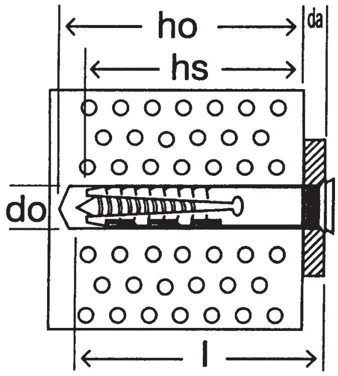


Tighten the screw.

29. Superfix Frame Anchor – SFA

Features:
Efficient through fixing.
SFA is resistant to weathering and rust for a temperature range of -40°C to 80°C.
Ideal for timber beams, wooden laths, battens, facade, metal profiles and doorframes.

Material: Polyamide, polypropylene galvanised steel, or stainless steel A4/316, or stainless steel A2/304.



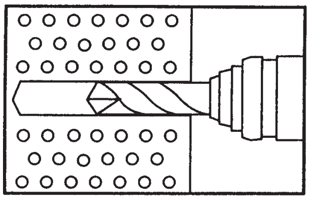
Product Range And Technical Data

Description	Drill Hole d_0 x h_0 (mm)	Anchor Length l (mm)	Fixture Thickness d_a (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Screw (Not Provided) d_s x l_s (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)
SFA 8 x 90	8 x 88	100	10	80	6 x 95	0.3	0.4
SFA 8 x 110	8 x 88	110	30	80	6 x 115	0.3	0.4
SFA 10 x 75	10 x 78	75	5	70	7 x 80	0.8	1.1
SFA 10 x 90	10 x 78	90	20	70	7 x 95	0.8	1.1
SFA 10 x 110	10 x 78	110	40	70	7 x 115	0.8	1.1
SFA 10 x 135	10 x 78	135	65	70	7 x 140	0.8	1.1
SFA 10 x 160	10 x 78	160	90	70	7 x 165	0.8	1.1

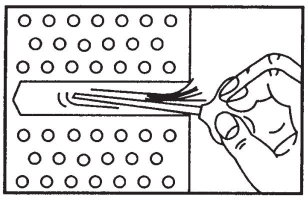
Description	Safe Tensile Resistance (Solid Brick) (kN)	Safe Shear Resistance (Solid Brick) (kN)	Safe Tensile Resistance (Hollow Brick) (kN)	Safe Shear Resistance (Hollow Brick) (kN)
SFA 8 x 90	0.25	0.2	0.25	0.2
SFA 8 x 110	0.25	0.2	0.25	0.2
SFA 10 x 75	0.45	0.2	0.4	0.2
SFA 10 x 90	0.45	0.2	0.4	0.2
SFA 10 x 110	0.45	0.2	0.4	0.2
SFA 10 x 135	0.45	0.2	0.4	0.2
SFA 10 x 160	0.45	0.2	0.4	0.2

- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26**.
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance, concrete grade influences.

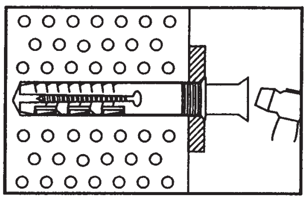
Installation



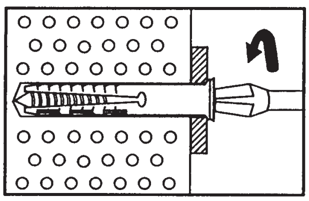
Drill to specified diameter and depth.



Clean the hole.



Tap SFA with fixture into the hole.

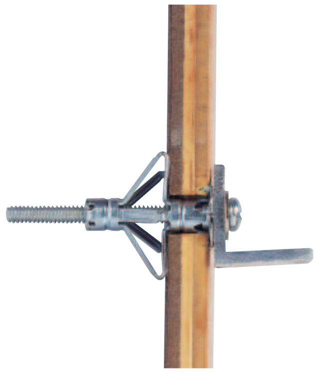


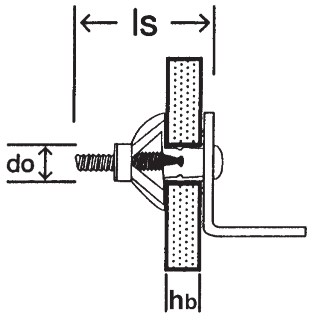
Position the fixture and tighten the screw.

30. Superfix Cavity Anchor – SCA

Features:
Pre-assembled anchor that allows quick installation with a puller tool. Ideal for gypsum board, ceiling fixtures and board buildings.

Material: Galvanised iron





Product Range And Technical Data

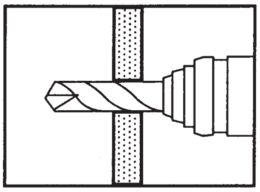
Description	Drill Hole d_0 (mm)	Fixture Thickness d_a (mm)	Board Thickness h_b (mm)	Cavity Depth (mm)	Safe Tensile Resistance (Plywood) (kN)	Safe Shear Resistance (Plywood) (kN)	Safe Tensile Resistance (Gypsum Board) (kN)	Safe Shear Resistance (Gypsum Board) (kN)
SCA 4 x 19	9	8	1 ~ 5	25	0.3	0.55	0.07	0.15
SCA 4 x 32	9	15	3 ~ 11	38	0.3	0.55	0.07	0.15
SCA 4 x 38	9	16	8 ~ 16	45	0.3	0.55	0.07	0.15
SCA 4 x 45	9	16	16 ~ 23	52	0.3	0.55	0.07	0.15
SCA 4 x 54	9	20	18 ~ 28	60	0.3	0.55	0.07	0.15
SCA 4 x 59	9	15	31 ~ 38	65	0.3	0.55	0.07	0.15
SCA 5 x 37	10	17	6 ~ 13	45	0.45	0.6	0.15	0.2
SCA 5 x 52	10	27	3 ~ 16	58	0.45	0.6	0.15	0.2
SCA 5 x 65	10	24	16 ~ 32	71	0.45	0.6	0.15	0.2
SCA 5 x 80	10	28	32 ~ 45	88	0.45	0.6	0.15	0.2
SCA 6 x 37	13	17	6 ~ 13	45	0.53	0.70	0.15	0.23
SCA 6 x 52	13	27	3 ~ 16	58	0.53	0.70	0.15	0.23
SCA 6 x 65	13	24	16 ~ 32	71	0.53	0.70	0.15	0.23
SCA 6 x 80	13	28	32 ~ 45	88	0.53	0.70	0.15	0.23

- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- No spacing, edge distance influences.

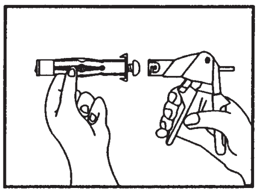
Setting Tool

ST-SCA

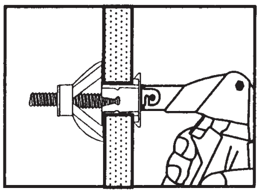
Installation



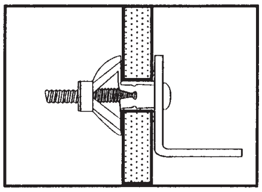
Drill to specified diameter.



Connect the SCA to the puller tool and insert the SCA into the drilled hole.



Pull the screw to expand the plug.

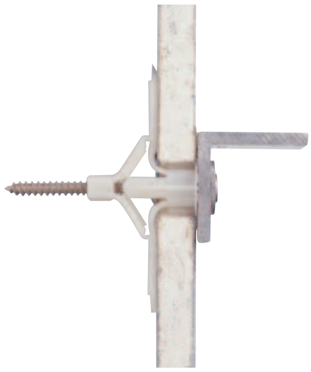


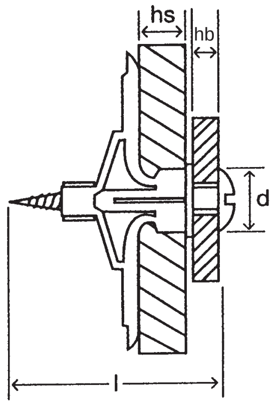
Position the fixture, insert the screw and tighten.

31. Superfix Plastic Toggle – SPT

Features:
Quick and easy to fix with ordinary self-tapping screws.
Stays in place even when screw is removed, allowing fixtures to be replaced.
Ideal for gypsum board, panels, concrete, solid brick, and board buildings.

Material: Polyamide.





Product Range And Technical Data

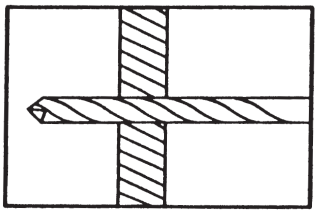
Description	Drill Hole For Plywood Or Gypsum d_0 (mm)	Anchor Length l (mm)	Fixture Thickness d_a (mm)	Board Thickness h_b (mm)	Cavity Depth (mm)	Screw (Not Provided) d_s x l_s (mm)
SPT 1	11	36	12	8 ~ 12	30	(4 ~ 4.5) x 45
SPT 2	11	43	19	15 ~ 19	30	(4 ~ 4.5) x 60
SPT 3	12	52	24	25 ~ 28	30	(4 ~ 4.5) x 73

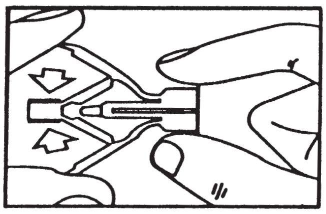
Description	Drill Hole For Concrete Or Solid Brick d_0 x h_o (mm)	Characteristic Setting Depth $h_{s\ cr}$ (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)	Safe Tensile Resistance (Solid Brick) (kN)	Safe Shear Resistance (Solid Brick) (kN)
SPT 1	10 x 39	36	0.09	0.2	0.03	0.2
SPT 2	10 x 46	43	0.16	0.2	0.05	0.2
SPT 3	10 x 55	52	0.25	0.2	0.05	0.2

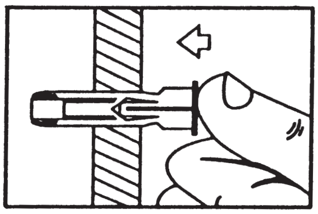
Description	Safe Tensile Resistance (Plywood) (kN)	Safe Shear Resistance (Plywood) (kN)	Safe Tensile Resistance (Gypsum Board) (kN)	Safe Shear Resistance (Gypsum Board) (kN)
SPT 1	0.17	0.2	0.07	0.2
SPT 2	0.2	0.2	0.07	0.2
SPT 3	0.23	0.2	0.15	0.2

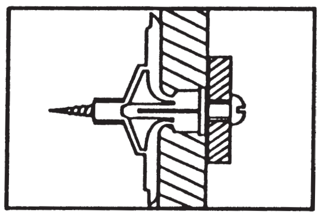
- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance, concrete grade influences.

Installation


Drill to specified diameter.


Compress the 'wings'.

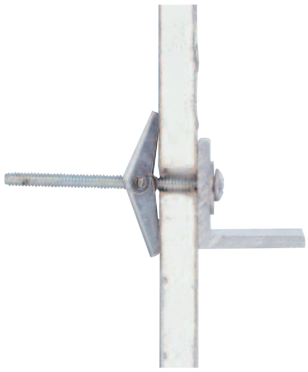

Push SPT into the base material.

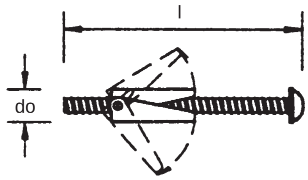

Position the fixture, insert the screw and tighten.

32. Superfix Spring Toggle – SST

Features:
Designed for fixings and suspensions on board walls.
Can be dismantled and re-used for subsequent assemblies.
Ideal for ceiling lights, ceiling fixtures, bathroom and kitchen fittings.

Material: Galvanised steel



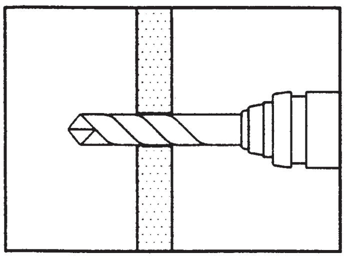


Product Range And Technical Data

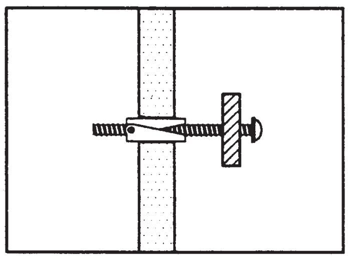
Description	Drill Hole d_0 (mm)	Fixture + Board Thickness $d_a + h_b$ (mm)	Cavity Depth (mm)	Safe Tensile Resistance (Plywood) (kN)	Safe Shear Resistance (Plywood) (kN)	Safe Tensile Resistance (Gypsum Board) (kN)	Safe Shear Resistance (Gypsum Board) (kN)
SST 1/8" x 2"	12	30	30	0.15	0.3	0.15	0.35
SST 1/8" x 3"	12	55	30	0.15	0.3	0.15	0.35
SST 1/8" x 4"	12	70	30	0.15	0.3	0.15	0.35
SST 3/16" x 2"	15	24.5	30	0.15	0.3	0.15	0.35
SST 3/16" x 3"	15	50	30	0.15	0.3	0.15	0.35
SST 3/16" x 4"	15	75	30	0.15	0.3	0.15	0.35
SST 1/4" x 3"	17	44	32	0.25	0.7	0.25	0.45
SST 1/4" x 4"	17	69	32	0.25	0.7	0.25	0.45
SST 1/4" x 5"	17	94	32	0.25	0.7	0.25	0.45
SST 1/4" x 6"	17	119	32	0.25	0.7	0.25	0.45

- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26**.
- No spacing, edge distance influences.

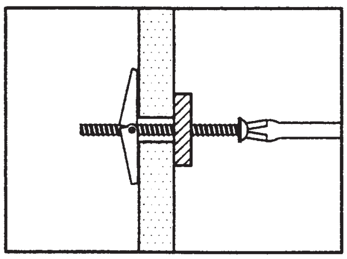
Installation



Drill to specified diameter.



Attach the fixture, compress the 'wings' and push SST through the hole.

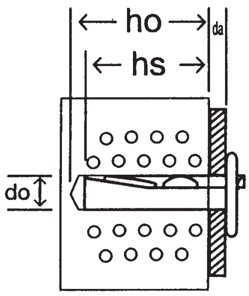


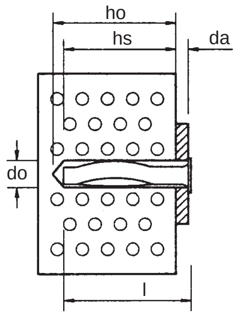
Pull the fixture against the screw head while tightening to prevent the 'wings' from rotating.

33. Superfix Hammer Nail – SHN

Features:
Capable of withstanding medium loads.
Rapid, easy and reliable installation.
Ideal for ceiling fixtures, suspension steel band, electrical works, and light construction materials.

Material: Galvanised steel, or stainless steel A4/316, or stainless steel A2/304.



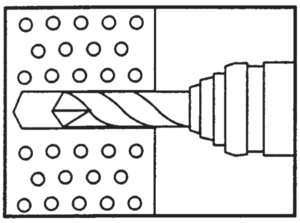


Product Range And Technical Data

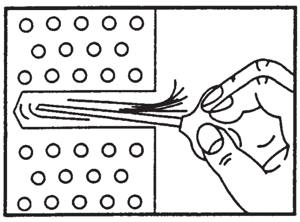
Description	Drill Hole $d_0 \times h_0$ (mm)	Anchor Length l (mm)	Fixture Thickness d_a (mm)	Char. Setting Depth $h_{s\ cr}$ (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)
SHN 6 x 35	6 x 34	35	4	31	1.0	1.5
SHN 6 x 65	6 x 34	65	34	31	1.0	1.5
SHN 6 x 38F	6 x 34	35	7	31	1.0	1.5
SHN 6 x 50F	6 x 34	65	19	31	1.0	1.5
SHN 6 x 63F	6 x 34	35	32	31	1.0	1.5
SHN 6 x 75F	6 x 34	65	44	31	1.0	1.5
SHN 6 x 90F	6 x 34	35	59	31	1.0	1.5
SHN 6 x 100F	6 x 34	65	69	31	1.0	1.5

- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance, concrete grade influences.

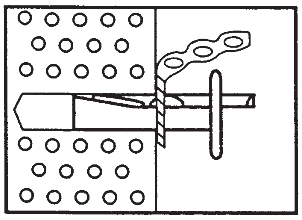
Installation



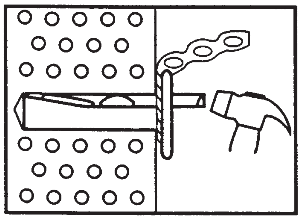
Drill to specified diameter and depth.



Clean the hole.

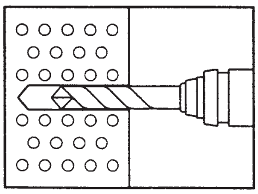


Attach fixture and insert SHN into the hole.

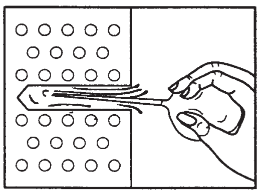


Hammer SHN expander nail until it is flush with collar.

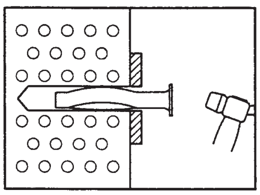
Installation



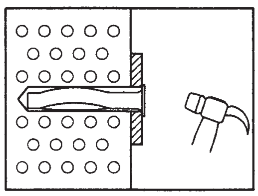
Drill to specified diameter and depth.



Clean the hole.



Attach fixture and insert SHN into the hole.



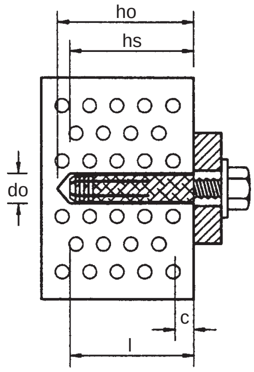
Hammer SHN fully into position.

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

34. Superfix Brass Anchor – SBA

Features:
Internal thread and shallow setting depth.
Anchor flush with surface of base material after removal of fixture.
Ideal for cable tray, suspended pipe works, electrical works, air-con ducting, sprinkler support systems.

Material: Brass



Product Range And Technical Data

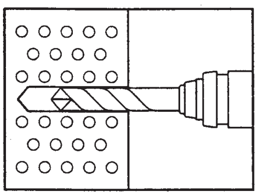
Description	Drill Hole $d_0 \times h_0$ (mm)	Anchor Length l (mm)	Thread Length c (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Tighten Torque (Concrete) (Nm)	Tighten Torque (Solid Brick) (Nm)
SBA M8	10 x 33	30	20	30	*15	*10
SBA M10	12 x 37	34	23	34	*40	*10
SBA M12	16 x 45	41	26	41	*40	*15

Description	Safe Tensile Resistance (Steel Grade 4.8) (Concrete) (kN)	Safe Shear Resistance (Steel Grade 4.8) (Concrete) (kN)	Safe Tensile Resistance (Steel Grade 4.8) (Solid Brick) (kN)	Safe Shear Resistance (Steel Grade 4.8) (Solid Brick) (kN)
SBA M8	*0.5	*0.8	*0.2	*0.25
SBA M10	*1.2	*0.8	*0.2	*0.25
SBA M12	*1.5	*1.5	*0.3	*0.25

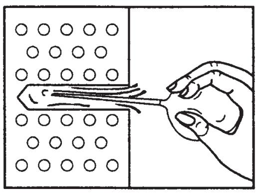
- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- All loads for concrete are derived from static load tests on non-cracked concrete of $f_{CU} = 30\ N/mm^2$.
- No spacing, edge distance, concrete grade influences.

* **Recommended loads and torque values are for bolts of Steel Grade 4.8 (not provided) and will differ for other steel grade values.**

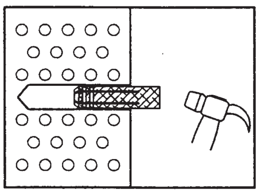
Installation



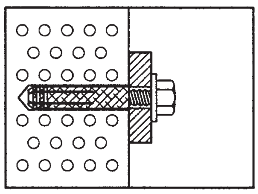
Drill to specified diameter and depth.



Clean the hole.



Tap SBA until it is flush with the surface.

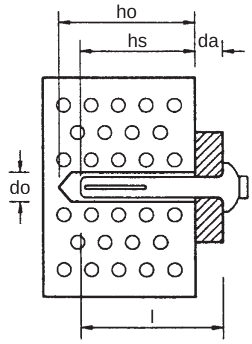


Attach fixture to threaded rod or screw and tighten.

35. Superfix Zinc Anchor – SZA

Features:
Quick and easy installation.
Corrosion resistant zinc alloy.
Ideal for light suspended works, electrical fittings, signboards, and general lightweight support systems.

Material: Zinc alloy Z410

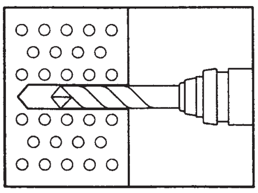


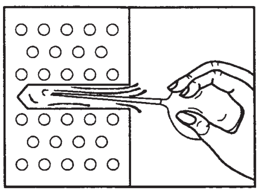
Product Range And Technical Data

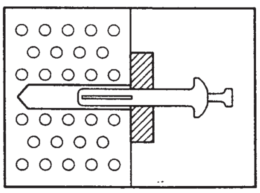
Description	Drill Hole d_0 x h_0 (mm)	Anchor Length l (mm)	Fixture Thickness d_a (mm)	Char. Setting Depth $h_{s\ cr}$ (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)
SZA 5 x 25	5 x 18	25	10	15	0.3	0.4
SZA 6 x 20	6 x 18	20	5	15	0.45	0.6
SZA 6 x 30	6 x 23	30	10	20	0.7	0.9
SZA 6 x 40	6 x 23	40	20	20	0.7	0.9
SZA 6 x 50	6 x 23	50	30	20	0.7	0.9
SZA 6 x 65	6 x 33	65	35	30	0.7	0.9

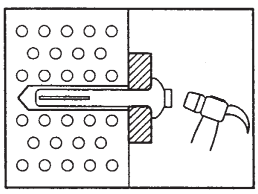
- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance, concrete grade influences.

Installation


Drill to specified diameter and depth.


Clean the hole.

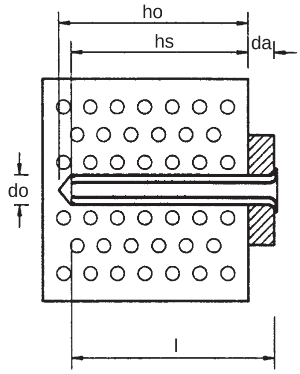

Attach fixture and tap SZA into the base material.


Hammer SZA into position.

36. Superfix Quickfix Nail – SQN

Features:
Quick and easy installation without requiring screws.
Cost effective and efficient.
Ideal for wood strip, timber door, battens, signboards, and most lightweight support systems.

Material: Galvanised steel.

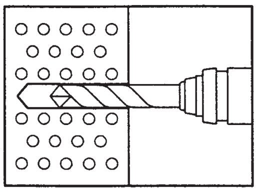


Product Range And Technical Data

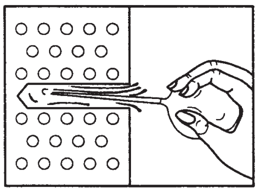
Description	Drill Hole d_0 x h_o (mm)	Anchor Length l (mm)	Fixture Thickness d_a (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)	Safe Tensile Resistance (Solid Brick) (kN)	Shear Resistance (Solid Brick) (kN)
SQN 6 x 30	6 x 28	30	5	25	0.05	0.18	0.05	0.18
SQN 6 x 40	6 x 33	40	10	30	0.07	0.2	0.07	0.2
SQN 6 x 50	6 x 33	50	20	30	0.07	0.2	0.07	0.2
SQN 6 x 60	6 x 33	60	30	30	0.07	0.2	0.07	0.2
SQN 6 x 80	6 x 43	80	40	40	0.07	0.2	0.07	0.2
SQN 8 x 70	8 x 44	70	30	40	0.55	0.25	0.2	0.2
SQN 8 x 90	8 x 44	90	50	40	0.55	0.25	0.2	0.2
SQN 8 x 110	8 x 54	110	60	50	0.55	0.25	0.2	0.2
SQN 8 x 120	8 x 54	120	70	50	0.55	0.25	0.2	0.2
SQN 8 x 130	8 x 54	130	80	50	0.55	0.25	0.2	0.2
SQN 8 x 150	8 x 54	150	100	50	0.55	0.25	0.2	0.2
SQN 8 x 180	8 x 54	180	130	50	0.55	0.25	0.2	0.2

- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance, concrete grade influences.

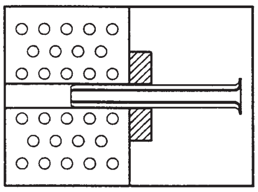
Installation



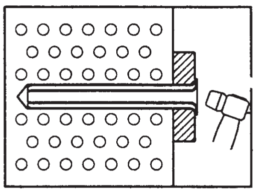
Drill to specified diameter and depth.



Clean the hole.



Attach fixture and push SQN into the base material.

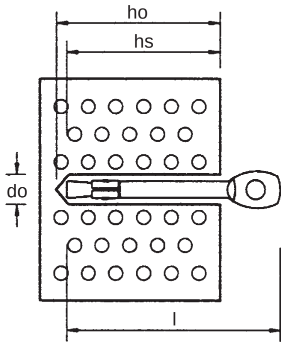


Hammer SQN into position.

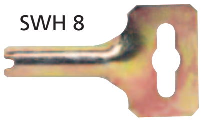
37. Superfix Wire Hanger – SWH

Features:
Quick and easy installation.
Ideal for wire suspension systems.

Material: Galvanised steel, or stainless steel A4/316, or stainless A2/304.



SWH 8



SWH 6W

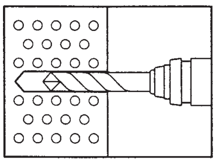
SWH 6

Product Range And Technical Data

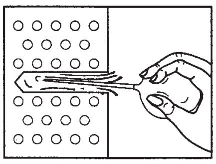
Description	Drill Hole d_0 x h_0 (mm)	Anchor Length l (mm)	Lug Hole For Wire (mm)	Char. Setting Depth $h_{s\,cr}$ (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)
SWH 6	6 x 28	45	5	25	0.25	1.0
SWH 6W	6 x 48	60	6	45	1.5	1.25
SWH 8	8 x 28	32	7	25	1.1	2.0

- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance, concrete grade influences.

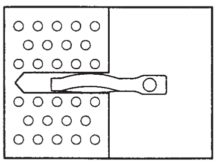
SWH 6



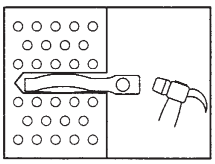
Drill to specified diameter and depth.



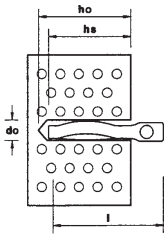
Clean the hole.



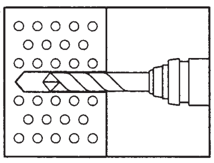
Insert SWH 6 into the hole.



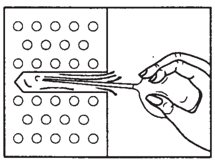
Hammer SWH 6 fully into the base material.



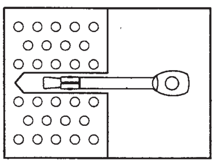
SWH 6W



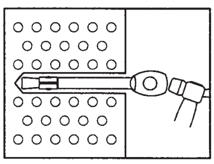
Drill to specified diameter and depth.



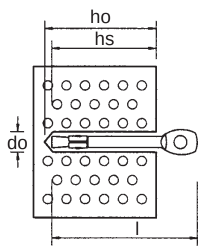
Clean the hole.



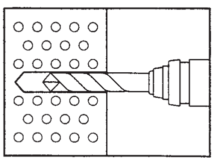
Insert SWH 6W into the hole.



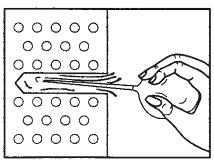
Hammer SWH 6W fully into the base material.



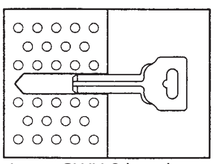
SWH 8



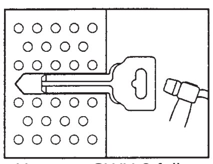
Drill to specified diameter and depth.



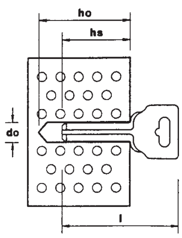
Clean the hole.



Insert SWH 8 into the hole.



Hammer SWH 8 fully into the base material.

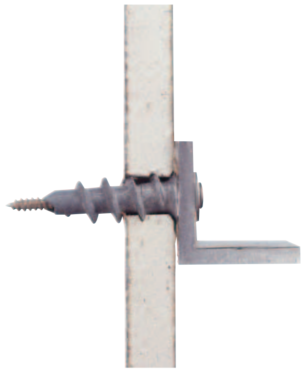


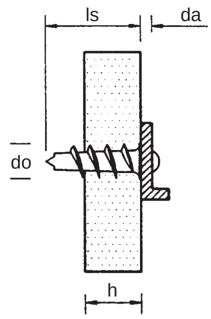
Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

38. Superfix Self-Drilling Fixing – SSF

Features:
Self-drill to fix and can be used with ordinary self-tapping screws.
Stays in place even when screw is removed so fixtures can be replaced.
Ideal for gypsum board, plaster board, panels and board buildings.

Material: Zinc alloy Z410





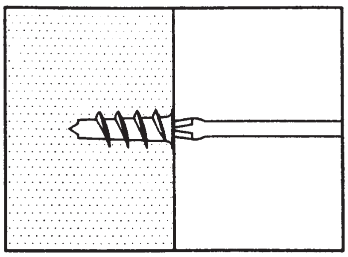
Product Range And Technical Data

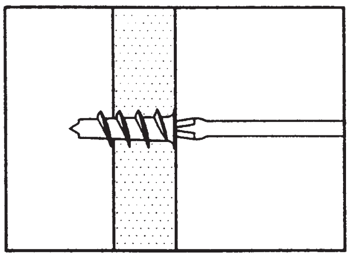
Description	Anchor Length l (mm)	Fixture Thickness d_a (mm)	Cavity Depth (mm)	Screw (not Provided) d_s x l_s (mm)
SSF 1	29	20	30	(4 ~ 4.2) x 40 (Gauge #8)
SSF 2	33	28	30	(3.2 ~ 3.5) x 68 (Gauge #6)

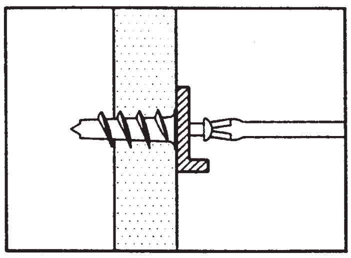
Description	Safe Tensile Resistance (Plywood)	Safe Shear Resistance (Plywood)	Safe Tensile Resistance (Gypsum Board)	Safe Shear Resistance (Gypsum Board)
SSF 1	0.25	0.4	0.07	0.1
SSF 2	0.25	0.4	0.07	0.1

- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26**.
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- No spacing, edge distance influences.

Installation

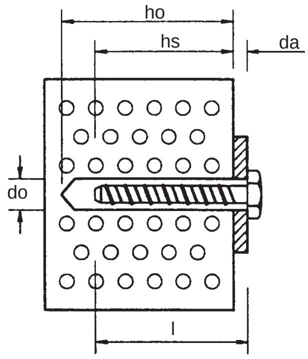

Install SSF into base material using a screwdriver


Screw SSF until it is flush with the surface.


Attach fixture to self-tapping screw into SSF and tighten.

39. Superfix Self-Tapping Bolt – STB

Features:
Light to medium load, self-tapping anchor.
Fast and efficient through fixing.
Ideal for carpenters, plumbers, electricians, builders, roofers, door and window installers, ventilation contractors, cladding contractors, and kitchen fitters.
Multi-substrate anchor – Concrete, Brick, Marble, Wood, Block, Stone.
Installation close to the edge is possible with no expansion forces during self-tapping process.
Threaded anchorage maintains its fix without preload.
Threading system allows for complete removal of anchor from substrate.
Galvanised steel, or stainless steel A4/316, or stainless steel A2/304.

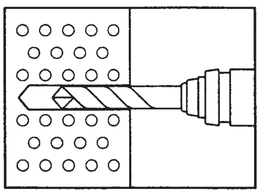


Product Range And Technical Data

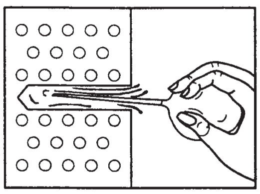
Description (Diameter & Length) (mm)	Drill Hole d_0 x h_o (mm)	Tighten Torque (Nm)	Fixture Thickness d_a (mm)	Fixture Hole (mm)	Char. Setting Depth $h_{s\ cr}$	Min. Spacing & Edge Distance (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)
STB 6 x 50F	6 x 40	15	20	8	30	50	1.6	0.9
STB 6 x 75F	6 x 40	15	45	8	30	50	1.6	0.9
STB 6 x 100F	6 x 40	15	55	8	30	50	1.6	0.9
STB 6 x 120F	6 x 40	15	75	8	30	50	1.6	0.9
STB 6 x 130F	6 x 40	15	85	8	30	50	1.6	0.9
STB 6 x 150F	6 x 40	15	105	8	30	50	1.6	0.9
STB 8 x 60	8 x 55	25	20	10	40	60	2.8	1.2
STB 8 x 75	8 x 55	25	35	10	40	60	2.8	1.2
STB 8 x 100	8 x 55	25	60	10	40	60	2.8	1.2
STB 10 x 75	10 x 70	40	25	12	50	70	3.0	1.9
STB 10 x 100	10 x 70	40	50	12	50	70	3.0	1.9
STB 10 x 150	10 x 70	40	100	12	50	70	3.0	1.9
STB 12 x 75	12 x 85	50	15	14	60	80	5.4	5.0
STB 12 x 100	12 x 85	50	40	14	60	80	5.4	5.0
STB 12 x 130	12 x 85	50	70	14	60	80	5.4	5.0
STB 12 x 150	12 x 85	50	90	14	60	80	5.4	5.0
STB 12 x 200	12 x 85	50	140	14	60	80	5.4	5.0

- All loads include a factor of safety of 5. See **Concept For Lightweight Fixings** on **Page 26.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.

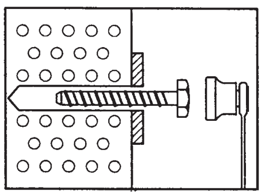
Installation



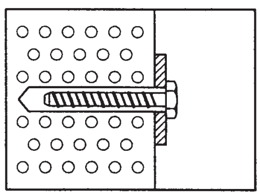
Drill to specified diameter and depth.



Clean the hole.



Attach fixture and tap STB into the base material.



Tighten the anchor.

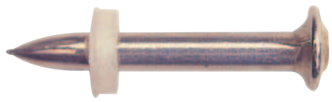
40. Superfix Powder-Actuated Tools & Drive Pins

Superfix Low Velocity Tool – LV360

Length	340 mm
Weight	2.4 kg
Drive Pins	72 mm
Feed	Automatic
Cartridges	6.8/11 mm

Features Of Superfix LV360

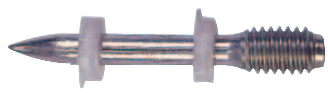
Automatic cartridge feeding system
Using 10 shots cartridge strip
Wide range of application
Simple maintenance and assembly



SN Drive Pins For LV360

Description	Shank Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)	Safe Tensile Resistance (Brick) (kN)	Safe Shear Resistance (Brick) (kN)
SN 19	19	19	0.7	1.2	0.4	0.8
SN 22	22	19	0.7	1.2	0.4	0.8
SN 25	25	19	0.7	1.2	0.4	0.8
SN 27	27	25	0.9	1.2	0.6	0.8
SN 32	32	25	0.9	1.2	0.6	0.8
SN 37	37	25	0.9	1.2	0.6	0.8
SN 52	52	25	0.9	1.2	0.6	0.8
SN 62	62	25	0.9	1.2	0.6	0.8
SN 72	72	25	0.9	1.2	0.6	0.8

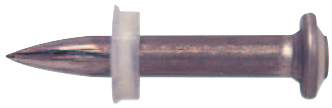
- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- For recommended depths, spacing and edge distances, please refer to **Page 33.**



SX Threaded Drive Pins For LV360

Description	Shank Length (mm)	Thread Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)	Safe Tensile Resistance (Brick) (kN)	Safe Shear Resistance (Brick) (kN)
SX 6-11-22	22	11	19	0.7	1.2	0.4	0.8
SX 6-11-27	27	11	25	0.9	1.2	0.6	0.8
SX 6-20-22	22	20	19	0.7	1.2	0.4	0.8
SX 6-20-27	27	20	25	0.9	1.2	0.6	0.8

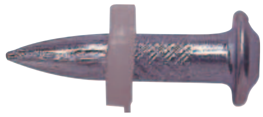
- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33**.
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- For recommended depths, spacing and edge distances, please refer to **Page 33**.



SNS Stainless Steel Drive Pins For LV360

Description	Shank Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)	Safe Tensile Resistance (Brick) (kN)	Safe Shear Resistance (Brick) (kN)
SNS 22	22	19	0.7	1.2	0.4	0.8
SNS 24	24	21	0.7	1.2	0.4	0.8
SNS 29	29	25	0.9	1.2	0.6	0.8

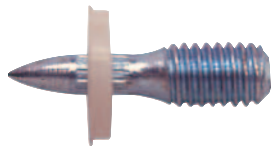
- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- For recommended depths, spacing and edge distances, please refer to **Page 33.**



SNK Knurled Drive Pins For LV360

Description	Shank Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Steel) (kN)	Safe Shear Resistance (Steel) (kN)
SNK 16	16	12	1.0	0.69
SNK 19	19	12	1.0	0.69
SNK 22	22	12	1.0	0.69

- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33**.
- For recommended depths, spacing and edge distances, please refer to **Page 33**.



SXK Knurled And Threaded Drive Pins For LV360

Description	Shank Length (mm)	Thread Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Steel) (kN)	Safe Shear Resistance (Steel) (kN)
SXK 6-11-12	12	11	12	1.2	1.2
SXK 6-20-12	12	20	12	1.2	1.2

- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33**.
- For recommended depths, spacing and edge distances, please refer to **Page 33**.

Cartridges For LV360

Description	Colour	Strength	No. Of Cartridges
6.8-11-W	White	Lowest	10
6.8-11-G	Green	Low	10
6.8-11-Y	Yellow	Medium	10
6.8-11-R	Red	High	10
6.8-11-B	Black	Highest	10

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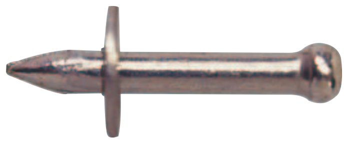
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

Superfix Low Velocity Tool – LV550

Length	350 mm
Weight	3.5 kg
Drive Pins	82 mm
Feed	Automatic
Cartridges	6.8/11 mm

Features Of Superfix LV550

Automatic cartridge feeding system
Using 10 shots cartridge strip
Wide range of application
Simple maintenance and assembly



SK Drive Pins For LV550

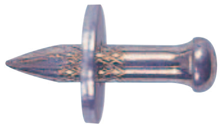
Description	Shank Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)	Safe Tensile Resistance (Brick) (kN)	Safe Shear Resistance (Brick) (kN)
SK 22	22	19	0.7	1.2	0.4	0.8
SK 25	25	19	0.7	1.2	0.4	0.8
SK 27	27	25	0.9	1.2	0.6	0.8
SK 32	32	25	0.9	1.2	0.6	0.8
SK 37	37	25	0.9	1.2	0.6	0.8
SK 52	52	25	0.9	1.2	0.6	0.8
SK 62	62	25	0.9	1.2	0.6	0.8
SK 72	72	25	0.9	1.2	0.6	0.8
SK 82	82	25	0.9	1.2	0.6	0.8

- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- For recommended depths, spacing and edge distances, please refer to **Page 33.**

SM Threaded Drive Pins For LV550

Description	Shank Length (mm)	Thread Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)	Safe Tensile Resistance (Brick) (kN)	Safe Shear Resistance (Brick) (kN)
SM 6-11-22	22	11	19	0.7	1.2	0.4	0.8
SM 6-11-27	27	11	25	0.9	1.2	0.6	0.8
SM 6-20-22	22	20	19	0.7	1.2	0.4	0.8
SM 6-20-27	27	20	25	0.9	1.2	0.6	0.8

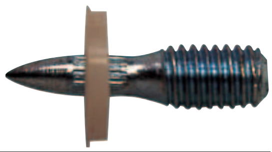
- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33**.
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- For recommended depths, spacing and edge distances, please refer to **Page 33**.



SKK Knurled Drive Pins For LV550

Description	Shank Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Steel) (kN)	Safe Shear Resistance (Steel) (kN)
SKK 16	16	12	1.2	1.2
SKK 19	19	12	1.2	1.2
SKK 22	22	12	1.2	1.2

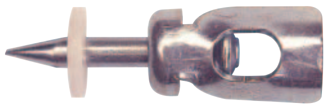
- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33**.
- For recommended depths, spacing and edge distances, please refer to **Page 33**.



SMK Knurled And Threaded Drive Pins For LV550

Description	Shank Length (mm)	Thread Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Steel) (kN)	Safe Shear Resistance (Steel) (kN)
SMK 6-11-12	12	11	12	1.5	0.8
SMK 6-20-12	12	20	12	1.5	0.8

- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33**.
- For recommended depths, spacing and edge distances, please refer to **Page 33**.



SB Eyelet Drive Pins For LV550

Description	Shank Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)	Safe Tensile Resistance (Brick) (kN)	Safe Shear Resistance (Brick) (kN)
SB 27	27	25	0.9	1.2	0.6	0.8
SB 32	32	25	0.9	1.2	0.6	0.8

- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33.**
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- For recommended depths, spacing and edge distances, please refer to **Page 33.**

Cartridges For LV550

Description	Colour	Strength	No. Of Cartridges
6.8-11-W	White	Lowest	10
6.8-11-G	Green	Low	10
6.8-11-Y	Yellow	Medium	10
6.8-11-R	Red	High	10
6.8-11-B	Black	Highest	10

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Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

Superfix High Velocity Tool – HV660

Length	355 mm
Weight	3.0 kg
Drive Pins	100 mm
Feed	Single
Cartridges	5.6/15 mm

Features Of Superfix HV660

Manual cartridge feeding system
Using single shot cartridge
Wide range of application for concrete
Simple maintenance and assembly

SH Drive Pins For HV660

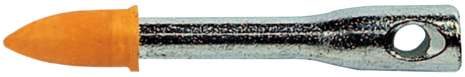
Description	Shank Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)	Safe Tensile Resistance (Brick) (kN)	Safe Shear Resistance (Brick) (kN)
SH 25	25	25	1.0	1.2	0.6	0.8
SH 30	30	25	1.0	1.2	0.6	0.8
SH 40	40	25	1.0	1.2	0.6	0.8
SH 50	50	25	1.0	1.2	0.6	0.8
SH 60	60	25	1.0	1.2	0.6	0.8
SH 80	80	25	1.0	1.2	0.6	0.8
SH 100	100	25	1.0	1.2	0.6	0.8

- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33**.
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- For recommended depths, spacing and edge distances, please refer to **Page 33**.

ST Threaded Drive Pins For HV660

Description	Shank Length (mm)	Thread Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)	Safe Tensile Resistance (Brick) (kN)	Safe Shear Resistance (Brick) (kN)
ST 6-20-25	25	20	25	1.0	1.2	0.6	0.8
ST 6-20-32	32	20	25	1.0	1.2	0.6	0.8
ST 9-20-32	32	20	25	1.0	1.2	0.6	0.8
ST 9-32-25	25	32	25	1.0	1.2	0.6	0.8

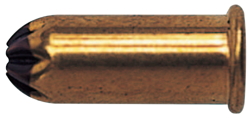
- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33**.
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- For recommended depths, spacing and edge distances, please refer to **Page 33**.



EP Eyelet Drive Pins For HV660

Description	Shank Length (mm)	Setting Depth (mm)	Safe Tensile Resistance (Concrete) (kN)	Safe Shear Resistance (Concrete) (kN)	Safe Tensile Resistance (Brick) (kN)	Safe Shear Resistance (Brick) (kN)
EP 40	40	25	1.0	1.2	0.6	0.8

- All loads include a factor of safety of 5. See **Drive Pins Fastening Concept** on **Page 33**.
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2.
- For recommended depths, spacing and edge distances, please refer to **Page 33**.



Cartridges For HV660

Description	Colour	Strength	No. Of Cartridges
5.6-15-G	Green	Low	1
5.6-15-Y	Yellow	Medium	1
5.6-15-R	Red	High	1
5.6-15-P	Purple	Highest	1

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5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

41. Superfix Self-Drilling Screws – SDS

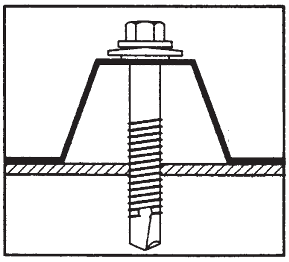
Superfix Self-Drilling Screws can be applied for most wall cladding, roofing, air-con ducting, steel and aluminium works. For screwing into wood, the Hex Washer Flange Type 17 has a wide range of screw lengths and comes with an EPDM washer. For screwing into steel, the screws available are the Hex Washer Flange (comes with an EPDM washer), Hex Washer Head, Pan Head Phillips, Countersunk Head Phillips, and Wafer Head Phillips. For resistance to corrosion, Superfix has screws, which conform to Class 1, Class 2, and Class 3 of AS 3566 for the salt spray test.

Superfix Self-Drilling Screws are made of galvanised steel (C-1022), corrosion resistant, and manufactured with conformance to DIN 7054. The EPDM washers (Ethylene/Propylene Diene Copolymers) have rubber-like properties and create watertight fixings, and resist temperatures of up to 142°C.

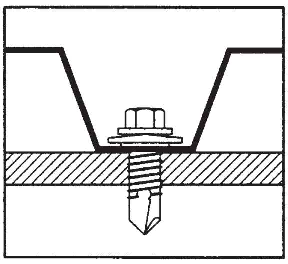
Other available materials: Stainless Steel A2/304
Other available coating: Magni, Kesternich SO_2, Ruspert

Applications For Steel Works

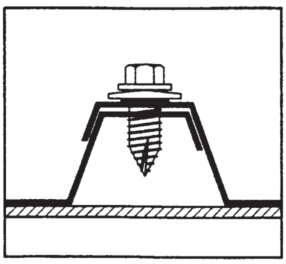
Crest-Fixing



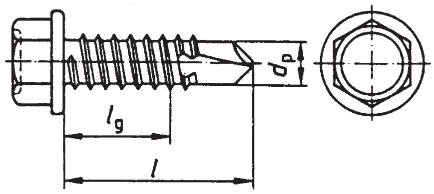
Valley-Fixing



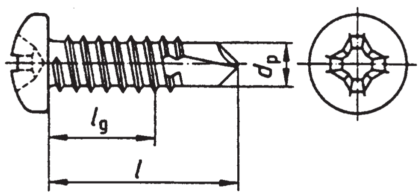
Side lap-Fixing



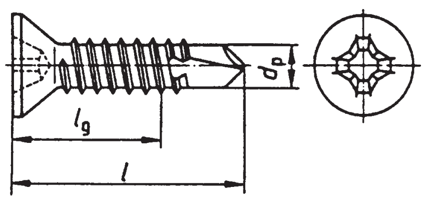
Grip Length Of Self-Drilling Screws



l_g: Grip Length



l_g: Grip Length

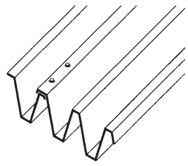


l_g: Grip Length

Hex Washer Flange Type 17 (Wood Screw) C/W EPDM – HWW

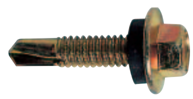
HWW

Description	Diameter (mm)	Length l (mm)	Grip Length l_g (mm)	Safe Tensile Resistance (kN)	Safe Shear Resistance (kN)
HWW #12 – 11x19	5.5	19	7	1.0	0.68
HWW #12 – 11x25	5.5	25	13	1.0	0.68
HWW #12 – 11x35	5.5	35	23	1.0	0.68
HWW #12 – 11x38	5.5	38	26	1.0	0.68
HWW #12 – 11x50	5.5	50	38	1.0	0.68
HWW #12 – 11x63	5.5	63	51	1.0	0.68
HWW #12 – 11x75	5.5	75	63	1.0	0.68
HWW #12 – 11x90	5.5	90	78	1.0	0.68
HWW #12 – 11x100	5.5	100	88	1.0	0.68
HWW #12 – 11x125	5.5	125	113	1.0	0.68

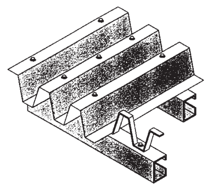


Hex Washer Flange C/W EPDM – HWF

HWF

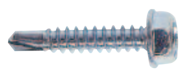


Description	Diameter (mm)	Length l (mm)	Grip Length l_g (mm)	Drilling Capacity (mm)	Drill Point Diameter d_p (mm)	Safe Tensile Resistance (kN)	Safe Shear Resistance (kN)
HWF #12 – 24x19	5.5	19	6	5.25	4.8	2.0	0.68
HWF #12 – 24x25	5.5	25	12	5.25	4.8	2.0	0.68
HWF #12 – 24x35	5.5	35	22	5.25	4.8	2.0	0.68
HWF #12 – 24x38	5.5	38	25	5.25	4.8	2.0	0.68
HWF #12 – 24x45	5.5	45	32	5.25	4.8	2.0	0.68
HWF #12 – 24x50	5.5	50	37	5.25	4.8	2.0	0.68
HWF #12 – 24x55	5.5	55	42	5.25	4.8	2.0	0.68
HWF #12 – 24x63	5.5	63	50	5.25	4.8	2.0	0.68
HWF #12 – 24x75	5.5	75	62	5.25	4.8	2.0	0.68
HWF #12 – 24x90	5.5	90	77	5.25	4.8	2.0	0.68
HWF #12 – 24x100	5.5	100	87	5.25	4.8	2.0	0.68
HWF #12 – 24x125	5.5	125	112	5.25	4.8	2.0	0.68

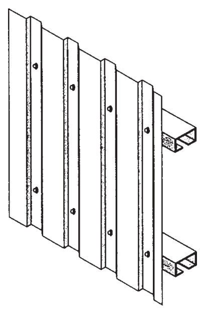


Hex Washer Head – HWH

HWH



Description	Diameter (mm)	Length l (mm)	Grip Length l_g (mm)	Drilling Capacity (mm)	Drill Point Diameter d_p (mm)	Safe Tensile Resistance (kN)	Safe Shear Resistance (kN)
HWH #10 – 16x13	4.8	13	3.7	4.4	4.1	1.9	0.52
HWH #10 – 16x16	4.8	16	5.8	4.4	4.1	1.9	0.52
HWH #10 – 16x19	4.8	19	8.7	4.4	4.1	1.9	0.52
HWH #10 – 16x25	4.8	25	14.6	4.4	4.1	1.9	0.52
HWH #10 – 16x32	4.8	32	21.5	4.4	4.1	1.9	0.52
HWH #10 – 16x38	4.8	38	27.5	4.4	4.1	1.9	0.52
HWH #10 – 16x50	4.8	50	39.5	4.4	4.1	1.9	0.52
HWH #12 – 14x19	5.5	19	8	5.25	4.8	2.0	0.68
HWH #12 – 14x25	5.5	25	14	5.25	4.8	2.0	0.68
HWH #12 – 14x32	5.5	32	21	5.25	4.8	2.0	0.68
HWH #12 – 14x38	5.5	38	27	5.25	4.8	2.0	0.68
HWH #12 – 14x50	5.5	50	39	5.25	4.8	2.0	0.68
HWH #12 – 14x75	5.5	75	64	5.25	4.8	2.0	0.68



• All loads include a factor of safety of 5.
* All screws for drilling into steel (diameter 4.8mm and 5.5mm) are of Drill Point #3.

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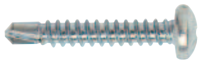
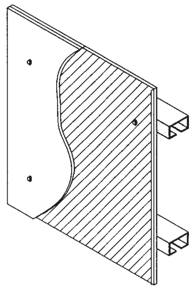
Pan Head Phillips – PHP

PHP

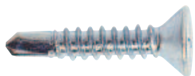


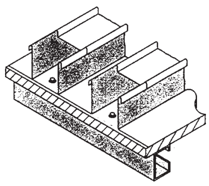


Description	Diameter (mm)	Length l (mm)	Grip Length l_g (mm)	Drilling Capacity (mm)	Drill Point Diameter d_p (mm)	Safe Tensile Resistance (kN)	Safe Shear Resistance (kN)
PHP #6 – 20x10	3.5	10	2.85	2.25	2.8	0.77	0.43
PHP #6 – 20x13	3.5	13	6.2	2.25	2.8	0.77	0.43
PHP #6 – 20x16	3.5	16	9.2	2.25	2.8	0.77	0.43
PHP #6 – 20x19	3.5	19	12.1	2.25	2.8	0.77	0.43
PHP #6 – 20x25	3.5	25	18.1	2.25	2.8	0.77	0.43
PHP #8 – 18x10	4.2	10	1.3	3	3.6	1.58	0.48
PHP #8 – 18x13	4.2	13	4.3	3	3.6	1.58	0.48
PHP #8 – 18x16	4.2	16	7.3	3	3.6	1.58	0.48
PHP #8 – 18x19	4.2	19	10.3	3	3.6	1.58	0.48
PHP #8 – 18x25	4.2	25	16.3	3	3.6	1.58	0.48
PHP #8 – 18x32	4.2	32	23	3	3.6	1.58	0.48
PHP #8 – 18x35	4.2	35	26	3	3.6	1.58	0.48
PHP #8 – 18x38	4.2	38	29	3	3.6	1.58	0.48
PHP #8 – 18x50	4.2	50	41	3	3.6	1.58	0.48

Countersunk Head Phillips – CSK

CSK





Description	Diameter (mm)	Length l (mm)	Grip Length l_g (mm)	Drilling Capacity (mm)	Drill Point Diameter d_p (mm)	Safe Tensile Resistance (kN)	Safe Shear Resistance (kN)
CSK #6 – 20x13	3.5	13	6.2	2.25	2.8	0.77	0.43
CSK #6 – 20x16	3.5	16	9.2	2.25	2.8	0.77	0.43
CSK #6 – 20x19	3.5	19	12.1	2.25	2.8	0.77	0.43
CSK #6 – 20x25	3.5	25	18.1	2.25	2.8	0.77	0.43
CSK #6 – 20x32	3.5	32	25.9	2.25	2.8	0.77	0.43
CSK #6 – 20x38	3.5	38	31.9	2.25	2.8	0.77	0.43
CSK #8 – 18x13	4.2	13	4.3	3	3.6	1.58	0.48
CSK #8 – 18x16	4.2	16	7.3	3	3.6	1.58	0.48
CSK #8 – 18x19	4.2	19	10.3	3	3.6	1.58	0.48
CSK #8 – 18x25	4.2	25	16.3	3	3.6	1.58	0.48
CSK #8 – 18x32	4.2	32	23	3	3.6	1.58	0.48
CSK #8 – 18x38	4.2	38	29	3	3.6	1.58	0.48
CSK #8 – 18x50	4.2	50	41	3	3.6	1.58	0.48
CSK #8 – 18x25R	4.2	25	16.3	3	3.6	1.58	0.48
CSK #8 – 18x32R	4.2	32	23	3	3.6	1.58	0.48
CSK #10 – 18x13	4.8	13	3.5	4.4	4.1	1.9	0.52
CSK #10 – 18x16	4.8	16	5.8	4.4	4.1	1.9	0.52
CSK #10 – 18x19	4.8	19	8.7	4.4	4.1	1.9	0.52
CSK #10 – 18x25	4.8	25	14.7	4.4	4.1	1.9	0.52
CSK #10 – 18x32	4.8	32	21.5	4.4	4.1	1.9	0.52
CSK #10 – 18x38	4.8	38	27.5	4.4	4.1	1.9	0.52
CSK #10 – 18x50	4.8	50	39.5	4.4	4.1	1.9	0.52

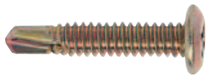
- All loads include a factor of safety of 5.

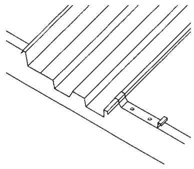
* All screws for drilling into steel (diameter 4.8mm) are of Drill Point #3.

** All screws for drilling into steel (diameter 3.5mm and 4.2mm) are of Drill Point #2.

Wafer Head Phillips – WHP

WHP



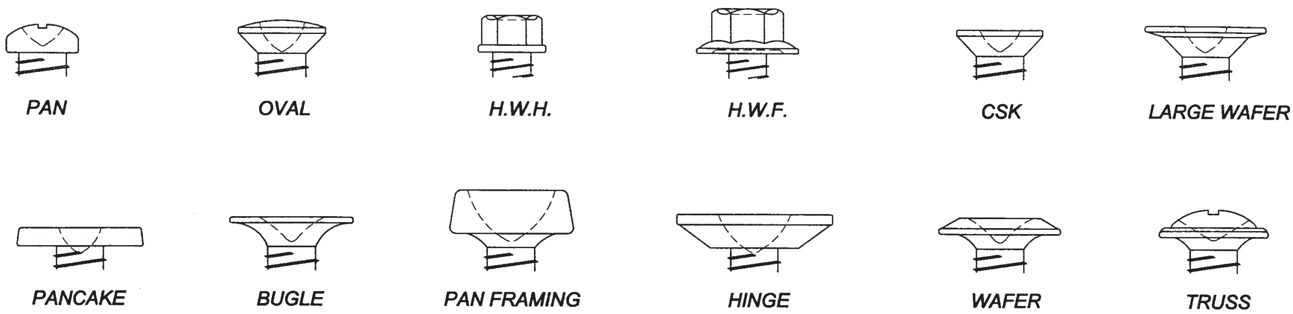


Description	Diameter (mm)	Length l (mm)	Grip Length l_g (mm)	Drilling Capacity (mm)	Drill Point Diameter d_p (mm)	Safe Tensile Resistance (kN)	Safe Shear Resistance (kN)
WHP #10 – 24x16	4.8	16	5.8	4.4	4.1	1.9	0.52
WHP #10 – 24x19	4.8	19	8.7	4.4	4.1	1.9	0.52
WHP #10 – 24x22	4.8	22	11.7	4.4	4.1	1.9	0.52
WHP #10 – 24x25	4.8	25	14.7	4.4	4.1	1.9	0.52
WHP #10 – 24x32	4.8	32	21.5	4.4	4.1	1.9	0.52
WHP #10 – 24x38	4.8	38	27.5	4.4	4.1	1.9	0.52

- All loads include a factor of safety of 5.

* All screws for drilling into steel (diameter 4.8mm) are of Drill Point #3.

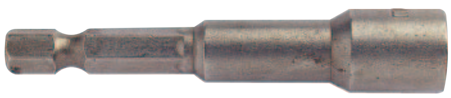
Other Head Types Available



SDS Accessories

Phillips Bit for Phillips Head Self-Drilling Screw	
Description	Length (mm)
#2	65

Hex Socket Bit for Hex Washer Self-Drilling Screw	
Description	Length (mm)
#8	65



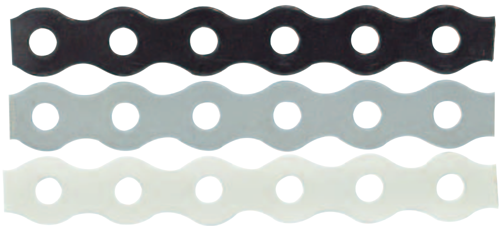
Material: Chrome Vanadium Steel.

Installation Guidelines

- For screw diameters of 3.5mm to 4.8mm, install using electric screwdriver with power rating of 600 watts and a variable speed of 1800 to 2500 RPM.
- For screw diameters of 5.5mm, install using electric screwdriver with power rating of 600 watts and a variable speed of 1000 to 1800 RPM.

42. Superfix Flexible Band – SFB

Galvanised:	Cold-rolled steel strip
Copper:	Half-hard copper strip
Stainless Steel:	Acid resisting stainless steel strip
Aluminium:	Soft aluminium strip
PVC Coat:	Resistant to seawater, fat and petrol-chemical. -100°C to 60°C. Good electrical insulator.



Superfix Flexible Band Galvanised (10 m/coil) – SFB-GV

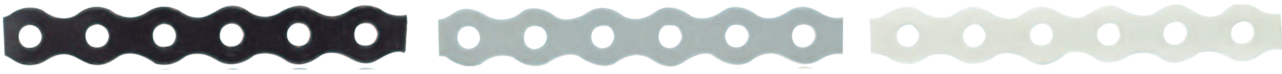
Description	Length Of Coil (m)	Average Ultimate Tensile Capacity (kN)	Safe Tensile Resistance F_N (kN)
AR 12 GV	10	0.83	0.16
AR 17 GV	10	1.15	0.23
AR 26 GV	10	2.55	0.51

Superfix Flexible Band Coated With Black PVC (10 m/coil) – SFB-PB

Description	Length Of Coil (m)	Average Ultimate Tensile Capacity (kN)	Safe Tensile Resistance F_N (kN)
AR 12 PB	10	0.83	0.16
AR 17 PB	10	1.13	0.22
AR 26 PB	10	2.5	0.5

Superfix Flexible Band Coated With Grey PVC (10 m/coil) – SFB-PG

Description	Length Of Coil (m)	Average Ultimate Tensile Capacity (kN)	Safe Tensile Resistance F_N (kN)
AR 12 PG	10	0.83	0.16
AR 17 PG	10	1.13	0.22
AR 26 PG	10	2.5	0.5



Superfix Flexible Band Coated With White PVC (10 m/coil) – SFB-PW

Description	Length Of Coil (m)	Average Ultimate Tensile Capacity (kN)	Safe Tensile Resistance F_N (kN)
AR 12 PW	10	0.83	0.16
AR 17 PW	10	1.13	0.22
AR 26 PW	10	2.5	0.50

Superfix Flexible Band Copper (10 m/coil) – SFB-CP

Description	Length Of Coil (m)	Average Ultimate Tensile Capacity (kN)	Safe Tensile Resistance F_N (kN)
AR 12 CP	10	0.59	0.11
AR 17 CP	10	0.78	0.15
AR 26 CP	10	1.81	0.36

Superfix Flexible Band Stainless Steel (10 m/coil) – SFB-SS

Description	Length Of Coil (m)	Average Ultimate Tensile Capacity (kN)	Safe Tensile Resistance F_N (kN)
AR 12 SS	10	0.98	0.19
AR 17 SS	10	1.47	0.29
AR 26 SS	10	3.04	0.60

Superfix Flexible Band Aluminium (10 m/coil) – SFB-AL

Description	Length Of Coil (m)	Average Ultimate Tensile Capacity (kN)	Safe Tensile Resistance F_N (kN)
AR 12 AL	10	0.29	0.05
AR 17 AL	10	0.39	0.07

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

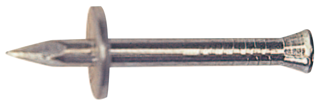
43. Superfix Hand Drive Tool & Hammer Pins – HDT, MP

Hand Drive Tool – HDT 50

- Safe and handy
- Wide range of application
- D.I.Y. fixture fitting

Miki Pin For HDT 50 – MP

Description	Shank Length (mm)
MP 16	16
MP 20	20
MP 25	25



44. Superfix Spindle Pin – SSP

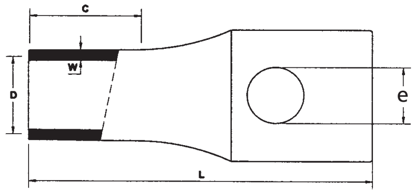
Description	Shank Length (mm)
SSP 38	38
SSP 65	65
SSP 80	80
SSP 100	100
SSP 115	115

Description	Shank Length (mm)
SSP 38A	38
SSP 65A	65
SSP 80A	80
SSP 100A	100
SSP 115A	115

Description	Volume / Tube (ml)
SP 50	200

45. Superfix Cast-In Socket – SCS

Features:
Medium load, cast-in anchor.
Tested for straight bar and hook bar steel anchorages of yield stress 460 N/mm^2.
Ideal for lifting of light precast components.
Galvanised steel, or stainless steel A4/316, or stainless steel A2/304.



Product Range And Technical Data

Description	Thread Length c (mm)	Thread	Eye Diameter e (mm)	Length l (mm)	Thickness w (mm)
M12-55	20	M12	10.3	55	1.5
M12-60	20	M12	10.3	60	2.0
M12-65	25	M12	10.3	65	2.0
M12-80	40	M12	10.3	80	1.5
M16-70	25	M16	12.3	70	2.5
M16-80	30	M16	12.3	80	2.5
M16-100	50	M16	12.3	100	2.5
M16-120	30	M16	12.3	120	2.5
M20-95	40	M20	14.3	95	3.0
M20-120	50	M20	14.3	120	3.5

Description	Straight Bar SB (Total Length)	SB Safe Working Load		Hook Bar HB (Length On Each Side)	HB Safe Working Load	
		Tension (kN)	Shear (kN)		Tension (kN)	Shear (kN)
M12-55	T10 x 150 mm	5.6	7.9	T10 x 300 mm	6.8	9.7
M12-60	T10 x 150 mm	5.6	7.9	T10 x 300 mm	6.8	9.7
M12-65	T10 x 150 mm	5.6	7.9	T10 x 300 mm	6.8	9.7
M12-80	T10 x 150 mm	5.6	7.9	T10 x 300 mm	6.8	9.7
M16-70	T10 x 150 mm	10.2	12.3	T10 x 350 mm	12.5	15.0
M16-80	T10 x 150 mm	10.2	12.3	T10 x 350 mm	12.5	15.0
M16-100	T10 x 150 mm	10.2	12.3	T10 x 350 mm	12.5	15.0
M16-120	T10 x 150 mm	10.2	12.3	T10 x 350 mm	12.5	15.0
M20-95	T13 x 150 mm	15.9	15.9	T13 x 400 mm	19.5	17.7
M20-120	T13 x 150 mm	15.9	15.9	T13 x 400 mm	19.5	17.7

- All loads include a factor of safety of 5.
- All loads for concrete are derived from static load tests on non-cracked concrete of f_{CU} = 30 N/mm^2, apply adjustment factor f_B for other concrete grades.
  $f_B = 0.02 (f_{CU} - 30) + 1 \leq 1.1$ (Tension)
  ≤ 1.0 (Shear)

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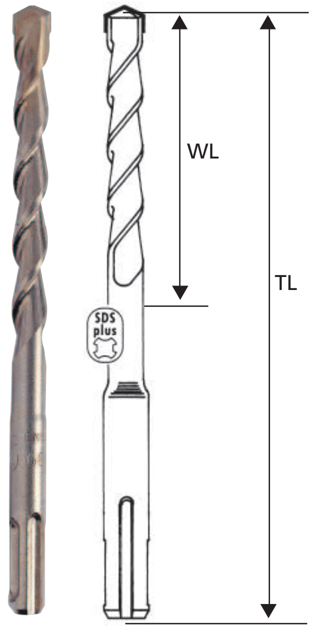
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg

46. Superfix Drill Bits – DBP, DBM

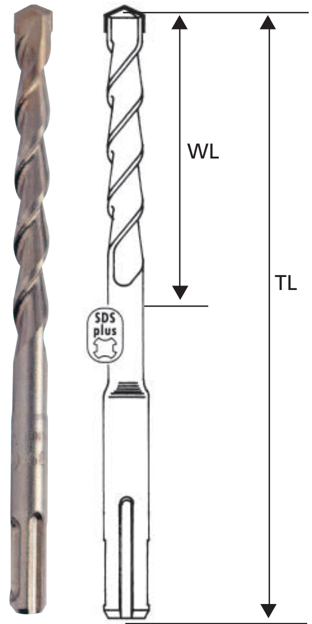
Features:
Dust and debris are removed quickly via the short, straight reliefs and carried away by the asymmetrical double flute.
Constantly updated hardening and brazing techniques ensure a consistently high-quality construction and superior life.
Drill bits of 5 ~ 25 mm diameters ensure convenient usage for a wide range of applications.
When using drill bits longer than 600 mm, it is necessary to drill to a depth of at least 150 mm using a shorter drill bit of the same diameter.



Drill Bit Plus (DBP)

Description	Diameter (mm)	Total Length (mm)	Working Length (mm)
DBP 5	5	110	50
DBP 5	5	160	100
DBP 5.5	5.5	110	50
DBP 5.5	5.5	120	60
DBP 5.5	5.5	160	100
DBP 6	6	110	50
DBP 6	6	120	60
DBP 6	6	160	100
DBP 6.5	6.5	120	60
DBP 6.5	6.5	160	100
DBP 7	7	110	50
DBP 7	7	160	100
DBP 8	8	110	50
DBP 8	8	130	70
DBP 8	8	160	100
DBP 9	9	160	100
DBP 9	9	210	150
DBP 10	10	110	50
DBP 10	10	130	70
DBP 10	10	160	100
DBP 10	10	210	150
DBP 11	11	160	100
DBP 11	11	250	200

Features:
Dust and debris are removed quickly via the short, straight reliefs and carried away by the asymmetrical double flute.
Constantly updated hardening and brazing techniques ensure a consistently high-quality construction and superior life.
Drill bits of 5 ~ 25 mm diameters ensure convenient usage for a wide range of applications.
When using drill bits longer than 600 mm, it is necessary to drill to a depth of at least 150 mm using a shorter drill bit of the same diameter.



Drill Bit Plus (DBP)

Description	Diameter (mm)	Total Length (mm)	Working Length (mm)
DBP 12	12	160	100
DBP 12	12	200	150
DBP 12	12	250	200
DBP 12	12	300	250
DBP 13	13	150	100
DBP 13	13	200	150
DBP 13	13	250	200
DBP 13	13	300	250
DBP 14	14	150	100
DBP 14	14	200	150
DBP 14	14	250	200
DBP 15	15	150	100
DBP 15	15	200	150
DBP 15	15	250	200
DBP 16	16	150	100
DBP 16	16	200	150
DBP 16	16	300	250
DBP 16	16	450	400
DBP 18	18	200	150
DBP 18	18	250	200
DBP 18	18	300	250
DBP 20	20	200	150
DBP 20	20	300	250
DBP 20	20	450	400
DBP 22	22	250	200
DBP 22	22	450	400
DBP 24	24	250	200
DBP 24	24	450	400
DBP 25	25	250	200
DBP 25	25	450	400

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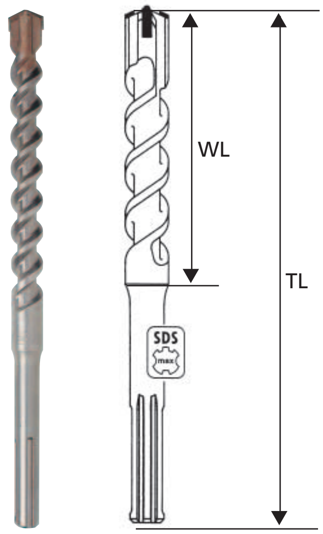
Features:
The short spiral inlets and the spacious fluting of the double spiral ensure rapid removal of dust and debris.
The two additional minor cutting edges protect the bit on contact with reinforcement bars and help to prevent damage to the drill head.
When using drill bits longer than 600 mm, it is necessary to drill to a depth of at least 150 mm using a shorter drill bit of the same diameter.



Drill Bit Max (DBM)

Description	Diameter (mm)	Total Length (mm)	Working Length (mm)
DBM 12	12	390	250
DBM 12	12	540	400
DBM 13	13	390	250
DBM 13	13	540	400
DBM 14	14	390	250
DBM 14	14	540	400
DBM 15	15	390	250
DBM 15	15	540	400
DBM 16	16	390	250
DBM 16	16	540	400
DBM 16	16	920	770
DBM 18	18	390	250
DBM 18	18	540	400
DBM 19	19	390	250
DBM 19	19	540	400
DBM 20	20	370	250
DBM 20	20	520	400
DBM 20	20	920	800
DBM 22	22	370	250
DBM 22	22	520	400
DBM 22	22	920	800
DBM 24	24	370	250
DBM 24	24	520	400
DBM 25	25	370	250
DBM 25	25	520	400
DBM 25	25	920	800
DBM 26	26	370	250
DBM 26	26	520	400
DBM 28	28	370	250
DBM 28	28	570	450
DBM 30	30	370	250
DBM 30	30	570	450
DBM 32	32	370	250
DBM 32	32	570	450
DBM 32	32	920	800
DBM 35	35	370	250
DBM 35	35	570	450
DBM 38	38	370	250
DBM 38	38	570	450
DBM 40	40	370	250
DBM 40	40	570	450

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Sales Agreement

1. Agreement for sale

The Seller agrees to sell and the Buyer agrees to buy the Goods at the total purchase price stated in the Purchase Order accepted by the Seller and on the terms and conditions set out in the Purchase Order, and the terms and conditions herein which form part of this agreement. Property in, and risk of loss or damage to, the Goods shall pass to the Buyer as soon as the Seller accepts the Buyer's Purchase Order.

2. Payment

The Buyer will pay the Initial Payment (if any) to the Seller on or before the signing of this agreement, and will pay the balance of the total purchase price to the Seller at the address stated (or at such other address as the Seller may specify in writing to the Buyer at the expiry of 30 days from the date of delivery of the goods / acceptance of the Purchase Order by the Seller. Payments by post shall be at the risk of the Buyer.

3. Seller's remedies

The Buyer acknowledges that punctual payment of the balance of the total purchase price is of the essence of this agreement, and that, if the Credit Limit is exceeded and / or if, the Initial Payment or the balance of the total purchase price or any part thereof remains unpaid for more than 7 days after becoming due, the Buyer will be deemed to have repudiated this agreement and:

3.1 the full remaining balance of the total purchase price shall immediately become due and payable with interest rate which is 2% above the average prime rate of The Development Bank of Singapore Limited from time to time in force, such interest to accrue from day to day and to run after as well as before any judgement; and

3.2 the Seller shall have the option to resell the Goods and on such resale:

3.2.1 this agreement shall be withdrawn, clause 3.1 shall cease to have effect and the Buyer will cease to have any property or interest in the Goods, but notwithstanding such withdrawal, the Seller will be entitled to retain all payments made by the Buyer under this agreement and to recover from the Buyer the amount of any deficiency in the total purchase price shown after resale together with interest and costs as provided below;

3.2.2 the Buyer will at the Buyer's own expense deliver up possession of the Goods to the purchaser at such address within Singapore as the purchaser may require, and on default the Buyer will indemnify the Seller against all loss and expense sustained by the Seller as a result of such default including, but not limited to the amount of any liability the Seller may insure to the purchaser by reason of the Buyer's default; and

3.2.3 except for the payment of any surplus payable to the Buyer pursuant to clause 4 below, all liabilities of the Seller to the Buyer shall be extinguished and the Buyer will have no rights or claims against the Seller of any kind whatsoever under or arising out of this agreement.

4. Proceeds of resale

The proceeds of any resale under clause 3.2 above shall, after deducting the costs and expenses of insurance (if any), storage, transport and resale, be applied in paying to the Seller the unpaid balance of the total purchase price and interest payable under this agreement with all costs incurred by the Seller (including legal costs on a full indemnity basis) in taking steps to enforce payment by the Buyer or to locate and resell the Goods. If such proceeds of sale are insufficient for that purpose, the Buyer will pay to the Seller on demand the amount of the deficiency. If such proceeds of sale exceed the amount to be paid to or retained by the Seller under this clause, the excess shall be paid to the Buyer, but the Seller will be entitled to retain and set off against what would otherwise be due to the Buyer under this clause such sum as in the sole opinion of the Seller necessary to provide the Seller with the Indemnities due to the Seller from the Buyer under this agreement.

5. Insurance

The Buyer will keep the Goods insured in their full replacement value and with Insurers to be approved by the Seller against loss or damage by fire and such other risks (including third party risks) as are usually covered by insurance in the type of business for which the Goods are for the time being used and such further risks as the Seller reasonably requires in making good the damage; or if the Goods are damaged beyond repair in replacing the Goods by other similar Goods to which the terms of this agreement shall apply.

6. Indemnity against third party claims

As an obligation surviving termination of this agreement, the Buyer will indemnify the Seller in respect of any claims made against the Seller and all damages, costs and expenses suffered or incurred by the Seller as a result of a claim made by a third party arising out of the state, condition or use of the Goods, or in any way arising out of the Goods being sold under this agreement.

7. Condition of Goods

It is now mutually agreed that:

7.1 The Buyer declares that he has examined the Goods and that they are in every respect satisfactory;

7.2 The Seller does not sell the Goods subject to any condition or warranty, express or implied, save those implied by the provisions of the Sale of Goods Act (Cap 393) Section 12 (relating to the title of the Seller to the Goods), so that (without prejudice to the generality of the foregoing) there is excluded:

7.2.1 any condition of fitness of the Goods for any particular purpose;

7.2.2 in cases where the Goods are sold by reference to a description, any condition that the Goods will correspond with the description; or

7.2.3 where the Goods are sold by reference to a sample, any condition that the bulk will correspond with the sample in quality, that the Buyer will have a reasonable opportunity of comparing the bulk with the sample, and that the Goods will be free from any defect rendering them unmerchantable which would not be apparent on reasonable examination of the sample; and

7.2.4 any condition of merchantable quality in respect of the Goods.

8. Notices

Any notice or demand served under this agreement shall be sufficiently served if sent by prepaid letter post or telex to the usual or last known place of business of the addressee, and proof of dispatch shall be conclusive evidence of receipt by the addressee in due course of transmission.

9. Disclosure

The Seller may disclose details of and relating to the transaction evidenced by this agreement to any credit reference agency or any other party at the Seller's discretion, and the Seller may refuse to enter into this agreement without stating a reason.

10. Interpretation and miscellaneous

10.1 The clause headings do not form part of this agreement and shall not be taken into account in its construction or interpretation.

10.2 Words importing one gender include all other genders and words importing the singular include the plural and vice versa.

10.3 References to the Seller shall where the context so admits include the Seller's successors in the tile and references to the Goods include all replacements and renewals of the Goods and all accessories and additions to the Goods.

10.4 The rights conferred on the Seller under this agreement shall be in addition to, and not in substitution for, any rights conferred on the Seller by the Sale of Goods Act (Cap 393) or at common law.

10.5 This agreement contains all the terms agreed between the Seller and the Buyer. The Buyer has not relied upon any representation or warranty by the Seller except as expressly stated or referred to in this agreement. No variation of this agreement shall be effective unless it be in writing and signed by or on behalf of the Seller and the Buyer. The rights of the Seller under this agreement shall not in any way be affected by any time or other indulgence granted by the Seller.

10.6 Any reference in this agreement to a statutory provision shall be construed as a reference to that provision as from time to time amended or re-enacted.

SUPERFIX®

Superfix is keen to establish a worldwide network of distributors and business partners. We look forward to technical discussions on anchor fastening systems, sharing of knowledge and expertise, and building up multi-party, beneficial business relationships in an era where society and the world becomes a global village. We are adaptable to changes and embrace Information Technology as a necessary step towards excellence in customer service.

Share our vision. Join us as a business partner. Together, we can be more competitive and reach out more effectively to our customers to serve them better.

Authorised Distributor

Superfix (Singapore) Pte Ltd
5 Yishun Industrial Street 1, North Spring BizHub #07-08, Singapore 768161
Tel: (65) 6748 2122 Fax: (65) 6747 9838 Email: sales@superfix.com.sg Website: www.superfix.com.sg