Ramset™

Fixing Design Guide

SPIT ANCHOR SOFTWARE

i-EXPERT by SPIT

Interface 3D

A userfriendly 3D visual interface

The new one I-Expert software allows you to create 3D design models of all your applications:

- Rectangular, circular, triangular base plates;
- Predefined applications such as safety barriers, brackets, lamp post, metallic stand for framework;
- Post installed rebar connections;

A logical and intuitive interface

A logical and intuitive interface

The main menu guides you through the easy to follow steps:

- Selection of the application,
- Definition of the dimensions of the base plate,
- Defintion of thee concrete base material and the environmental conditions,
- Data input of combined forces ie : tensile, shear, bending moment, torsion moment…

A userfriendly result display

A userfriendly result display

From the resulting display, by using filter you can select the optimal anchor, have access to the resistance tables for the group of anchors, the installation data and edit the calculation sheet in PDF format.

You can also select one anchor and run the manual and automatic optimisation program.

Custom mode

WITH THE CUSTOM MOD, I-EXPERT HAS NO LIMITS

It gives the possibility to design applications with unlimited fixings and defines the position coordinates of each anchors

Calculation method

EUROPEAN CALCULATION METHOD

The new I-Expert software allows you to design according to the following calculation methods :

- Design according to ETAG 001 Annex C (Amended September 2010);
- Design according to Technical Report TR029 (amended September 2010) for chemical anchors with variable embedment);
- Design resistance to fire according to Technical report TR020;
- Design of anchorage under seismic actions according to TR045 technical report;
- Design rebar reinforcement according to Eurocode 2, including the possibility to design to fire and seismic actions (DTA 3/11-684).

Checking of the base plate thickness

FINITE ELEMENTS CALCULATION

I-EXPERT software offers the possibility of creating a design model of the base plate using finite elements in order to check that it is thick enough to guarantee its rigidity.

Index

Ramset™

Principle

Foreword 1

Anchor selection guide 2

Types of anchors 4

ETAG parts and application range for each anchor type 4

ETAG options 4

Safety concept – Design Method according ETA Guideline 5

Design actions 5

- Type of loads
- Design action calculation

Seismic performance of anchors 6

- Seismic performance categories C1 and C2
- Recommended seismic performance categories for metal anchors

Terminology 7

Design resistance 8

- Calculation of the design resistance
- Characteristic resistance
- Calculation of partial safety factor

Design CC method 9

Combined load (oblique) 10

Using CC methodology 10

Examples 12

Concrete 13

- Concrete strength
- Field of usage: cracked or non cracked concrete

Other base material 15

Steel mechanical properties 15

Dimensions wrench torque / nuts / washers 16

Units / Conversion table 16

Corrosion / Atmosphere 17

Solutions for corrosion 18

Fire resistance 19

SPIT Laboratory 20

Chemical fixings in ceiling 21

Rebar design 22

Foreword

The anchor design is carried out according to Method A of ETAG for metallic anchors - Annex C.

This method takes into account the direction of stresses, the different failure types. This method is very precise but as a consequence of that demands a lot of time to make the design calculations.

In order to make the design calculation easier for our users, this technical guide proposes an approximate «method CC» (Concrete Capacity). This method uses the technical specifications stipulated in the ETA's or the SPIT specifications based on the assessment system of the ETAG.

Ramset™ Anchor selection guide

	Anchor diameter	Stainless steel	Crack concrete	Seismic
MECHANICAL ANCHORS				
TRIGA Z XTREM	M6 - M20		●	●
TRIGA Z - A4	M8 - M16	●	●	
FIX Z XTREM	M8 - M20		●	●
FIX Z - A4	M8 - M16	●	●	
FIX3	M6 - M20			
FIX II HDG	M8 - M16			
TAPCON XTREM	M8 - M14	●	●	●
ANKA SCREW	M6 - M12			
CHEMICAL ANCHORS				
VIPER XTREM TR	M8 - M30	●	●	●
EPCON G5	M8 - M30	●	●	●
LIGHT WEIGHT ANCHORS				
HIT M & HIT M A2	Ø5 - Ø8	●		
B-LONG	Ø8 - Ø10	●		●
PROLONG	Ø10 - Ø16			
PRO6	Ø5 - Ø14			
UDZ	Ø6			
P6	Ø6			
G8	Ø8			
CAST-IN ANCHORS				
TCM	M8 - M24	●	◊	
CIM	M6 - M24	●		
DROP-IN ANCHORS				
DYNA SET	M6 - M20	●		
REBAR & CHEMICAL				
VIPER XTREM TR	Y8 - Y32	●	●	●
EPCON G5	Y8 - Y40	●	●	●

Anchor selection guide

Ramset™

Principle

Concrete	Stone/Solid concrete block/ Solid brick	Hollow concrete blok/ Hollow brick	Plasterboard	Aerated concrete	Beam slab	Page
●						24
●						30
●						34
●						40
●						44
●						48
●						52
●						105
●	●					58
●	●					120
●	●	●	●	●		76
●	●	●	◊	●		78
●	●	●	◊			80
●	●	●	●			81
●						82
●						83
●						83
●						88
●						96
●						112
●						75
●						120

● SUITABLE ◊ POSSIBLE USE

Type of anchors

Torque controlled expansion anchor - type A

The expansion is achieved by a torque acting on the screw or bolt, the intensity of the anchorage is controlled by this torque.

Hammer set expansion anchor - type B

The expansion is achieved by impacts acting on a sleeve or cone. In the case of the dynaset anchor, the sleeve is expanded by driving in the cone, the anchorage being controlled by the length of travel of the cone.

Undercut anchors - type C

Undercut anchors are anchored by mechanical interlock provided by an undercut in the concrete. The undercutting can be achieved by hammering or rotating the anchor sleeve into a drilled undercut hole, or by driving the anchor sleeve onto the tapered bolt in a cylindrical hole.

Bonded anchors - type D

Bonded anchors are anchored in drilled holes by bonding the metal parts to the sides of the drilled hole with a resin mortar. Tensile loads are transmitted to the concrete via bond stresses between the metal parts and the resin, and the resin and the concrete face of the drilled hole.

Light weight plastic anchors

Plastic sleeves are expanded by hammering or screwing in the expansion element which presses the sleeve against the wall of the drilled hole. The expansion element could be a nail or a screw.

ETAG

Part and application range for each anchor type

Suitable anchors type	ETA Guideline number	Application range
TORQUE CONTROLLED EXPANSION ANCHORS	ETAG n° 001 Part 2	Applications for concrete with high risk level • «actual» risk of loss of human life • serious economic consequences • affect fitness of the structure to fulfil its functions Applications for concrete with limited risk level • «negligible» risk of human life • low economic consequences • localized damages
UNDERCUT ANCHORS	ETAG n° 001 Part 3	
HAMMER SET EXPANSION ANCHORS	ETAG n° 001 Part 4	
BONDED ANCHORS: embedded parts may be threaded rod, internal threaded socket	ETAG n° 001 Part 5	
RESISTANCE UNDER SEISMIC ACTIONS	TR n° 045	• Design of metal anchors for use in concrete under seismic actions
TORQUE CONTROLLED EXPANSION ANCHORS UNDERCUT ANCHORS HAMMER SET EXPANSION ANCHORS BONDED ANCHORS	ETAG n° 001, Part 6	Anchors for multiple use in non-structural applications (typical example include pipework,ductwork and cable tray)
BONDED ANCHORS	TR029-Design method	• Design of bonded anchors
RESISTANCE TO FIRE	TR n° 020	Evaluation of anchorages in concrete concerning resistance to fire.
BONDED ANCHORS : Post-installed rebar connections	TR n° 023 Technical Report for post-installed Rebar Connections	Application for rebar connections designed in accordance with Eurocode 2
BONDED ANCHORS : for masonries	ETAG n° 029	ETAG of metal injection anchors for use in masonry
LIGHT WEIGHT PLASTIC ANCHORS	ETAG n° 014	Anchors for fixing external thermal insulation composite systems with rendering
LIGHT WEIGHT PLASTIC ANCHORS	ETAG n° 020	ETAG of plastic anchors for multiple use in concrete and masonry for non-structural applications

ETAG options

Option n°	Cracked and non cracked	Non cracked only	C20/25 only	C20/25 to C50/60	One value F_{Rk}	F_{Rk} according to direction	C_{cr}	S_{cr}	C_{min}	S_{min}	Design method
1	•			•		•	•	•	•	•	A
2	•		•			•	•	•	•	•	
3	•			•	•		•	•	•	•	B
4	•		•		•		•	•	•	•	
5	•			•	•		•	•			C
6	•		•		•		•	•			
7		•		•		•	•	•	•	•	A
8		•	•			•	•	•	•	•	
9		•		•	•		•	•	•	•	B
10		•	•		•		•	•	•	•	
11		•		•	•		•	•			C
12		•	•		•		•	•			

Safety concept

Design method according to ETA guideline

Ramset™

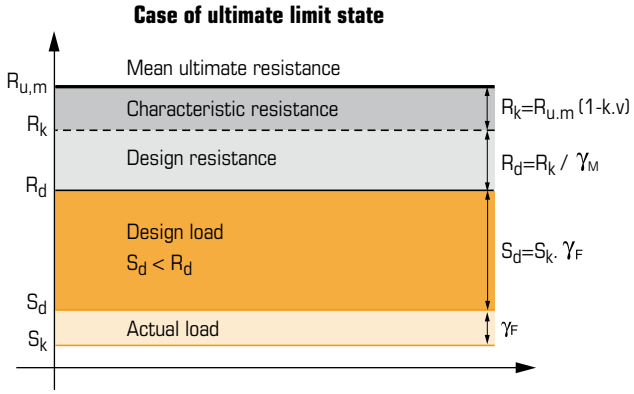
Principle

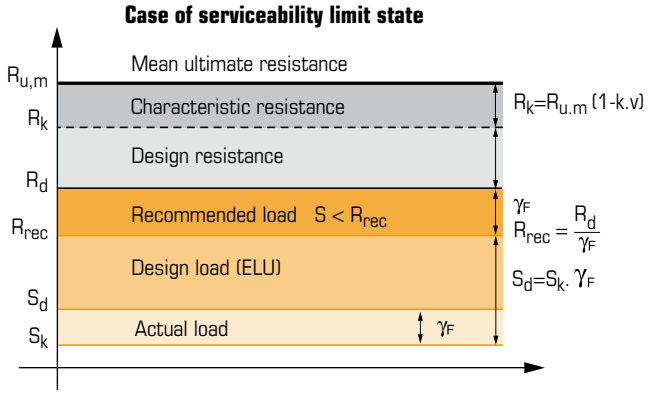
General

For the design of anchorages according to method A of the guideline ETAG 0001, the safety concept of partial safety factors shall be applied at the ultimate limit state. It shall be shown that the value of the design action **S_d** does not exceed the value of the design resistance **R_d**

$$S_d \leq R_d$$

Principle of partial safety concept

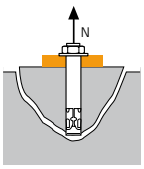




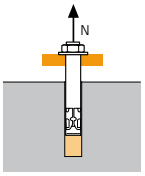
Different types of failure mode

According to the method A of the guideline ETAG 0001, the proof of the resistance must be carried out for each following types of failures in tensile and shear load. The purpose of differentiating these failure modes, is to be able to apply an appropriate safety factor as a function of the specific failure mode.

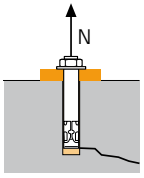
Tensile load



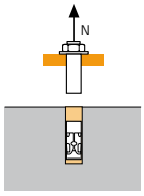
Concrete cone failure



Pull-out failure

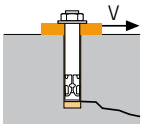


Splitting failure

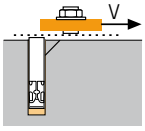


Steel failure

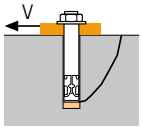
Shear load



Concrete edge failure



Steel failure



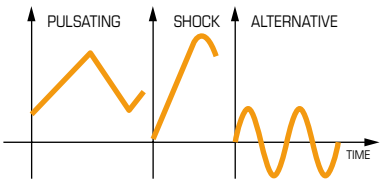
Pryout failure

Type of loads

Static or quasi-static loads

The static or quasi-static loads are dead loads of the element fixed, permanent and variable actions as wind, snow …

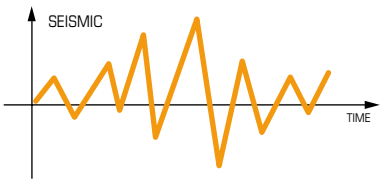
Dynamic loads



The dynamic loads are variable actions in time with a medium or high amplitude. For example, motor vibration, regular shock …

Some dynamic loads could be considered as quasi-static loads (wind …).

Seismic loads



The seismic loads are calculated using the acceleration spectrum of the seismic zone, according to Eurocode 8.

Seismic performance categories C1 and C2

The seismic performance of anchors subjected to seismic loading is categorized by performance categories C1 and C2. Seismic performance category C1 provides anchor capacities only in terms of resistances at ultimate limit state, while seismic performance category C2 provides anchor capacities in terms of both resistances at ultimate limit state and displacements at damage limitation state and ultimate limit state.

Table below relates the seismic performance categories C1 and C2 to the seismicity level and building importance class. The level of seismicity is defined as a function of the product $\mathbf{a_g.S}$, where $\mathbf{a_g}$ is the design ground acceleration on Type A ground and S the soil factor both in accordance with EN 1998-1.

The value of $\mathbf{a_g}$ or that of the product $\mathbf{a_g.S}$ used in a Member State to define thresholds for the seismicity classes may be found in its National Annex of EN 1998-1 and may be different to the values given in Table below. Furthermore, the assignment of the seismic performance categories C1 and C2 to the seismicity level and building importance classes is in the responsibility of each individual Member State.

Category	European requirement according to TR 045 Technical Report	Assessment of tests according to ETAG 001 - Annex E
Category C1	for non-structural applications	Alternative tests in cracked-concrete (crack widths 0,5 mm)
Category C2	for structural and non-structural applications	Tests of increased severity with varying crack widths, simulating earthquake (crack widths 0,8 mm)

Recommended seismic performance categories for metal anchors

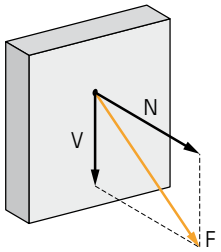
Seismicity level[a]		Building importance class acc. to EN 1998-1:2004, 4.2.5			
Class	**$a_g.S$[c]**	**I**	**II**	**III**	**IV**
Very low[b]	**$a_g.S \leq 0,05$ g**	**No additional requirement**			
Low[b]	**$0,05$ g $< a_g.S \leq 0,10$ g**	**C1**	**C1[d] or C2[e]**		**C2**
> Low	**$a_g.S > 0,10$ g**	**C1**	**C2**		

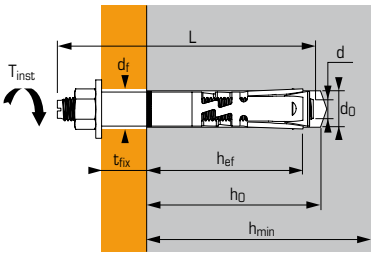
[a] The values defining the seismicity levels are may be found in the National Annex of EN 1988-1.
[b] Definition according to EN 1998-1:2004, 3.2.1.
[c] ag = design ground acceleration on Type A ground (EN 1998-1:2004, 3.2.1),
S = soil factor (see e.g. EN 1998-1:2004, 3.2.2).
[d] C1 for Type 'B' connections (see TR045 §5.1) for fixings of non-structural elements to structures
[e] C2 for Type 'A' connections (see TR045 § 5.1) for fixings of structural elements to structures

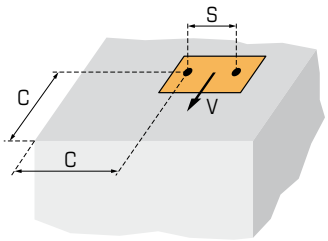
Class	Building type
I	Buildings and structures that normally are not subject to human occupancy (e.g., equipment storage sheds, barns, and other agricultural buildings) and that do not contain equipment or systems necessary for disaster response or hazardous materials.
II	Most buildings and structures of ordinary occupancy (e.g., residential, commercial, and industrial buildings) except those buildings contained in other categories (less than 300 people, building height ≤ 28 m).
III	Buildings and structures that: • Have large numbers of occupants (more than 300 people, building height ≥ 28 m) e.g., high-rise office buildings,sports arenas, and large theaters… • Shelter persons with limited mobility (e.g., jails, schools, and some healthcare facilities); • Support lifelines and utilities important to a community's welfare; • Contain materials that pose some risks to the public if released.
IV	Buildings and structures that: • Are essential to post-earthquake response (e.g., hospitals, police stations, fire stations, and emergency communications centers) • House very large quantities of hazardous materials.

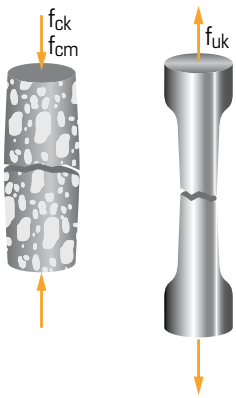
Ramset™

Symbols used









Actions

S_k	Action on the anchor at the serviceability limit state (ELS)
S_d	Action on the anchor at the ultimate limit state (ELU)

Resistance of the anchor

$R_{u,m}$	Mean ultimate resistance
R_k	Characteristic resistance
R_d	Design resistance
F_{rec}	Recommended resistance

Type of load

N	Tensile force (N_{Sd}, $N_{Ru,m}$, N_{Rk}, N_{Rdp}, N_{Rds}, N_{Rdc}, N_{rec})
V	Shear force (V_{Sd}, $V_{Ru,m}$, V_{Rk}, V_{Rds}, V_{Rdc}, V_{rec})
F	Oblique force (F_{Sd}, $F_{Ru,m}$, F_{Rk}, F_{Rds}, F_{Rdc}, F_{rec})
M	Bending moment (M_{Rk}, M_{Rec})

Anchors

h_{ef}	Effective anchorage depth
h_{nom}	Embedment depth in the concrete
h_0	Drilling depth
d	Thread diameter
d_0	Drilling diameter
d_f	Clearance hole diameter in the part to be fixed
d_{nom}	External diameter of the anchor
L	Total anchor length
l_2	Threaded length
T_{inst}	Required setting torque
t_{fix}	Thickness of the part to be fixed
h_{min}	Minimum thickness of base material

Distances

S	Distance between 2 anchors
S_{cr}	Spacing for ensuring the realisation of the characteristic resistance
S_{min}	Minimum allowable spacing
C_{min}	Minimum allowable edge distance
$C_{cr,N}$	Edge distance for ensuring the realisation of the characteristic tensile resistance

Concrete and steel

f_{cm}	Average concrete compression strength
f_{ck}	Characteristic concrete compression strength
f_{uk}	Characteristic steel ultimate strength
f_{yk}	Characteristic yield strength

Calculation of the design resistance

The design value of resistance R_d, in any direction and for all type of failure, is calculated from the characteristic resistance and the partial safety factor.

$$R_d = \frac{R_k}{\gamma_M}$$

with R_k : characteristic resistance of the anchor

γ_M : partial safety factor depends on the type of failure*, Hong Kong BD requirement, Fos=3.

Characteristic resistance

- The characteristic load of the anchor for concrete cone failure, in any direction, is calculated from the average value of the mean failure load for the single anchor, without the effect of spacing and edges. The characteristic load corresponds to the 5% - fractile of failure loads for the level of confidence (90%).

  $F_{Rk} = (1 - k.v) \cdot F_{Ru,m}$

  This calculation depends on number of tests (k) and the variation coefficient of tests (v)
  Example : for a number of tests equal to 10 anchors, we can take k = 2,568.

- The characteristic load of steel failure are calculated as follows :

  - For tensile load:

    $N_{Rk,s} = A_0.f_{uk}$ [N]

    A_0: min cross section [mm²]

    f_{uk}: min tensile strength [N/mm²]

  - For shear load:

    $V_{Rk,s} = 0,5.A_S.f_{uk}$[N]

    A_s: stressed cross section [mm²]

    f_{uk}: min tensile strength [N/mm²]

Calculation of partial safety factor

- **For concrete cone failure:** $\gamma_{Mc} = \gamma_c \cdot \gamma_1 \cdot \gamma_2$

  γ_c: Partial safety factor for concrete under compression :$\gamma_c = 1,5$
  γ_1: Partial safety factor taking account of the scatter of the tensile strength of site concrete.
  $\gamma_1 = 1$ for concrete produced and cured with normal care (EUROCODE 2 chap. 7)
  γ_2: Partial safety factor taking into account of the installation safety* of an anchor system

  Tensile load:
  $\gamma_2 = 1$ for systems with high installation safety*,
  $\gamma_2 = 1,2$ for systems with normal installation safety*,
  $\gamma_2 = 1,4$ for systems with low but still acceptable installation safety*.

  Shear load:
  $\gamma_2 = 1$

- **For steel failure:** γ_{Ms}

  Tensile load:

  - $\gamma_{Ms} = \frac{1,2}{f_{yk}/f_{uk}} \geq 1,4$

  Shear load:

  - $\gamma_{Ms} = \frac{1,0}{f_{yk}/f_{uk}} \geq 1,25$ with $f_{uk} \leq 800$ N/mm² and $f_{yk}/f_{uk} \leq 0,8$
  - $\gamma_{Ms} = 1,5$ with $f_{uk} > 800$ N/mm² or $f_{yk}/f_{uk} > 0,8$

(*) Installation safety means the influence of installation defects, such as diameter of drilled hole, cleaning of the hole, intensity of anchorage and striking the reinforcement during drilling.

Design method CC

Flowchart

In this guide, we use the calculation method SPIT-CC (Concrete capacity). It is a simplified method extracted from the method A as detailed in the Annexe C of the ETA guideline.

Tensile resistance

Pull out failure

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

- $N^0_{Rd,p}$ Design resistance for pull-out failure
- f_b Factor taking into account the concrete strength

Concrete cone failure

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

- $N^0_{Rd,c}$ Design resistance at the ultimate limit state for one anchor without influence of spacing and distance from the edge concrete
- f_b Factor taking into account the concrete strength
- Ψ_s Factor taking into account the influence of spacing
- $\Psi_{c,N}$ Factor taking into account the influence of distance from the edge concrete

Steel failure

- $N_{Rd,s}$ Design resistance at the ultimate limit state for steel failure

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

$$\beta_N = N_{Sd} / N_{Rd}$$

Shear resistance

Concrete edge failure

$$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$$

- $V^0_{Rd,c}$ Design resistance at the ultimate limit state for one anchor placed at C_{min} from edge concrete
- f_b Factor taking into account the concrete strength
- $f_{\beta,V}$ Factor taking into account the influence of shear loading direction.
- $\Psi_{S\text{-}C,V}$ Factor taking into account the influence of spacing between anchor and edge distance.

Pryout failure

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

- $V^0_{Rd,cp}$ Design resistance at the ultimate limit state for pryout failure
- f_b Factor taking into account the concrete strength
- Ψ_s Factor taking into account the influence of spacing
- $\Psi_{c,N}$ Factor taking into account the influence of distance from the edge concrete

Steel failure

- $V_{Rd,s}$ Design resistance at the ultimate limit state for steel failure

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

$$\beta_V = V_{Sd} / V_{Rd}$$

Combined load

$$\beta_N = N_{Sd} / N_{Rd} \leq 1$$

$$\beta_V = V_{Sd} / V_{Rd} \leq 1$$

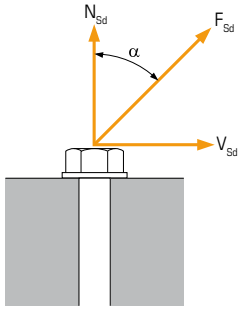
$$\beta_N + \beta_V \leq 1{,}2 \text{ (CC method)}$$

$$\beta_N^{1.5} + \beta_V^{1.5} \leq 1 \text{ (I-expert)}$$

The anchor is suitable for your application

Combined load

The combined load F_{Sd} with an angle α is obtained by:

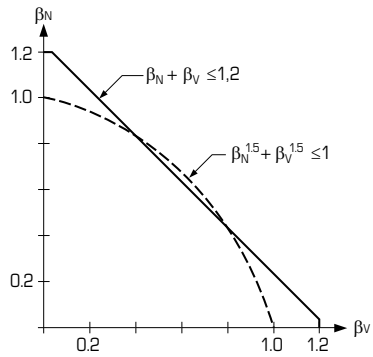


$$F_{Sd} = \sqrt{(N_{Sd})^2 + (V_{Sd})^2} \qquad \alpha = \arctan (V_{Sd}/N_{Sd})$$

with N_{Sd}: action in tensile direction ($N_{Sd} = F_{Sd} \times \cos \alpha$)
V_{Sd}: action in shear direction ($V_{Sd} = F_{Sd} \times \sin \alpha$)

To verify the resistance for a combined load with the method CC, we proceed as follows :

- the tensile resistance: $\beta_N = N_{Sd} / N_{Rd} \leq 1$
- the shear resistance: $\beta_V = V_{Sd} / V_{Rd} \leq 1$
- the combined load with the following interactive equation: $\beta_N + \beta_V \leq 1{,}2$



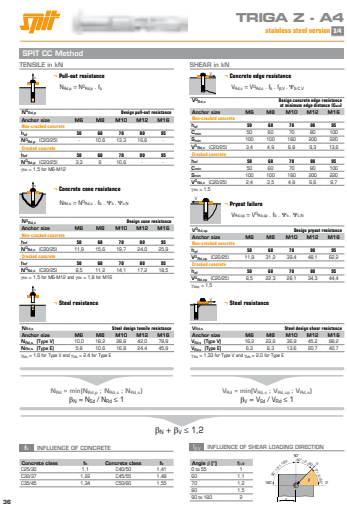
Using CC methodology

This simplified method is based on the principle of Method A from ETAG – Annex C, without taking into account splitting and pryout failure. This method was simplified to retain as much as possible of the ETAG method, whilst including as much of the latest approach as possible.

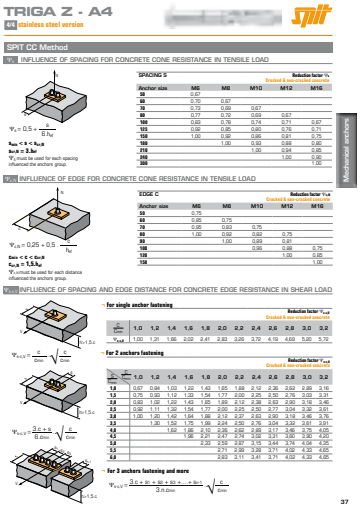
In this technical guide, for each product covered by the calculation method CC, you will find 4 pages:

- Pages 1/4 and 2/4 give the general technical data on the product and the performance of the product
- Pages 3/4 and 4/4 contain data to design according to this method.

Page 3/4 gives the design resistance Rd for each type of failure, this data is calculated with the characteristic resistance (R_k) and the safety partial factor (γ_M) given in the ETA (if the anchor has CE marking), or from the product evaluation according to ETAG carried out by SPIT.



Page 4/4 gives the factors (Ψ_S, $\Psi_{C,N}$ et $\Psi_{S\text{-}C,V}$) to be used in the calculation for concrete cone failure in tensile and shear load to take into account the influence of spacing and distance from edge.



Using CC methodology

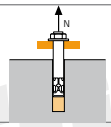
Photocopy this form and insert figures for your calculation

Ramset™

Project Description :

TENSILE LOAD

Ultimate design action N_{Sd} — **kN**



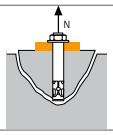
Pull-out failure

☐ Non-cracked concrete
☐ Cracked concrete

$N^0_{Rd,p}$ — kN

Concrete class: f_b

$N_{Rd,p} = N^0_{Rd,p} \times f_b$ — kN

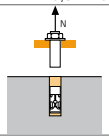


Concrete cone failure

$N_{Rd,c}$ — kN

Concrete class:	f_b
Spacing and edge distance	Reduction factor
s1 =	Ψ_{s1}
s2 =	Ψ_{s2}
s3 =	Ψ_{s2}
C1 =	$\Psi_{C1,N}$
C2 =	$\Psi_{C2,N}$
C3 =	$\Psi_{C3,N}$
C4 =	$\Psi_{C4,N}$

$N_{Rd,c} = N^0_{Rd,c} \times f_b \times \Psi_{s1} \times .... \times \Psi_{s3} \times \Psi_{C1,N} \times .... \times \Psi_{C4,N}$ — kN



Steel failure

$N_{Rd,s}$ — kN

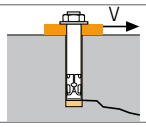
Ultimate design resistance N_{Rd}

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

$\beta_N = N_{Sd} / N_{Rd} \leq 1$

SHEAR LOAD

Ultimate design action V_{Sd} — **kN**



Edge concrete failure
(do not take into account for group of anchors without edge influence)

$V^0_{Rd,c}$ for Cmin = — kN

Concrete class : f_b

Shear direction : $f\beta_{,V}$

Distance C : Edge distance in the direction of shear load, otherwise the edge distance in the direction perpendicular to shear load

Case of single anchor fastening

C = C / Cmin = $\Psi_{S_C,V}$ =

Case of 2 anchors fastening

C = C / Cmin = $\Psi_{S_C,V}$ =

S = S / Cmin =

Case of 3 anchors fastening

$$\Psi_{S_C,V} = \frac{3.c + S_1 + S_2 + S_3 + ... + S_{n-1}}{3.n.c_{min}} \sqrt{\frac{C}{C_{min}}}$$

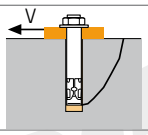
C =

S1 = $\Psi_{S_C,V}$ =

S2 =

S3 =

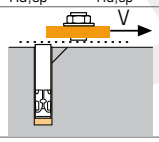
$V_{Rd,c} = V^0_{Rd,c} \times f_b \times f_{\beta,V} \times \Psi_{S_C,V}$ — kN



Pryout failure

$V^0_{Rd,cp}$ — kN

$V_{Rd,cp} = V^0_{Rd,cp} \times fb \times \Psi_{s1} \times .... \times \Psi_{s3} \times \Psi_{C1,N} \times ... \times \Psi_{C4,N}$ — kN



Steel failure

$V_{Rd,s}$ — kN

Ultimate design resistance V_{Rd}

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

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

COMBINED LOAD:

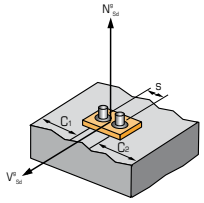
$\beta_N + \beta_v \leq 1,2$*

*If $\beta_N + \beta_v > 1,1$, we recommend you to check the result with the EXPERT SOFTWARE or to call our technical support

Principle

Project:
Crack concrete - class C20/25
Thickness of base material: 200 mm
S = 105 mm
C_1 = 100 mm
C_2 = 100 mm

Design actions per anchor:
N_{Sd} = 2,5 kN
V_{Sd} = 3 kN



TENSILE LOAD

Ultimate design action N_{Sd}		2.5 kN
Pull-out failure		
☐ Non-cracked concrete		
☒ Cracked concrete		
$N^0_{Rd,p}$		4.0 kN
Concrete class:	f_b	1.0
$N_{Rd,p} = N^0_{Rd,p} \times f_b$		4.0 kN
Concrete cone failure		
$N_{Rd,c}$		6.5 kN

Concrete class: C20/25	f_b	1
Spacing and edge distance	Reduction factor	
s1 = 105 mm	Ψ_{s1}	0.92
s2 = /	Ψ_{s2}	/
s3 = /	Ψ_{s2}	/
C1 = 100 mm	$\Psi_{C1,N}$	1.0
C2 = 100 mm	$\Psi_{C2,N}$	1.0
C3 = /	$\Psi_{C3,N}$	/
C4 = /	$\Psi_{C4,N}$	/

$N_{Rd,c} = N^0_{Rd,c} \times f_b \times \Psi_{s1} \times .... \times \Psi_{s3} \times \Psi_{C1,N} \times .... \times \Psi_{C4,N}$		5.98 kN
Steel failure		
$N_{Rd,s}$		14.4 kN
Ultimate design resistance N_{Rd}		
$N_{Rd} = \min(N_{Rd,p} ; N_{Rd,c} ; N_{Rd,s})$		4.0 kN
$\beta_N = N_{Sd} / N_{Rd} \leq 1$		0.62

SHEAR LOAD

Ultimate design action V_{Sd}		3.0 kN
Edge concrete failure (do not take into account for group of anchors without edge influence)		
$V^0_{Rd,c}$ for Cmin = 65 mm		4.1 kN
Concrete class :	f_b	1.0
Shear direction :	$f\beta_{,V}$	2.0
Distance C : Edge distance in the direction of shear load, otherwise the edge distance in the direction perpendicular to shear load		
Case of single anchor fastening		
C = C / Cmin =	$\Psi_{S_C,V}$ =	/
Case of 2 anchors fastening		
C = C / Cmin = 1.5	$\Psi_{S_C,V}$ =	1.28
S = S / Cmin = 1.6		
Case of 3 anchors fastening		
$\Psi_{S_C,V} = \frac{3.c + S_1 + S_2 + S_3 + ... + S_{n-1}}{3.n.c_{min}} \sqrt{\frac{C}{C_{min}}}$		
C =		
S1 =	$\Psi_{S_C,V}$ =	/
S2 =		
S3 =		
$V_{Rd,c} = V^0_{Rd,c} \times f_b \times f_{\beta,V} \times \Psi_{S_C,V}$		10.5 kN
Pryout failure		
$V^0_{Rd,cp}$		6.5 kN
$V_{Rd,cp} = V^0_{Rd,cp} \times fb \times \Psi_{s1} \times .... \times \Psi_{s3} \times \Psi_{C1,N} \times ... \times \Psi_{C4,N}$		5.98 kN
Steel failure		
$V_{Rd,s}$		12 kN
Ultimate design resistance V_{Rd}		
$V_{Rd} = \min(V_{Rd,c} ; V_{Rd,cp} ; V_{Rd,s})$		5.98 kN
$\beta v = V_{Sd} / V_{Rd} \leq 1$		0.50

COMBINED LOAD: 0.62 + 0.50 = 1.12 < 1.2

$\beta_N + \beta_v \leq 1,2$* the FIX Z A4 M10 anchor is suitable for this application

*If $\beta_N + \beta_v > 1,1$, we recommend you to check the result with the I-EXPERT SOFTWARE or to call our technical support

Concrete strength

Concrete is classified according to its compressive strength which is based on the classification per strength measured on cylinders as indicated in the NF EN 206-1 standard. For information, the table below gives an equivalence between the characteristic values and average strength on cylindrical and cubic specimens in Mpa.

Concrete classes		Characteristic strength fck	
According to Eurocode 2	According to P18-305	Cylinder 16 x 32 cm	Cube 15 x 15 x 15 cm
C 16/20	B16	16	20
C 20/25*	B20	20	25
C 25/30	B25	25	30
C 30/37*	B30	30	37
C 35/45	B35	35	45
C 40/50*	B40	40	50
C 45/55	B45	45	55
C 50/60*	B50	50	60

* The most usual classes

Field of usage: cracked or non cracked concrete

Concrete can be considered as cracked for many reasons. According to the ETA Guideline, we must verify if the concrete is cracked or non cracked by calculation of stresses in the works or part of the works serving as the base material (ETA Guideline - Annex C - §4.1) :

$\sigma_L + \sigma_R \leq 0$

σ_L: Stresses in the concrete induced by external loads, including anchors loads

σ_R: Stresses in the concrete due to restraint of extrinsic imposed deformations

(e.g; shrinkage of concrete) or extrinsic imposed deformations (e.g. due to displacement of support or temperature variations). If no detailed analysis is conducted, then $\sigma_R = 3N/mm^2$ should be assumed, according to Eurocode 2.

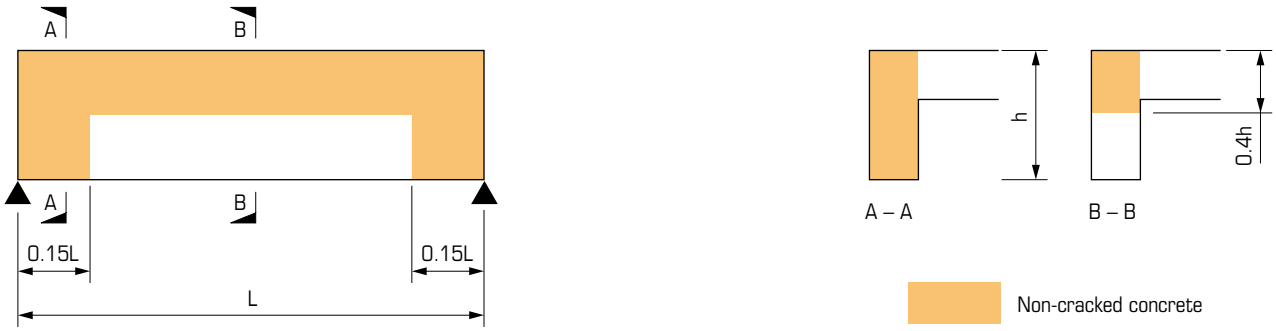
If there are no details available to make the above calculation, use the table below.

Nevertheless, it is the responsibility of the designer to check the status of the base material (cracked or non cracked).

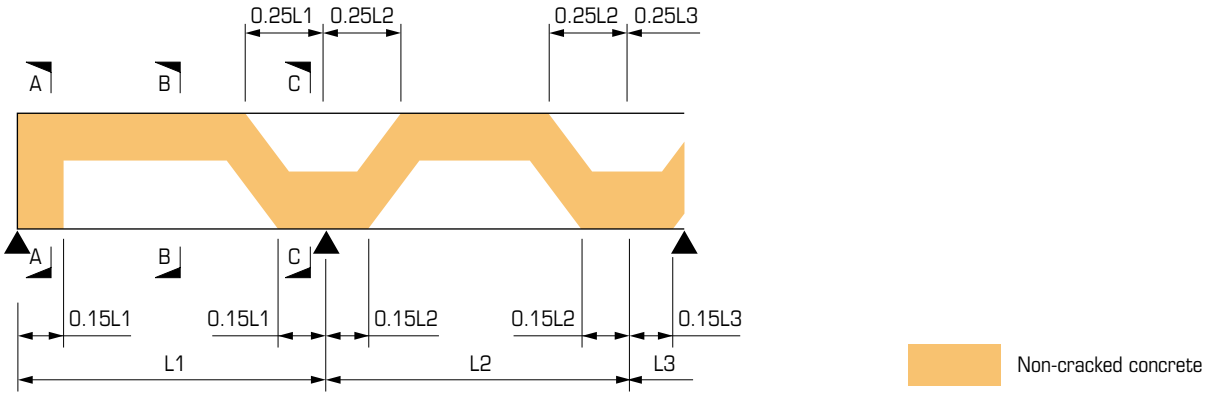
Works or parts of works used as anchoring base	Concrete conditions	
	Non cracked	Cracked
Deflected elements (slabs, longitudinal beam, firder, purlin) in reinforced concrete		X
Deflected elements (slabs, longitudinal beam, firder, purlin) in prestressed concrete	X	
Outside wall of a building in not reinforced (according to BAEL) or with reinforced skin		X
Outside wall of a building in reinforced concrete	X	
Inside wall of a building	X	
Angle or edge post		X
Inside post	X	
Base plate paving		X
Keying areas of a building made from prefabricated elements		X
Ends of deflected elements (ex: projected balcony noses)	X	
Tanking	X	

The following are examples of non-cracked locations in simple structures (issue from the technical report n° CEN/TC250/SC2/WG2 "effect of cracking" published by CEN.

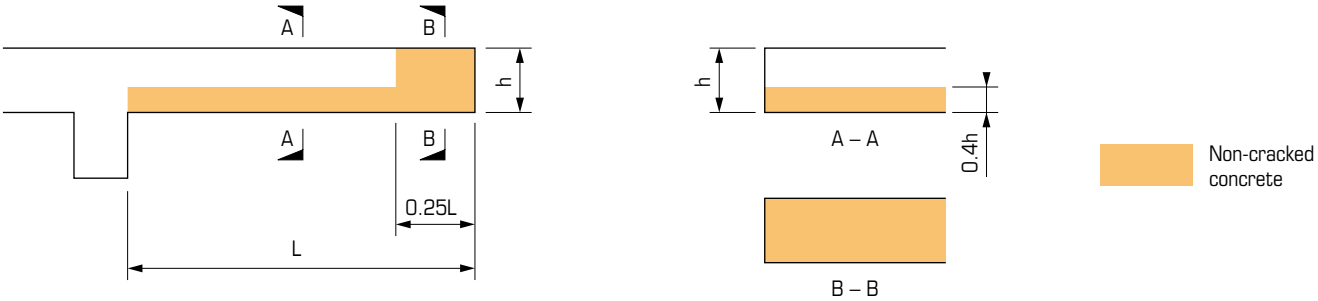
Solid slabs, beams - simply supported



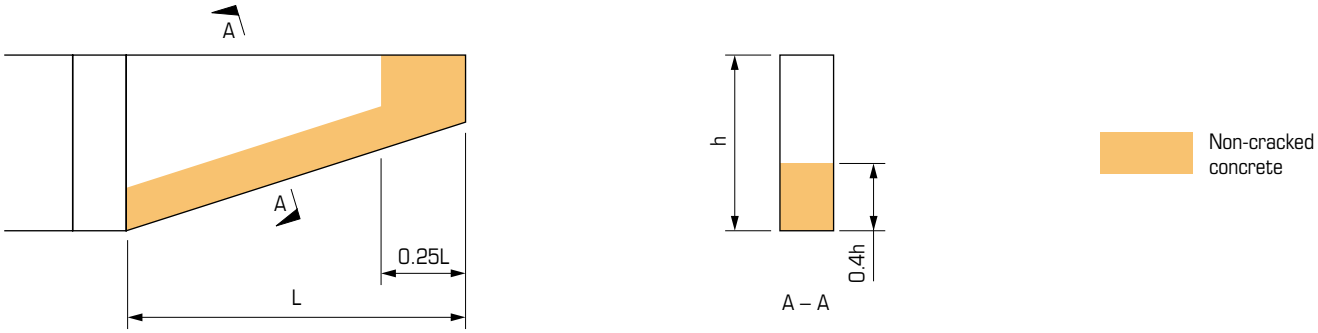
Solid slabs, beams, ribbed floors - Continuous



Cantilever slabs



Cantilever beams



Other base substrate

Ramset™

Perforated clay bricks
type ECO-30, not rendered or rendered
Rc = 3.7 N/mm² – 57x20x30 (cm) - NF EN 771-1

Engineer clay bricks Murbric type T20,
not rendered or rendered
Rc = 14.5 N/mm² – 20x24x50 - NF EN 771-1

Clay bricks
Rc = 55 N/mm² 22x10x5.5 (cm) NF EN 771-1

Solid concrete blocs B120
Rc = 13,5 N/mm² - 20x20x50 (cm) – NF EN 771-3

Hollow concrete block type B40,
not rendered or rendered
Rc = 6,5 N/mm² – 20x20x50 (cm) – NF EN 771-3

Plasterboard Lafarge type BA13
et BA10 + polystyren – NFP 72-302

Aerated concrete
Mvn = 500 kg/m³ – NF EN 771-4

Steel mechanical properties

Mechanical characteristics

The steel properties are determined by :
- the tensile strength f_{uk} (N/mm²),
- the yield strength f_{yk} (N/mm²).

Zinc coated steel : the standard NF EN 20898-1 gives the characteristics of studs and screws depending on the grade of steel.

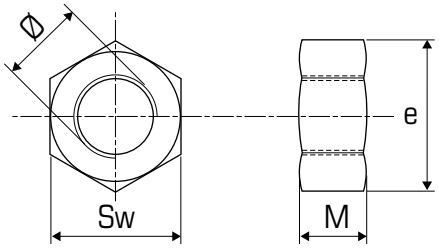
Stainless steel : the standard NF EN 25100-0 gives the stainless steel characteristics.

Mechanical characteristics	Steel Grade									Stainless Steel grade A1, A2 & A4		
	3.6	4.6	4.8	5.6	5.8	6.8	8.8	10.9	12.9	50	70	80
Min. tensile strength. f_{uk} (N/mm²)	330	400	420	500	520	600	800	1040	1220	500	700	800
Min. yield strength. f_{yk} (N/mm²)	190	240	340	300	420	480	640	940	1100	210	450	600

Minimum Failure loads (kN) - Iso metric thread to NF EN 20898-1

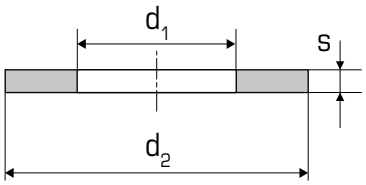
Nominal thread diameter	Thread pitch	Nominal cross section	Steel Grade									Stainless Steel A4 grade		
			3.6	4.6	4.8	5.6	5.8	6.8	8.8	10.9	12.9	50	70	80
(mm)	(mm)	As/mm²	Minimum failure load									Minimum failure load		
1.6	0.35	1.27	0.420	0.510	0.530	0.640	0.660	0.760	1.020	1.320	1.550	0.640	0,89	1.020
2.0	0.4	2.07	0.680	0.830	0.870	1.040	1.080	1.240	1.660	2.150	2.530	1.040	1,45	1.660
2.5	0.45	3.39	1.120	1.360	1.420	1.700	1.760	2.030	2.710	3.530	4.140	1.700	2,37	2.710
3.0	0.5	5.03	1.660	2.010	2.110	2.510	2.620	3.020	4.020	5.230	6.140	2.510	3,52	4.020
3.5	0.6	6.78	2.240	2.710	2.850	3.390	3.530	4.070	5.420	7.050	8.270	3.390	4,74	5.420
4.0	0.7	8.78	2.900	3.510	3.690	4.390	4.570	5.270	7.020	9.130	10.700	4.390	6,15	7.020
5.0	0.8	14.2	4.690	5.680	5.960	7.100	7.380	8.520	11.350	14.800	17.300	7.100	9,94	11.350
6.0	1.0	20.1	6.630	8.040	8.440	10.000	10.400	12.100	16.100	20.900	24.500	10.000	14,07	16.100
7.0	1.0	28.9	9.540	11.600	12.100	14.400	15.000	17.300	23.100	30.100	35.300	14.400	20,23	23.100
8.0	1.25	36.6	12.100	14.600	15.400	18.300	19.000	22.000	29.200	38.100	44.600	18.300	25,62	29.200
10.0	1.5	58.0	19.100	23.200	24.400	29.000	30.200	34.800	46.400	60.300	70.800	29.000	40,6	46.400
12.0	1.75	84.3	27.800	33.700	35.400	42.200	43.800	50.600	67.400	87.700	103.000	42.200	59,01	67.400
14.0	2.0	115.0	38.000	46.000	48.300	57.500	59.800	69.000	92.000	120.000	140.000	57.500	80,5	92.000
16.0	2.0	157.0	51.800	62.800	65.900	78.500	81.600	94.000	125.000	163.000	192.000	78.500	109,9	125.000
18.0	2.5	192.0	63.400	76.800	80.600	96.000	99.800	115.000	159.000	200.000	234.000	96.000	134,4	159.000
20.0	2.5	245.0	80.800	98.000	103.000	122.000	127.000	147.000	203.000	255.000	299.000	122.000	171,5	203.000
22.0	2.5	303.0	100.000	121.000	127.000	152.000	158.000	182.000	252.000	315.000	370.000	152.000	212,1	252.000
24.0	3.0	353.0	116.000	141.000	148.000	176.000	184.000	212.000	293.000	367.000	431.000	176.000	247,1	293.000
27.0	3.0	459.0	152.000	184.000	193.000	230.000	239.000	275.000	381.000	477.000	560.000	230.000	321,3	381.000
30.0	3.5	561.0	185.000	224.000	236.000	280.000	292.000	337.000	466.000	583.000	684.000	280.000	392,7	466.000
33.0	3.5	694.0	229.000	278.000	292.000	347.000	361.000	416.000	576.000	722.000	847.000	347.000	485,8	576.000
36.0	4.0	817.0	270.000	327.000	343.000	408.000	425.000	490.000	678.000	885.000	997.000	408.000	571,9	678.000
39.0	4.0	976.0	322.000	390.000	410.000	488.000	508.000	586.000	810.000	1020.000	1200.000	488.000	683,2	810.000

NUTS dimensions for torque wrench sockets



	NUTS according to DIN 934			NUTS according to NF EN ISO 4032		
(mm)	**Sw**	**e**	**M**	**Sw**	**e**	**M**
M6	10	11,5	5	10	11,05	5,2
M8	13	15	6,5	13	14,38	6,8
M10	17	19,6	8	16	17,77	8,4
M12	19	21,9	10	18	20,03	10,8
M16	24	27,7	13	24	26,75	14,8
M20	30	34,6	16	30	32,95	18
M24	36	41,6	19	36	39,55	21,5
M30	46	53,1	24	46	50,85	25,6

Washers: dimensions of the washers used with SPIT Products



	WASHERS according to NF EN ISO 7091			special WASHERS (used with SPIT TRIGA Z)			TRIGAZ A4		
(mm)	**d_2**	**d_1**	**s**	**d_2**	**d_1**	**s**	**d_2**	**d_1**	**s**
M6	12	6,6	1,6	18	6,7	2	18	6,3	2
M8	16	9,0	1,6	20	8,7	2	22	8,2	2
M10	20	11,0	2	26	10,5	3	28	10,5	3
M12	24	13,5	2,5	30	12,5	3	30	12,3	3
M16	30	17,5	3	40	16,7	4	-	-	-
M20	37	22,0	3	45	20,7	4	-	-	-
M24	44	26,0	4	-	-	-	-	-	-
M30	56	33,0	4	-	-	-	-	-	-

Units

Length: 1 mm = 0,1 cm = 0,0394 in (pouce)
Force: 1 kN = 100 daN = 1000 N ~ 100 kg
1 kg = 9,81 N
1 N = 0,2248 lbf (livre-force)

Concrete compressive strength:
1 Mpa = 1 N/mm² = 10 kg/cm²
1 Mpa = 10 bars
1 N/mm² = 149,2 lbf/in² (pound-force per square inch)

Conversion table

METRIC		IMPERIAL		Factor conversion	
Units	**Symbols**	**Units**	**Symbols**		
Concrete strength					
newton per square millimeter	N/mm² (=Mpa)	pound-force per square inch	lbf/in² (=psi)	1 lbf/in2 = 0,00689 N/mm²	1 N/mm² = 145,0 lbf/in²
Tightening torque					
newton-meter	Nm	pound-force foot	lbf/ft	1 lbf ft = 1,356 Nm	1 Nm = 0,738 lbf ft
Mass					
ton	t	pound	Lb	1 lb = 0,00454 t	1 t = 220,26 lb
ton	t	ton	Ton	1 ton = 1,016 t	1 t = 0,9842 ton
kilogram	kg	pound	lb	1 lb = 0,4536 kg	1 kg = 2,204 lb
Force					
kilonewton	kN	ton-force	ton f	1 ton f = 0,10036 kN	1 kN = 9,9640 ton f
kilonewton	kN	pound-force	lbf	1 lbf = 0,004448 kN	1 kN = 224,8 lbf
newton	N	pound-force	lbf	1 lbf = 4,448 N	1 N = 0,2248 lbf
Length					
meter	m	foot	ft	1ft = 0,3048 m	1 m = 3,2808 ft
centimeter	cm	inch	in	1 in = 2,54 cm	1 cm = 0,3937 in
millimeter	mm	inch	in	1 in = 25,4 mm	1 mm = 0,03937 in
Area					
square millimeter	mm²	square inch	in²	1 in² = 645,16 mm²	1 mm² = 0,0015 in²
Temperature					
Celsius degree	°C	Fahrenheit degree	°F	1°F = (9/5 °C + 32)	1°C = 5/9(°F - 32)
				0 °C = 32 °F	30 °C = 86 °F
				10 °C = 50 °F	40 °C = 104 °F
				20 °C = 68 °F	50 °C = 122 °F

Corrosion / Atmosphere

Ramset™

Choice of steel quality according to atmosphere

Atmospheric corrosion is linked to ambient atmosphere. The agents combined themselves to air components. The mixture of oxygen, moisture and industrial pollutants, mainly chlorous and sulphurous, attacks and destroys metals and alloys. We can indicate 6 principal types of atmosphere.

TYPES OF ATMOSPHERE			Zinc deposit 5-10 µm	Hot dip galvanized 45 µm mini	Stainless steel A4
INSIDE	DRY	Clean rooms, heated in winter without condensation. Housing inside, air-conditioned rooms.	●	●	●
	HUMID	Rooms subjected to condensation, warehouses, stores, cellars...	☐	●	●
OUTSIDE	RURAL	Housing in temperate climate and a long way from large cites and factories (country).	☐	○	●
	URBAN	Housing in towns with one or more factories emitting smoke creating atmospheric corrosion.	☐	○	●
	INDUSTRIAL	Factories and their surroundings significant atmospheric corrosion (depending on industrial process).	☐	☐	●
	SALT ATMOSPHERE	Atmosphere of seaside or on sea. High corrosion due to presence of relatively high humidity combined with certain contents of sea salt in the air	☐	☐	●

Source : NFA 91-102 - Metal surface

☐ Quality not suitable for the medium
○ Get into touch with us
● Possible use

Choice of steel quality according to contacts between materials

Electrolytic corrosion may occur when two different metals are in contact with each other. This creates an electrolytic action which causes the gradual destruction of one of the elements.

Metal of the part to be fixed	Metal of the fixing					
	Stainless steel	Galvanised steel	Zinc coated steel	Zinc alloy	Lead	Brass
Stainless steel	●	↑	↑	↑	↑	↑
Galvanised steel	←	●	●	●	●	←
Zinc coated steel	←	●	●	●	●	←
Mild steel	←	↑	↑	↑	●	←
Aluminium alloy	←	↑	↑	↑	●	↑
Zinc alloy	←	●	●	●	←	←

● Possible contact between the two metals ← Metal of part to be fixed is attacked ↑ Metal of fixing is attacked

Coatings and corrosion resistance

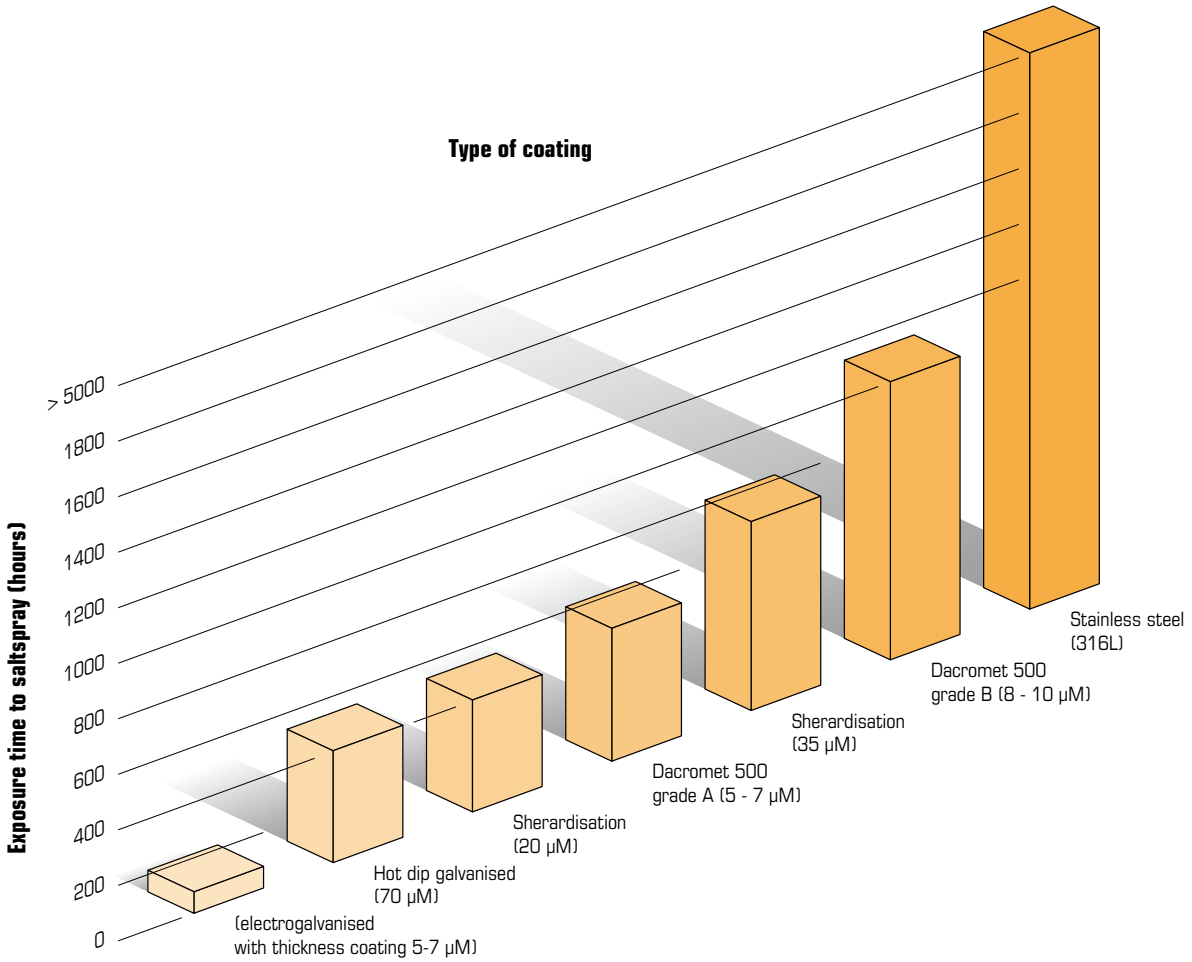


Table of principal stainless resistance

FRANCE NF EN 10088-1		According to NFA 35-573 1990, NFA 35-574 1990 (or NFA 36-209 or NFA 35-577)	USA	GERMANY		SWEEDEN	U.K.	ITALY	Quality grade
Symbol	**Code**		**AISI**	**Werkstoff**	**DIN**	**SIS**	**BS 970**	**UNI**	
X2 CrNi 19-11	14306	Z3 CN 18-10	304 L	1.4306	X2 Cr Ni 18-09	2352	304-512	X2 CrNi 18-11	A2L
		Z3 CN 19-11							
X5 CrNi 18-10	14301	Z6 CN 18-09	304	1.4301	X5 Cr Ni 18-09	2332	304-515	X5 CrNi 18-10	A2
		Z7 CN 18-09							
X10 CrNi 18-8	14310	Z11 CN 17-08	≈ 302	1.4300	X12 Cr Ni 18-09	2330/31	302-525	X10 CrNi 18-09	A2
		Z11 CN 18-08							
		Z12 CN 18-09							
X4 CrNi 18-12	14303	Z5 CN 18-11	305	1.4303	X5 CrNi-19-11		305-519	X8 CrNi 18-12	A2
X6CrNiTi 18-10	14541	Z6 CND 18-10	321	1.4541	X10 CrNiTi 18-09	2337	321-512		A3
X5CrNiMo 17-12-2	14401	Z6 CND 17-12	316	1.4401	X5CrNiMo 18-10	2343	316-516	X5CrNiMo17-12	A4
X6 CrNiMoTi 17-12-2	14571	Z6 CNDT 17-11	316 Ti	1.4571	X10CrNiTi 18-10	2334	320-517	X6CrNiMoTi17-12	A5
X2 CrNiMo 17-13-3	14404	Z3 CND 17-12	316 L	1.4404	X2CrNiMo 18-10	2353	316-512	X2CrNiMo17-12	A4L
X2CrNiMoN17-13-3	14406	Z3 CND 17-11 AZ							A4L
X3CrNiCu 18-9-3	14560	Z4 CNU 19-09 FF							A2

Fire resistance

Ramset™

Principle

Reference document : the test has been performed according to the following document « Evaluation of Anchorages in Concrete concerning resistance to fire "Technical Report TR020" published by EOTA, with standardised fire curve (ISO 834).

The design value resistance under fire exposure $\mathbf{R_{d,fi(t)} = R_{k,fi(t)} / \gamma_{M,fi}}$ usually the safety factor for resistance under fire exposure $\gamma_{M,fi} = \mathbf{1}$.

The design value of resistance under fire exposure does not deal with the mechanical design at ambient temperature. So, the fire proof must be done in addition the design at ambient temperature.

For more details, concerning the design method for the determination of the duration of the fire resistance of anchorages in cracked and non cracked concrete according to ETAG001, you could refer to the technical report TR020.

The table below gives characteristic resistance under fire exposure **($R_{k,fi(t)}$ in kN)** established from test results.

Anchor type	Dimension	Reference approval	Steel characteristic resistance under fire exposure $N_{Rk,s,fi}$			
			$N_{Rk,s,fi}$ (kN) 30 min.	$N_{Rk,s,fi}$ (kN) 60 min.	$N_{Rk,s,fi}$ (kN) 90 min.	$N_{Rk,s,fi}$ (kN) 120 min.
SPIT TRIGA Z type E, V, TF	**M6**	Fire resistance included in ETA 05/0044	0,9	0,6	0,4	0,3
	M8		2,8	2,1	1,3	0,9
	M10		4,5	3,3	2,1	1,5
	M12		17,6	11,4	5,3	2,2
	M16		32,8	21,3	9,8	4,1
	M20		51,1	33,2	15,3	6,4
SPIT FIX Z XTREM	**M8**	Fire resistance included in ETA 15/0388	0,9	0,7	0,5	0,4
	M10		2,8	2,3	1,8	1,6
	M12		3,6	3,1	2,6	2,4
	M16		6,6	5,7	4,9	4,4
	M20		10,4	9,0	7,6	6,9
SPIT FIX Z-A4	**M8**	Fire resistance included in ETA 04/0010	4,9	3,2	1,5	0,7
	M10		7,7	5,1	2,4	1,1
	M12		11,3	8,2	5,1	3,5
	M16		21,0	15,2	9,5	6,6
SPIT TAPCON XTREM	**M8** h_{nom} = 45	Fire resistance included in ETA 16/0276	1,3	1,3	1,1	0,8
	M8 h_{nom} = 65		2,3	1,7	1,1	0,8
	M10 h_{nom} = 55		1,3	1,3	1,3	1,0
	M10 h_{nom} = 85		4,0	3,3	2,2	1,7
	M12 h_{nom} = 65		3,0	3,0	3,0	2,4
	M12 h_{nom} = 100		6,3	5,8	4,2	3,4
	M14 h_{nom} = 75		4,0	4,0	4,0	3,2
	M14 h_{nom} = 115		9,8	8,1	5,9	4,8

SPIT laboratory

At Spit we have our own laboratory to test all types of fixings in any base material. This laboratory is used for new product development, approvals and quality control.

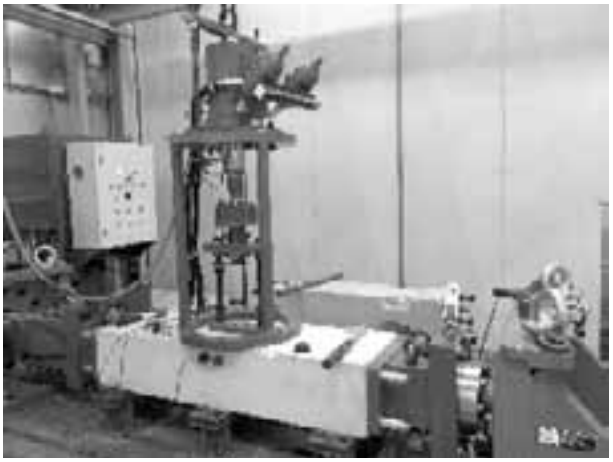
Our laboratory is accredited by COFRAC in accordance with programme 39.2 «testing of mechanical anchors - Part 2 : Expansion Anchors». Tests for metal anchors in concrete are carried out in accordance with ETA Guide no.001 «European Technical Approval for metal anchors in concrete».

To carry out these tests, the laboratory is equipped with high performance test benches able to apply pull out loads up to 80 tonnes. Shear tests, long term load tests, pulsating load tests, tests in static cracks from 0.3 mm to 0.5 mm, tests in dynamic cracks, and seismic tests for qualification of anchors C1 & C2 categories, are also carried out on these equipments.

Equipment for testing in cracked concrete

Pull out equipment test

Oven to test the behaviour at high temperature chemical resins



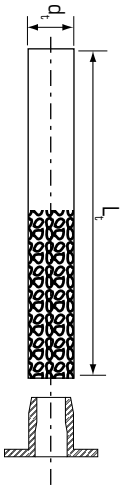
Seismic test bench

Ramset™

FIXINGS OF REBARS AND THREADED STUDS M8 TO M20 IN CEILING USING CEILING CAP AND MEASURING CONNECTOR

- Resin injection (EPOBAR for rebars or EPOMAX for studs) with measuring connector
- Cap introduction into drilled hole
- Installation : the rebar or the stud is maintained by the cap blades

FIXINGS OF THREADED STUDS M8 TO M20 IN CEILING IN USING SIEVE

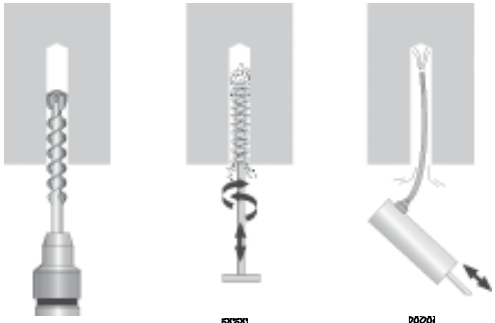


Characteristics of these sieve and installation data :

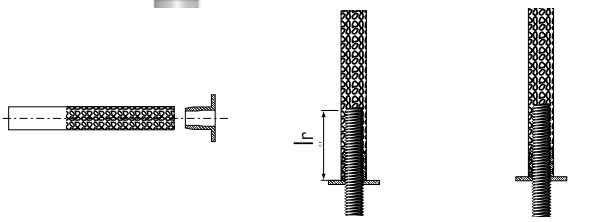
Stud dimension	Min. support thickness (mm)	Hole diameter d_0 (mm)	Hole depth h_0 (mm)	Stud length inserted into sieve L_r (mm)
M8	120	15	80	10
M10	130	15	90	10
M12	160	18	110	15
M16	175	22	125	50
M20	220	28	170	65

Internal diameter of the sieve d_t (mm)	Sieve length L_t (mm)	Sieve codes	Cap types	Cap codes
12,5	75	63400	W5	63460
12,5	85	63400	W5	63460
15	105	63410	W7	63470
20,5	120	63420	W10	63480
26	165	63430	W13	63490

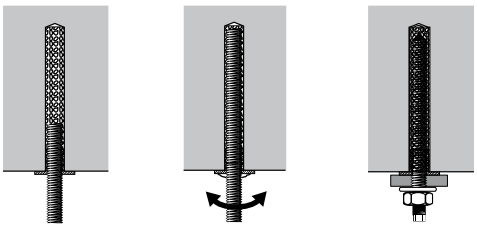
The design resistances for stud dimensions M8 to M20 in ceiling are reduced by 20% for anchoring with resin.



1 - Drill a hole according to the diameter and the selected depth
2 - Carefully clean with metal brush
3 - Remove the dust by blowing with air pump



4 - Cut a length of screen corresponding to the length L_t of the table above and insert the cap.
5 - Insert the threaded stud in the cap and push it into the sieve to the length l_r of the table above
6 - Fill the remaining volume of sieve with resin.



7 - Insert the assembly in the hole until the cap locks itself in the hole
8 - Push the stud by hand with a twisting motion through the cap to the bottom of the hole. A slight excess of resin should emerge.
9 - Observe loading and tightening torque times.

Design calculations in compliance with eurocode 2

The reference anchoring length is calculated according to Eurocode 2 rules and in compliance with the ETA, according to technical report TR 023 concerning post-installed rebar connections, to transfer the stress to the ultimate limit state of the concrete reinforcing bar N_{Rd}.

CALCULATION METHOD

Calculation of reference anchoring length $L_{b,rqd}$:

$$L_{b,rqd} = \frac{F_{Rd}}{\Pi \cdot Ø \cdot f_{bd}}$$

F_{Rd} Ultimate resistance (N)
Ø $Ø_{fer}$ (mm)
f_{bd} Bond stress (N/mm²) depending on concrete strength

Calculation of design anchoring length L_{bd}:

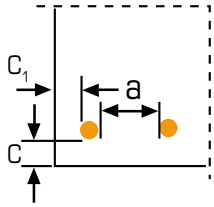
$$L_{bd} = \alpha 2 \cdot \alpha 5 \cdot L_{b,rqd}$$

Calculation of coefficient $\alpha 2$ [1] taking the influence of the cover into account:

$$\alpha 2 = 1 - 0{,}15(C_d - Ø) / Ø$$

$$C_d = \min(a/2 ; c_1 ; c)$$

$\alpha 2$ Influence of minimum cover ($0{,}7 \leq \alpha 2 \leq 1$)
$\alpha 5$ Influence of confinement by transverse compression ($\alpha 5 = 1$)
a Distance between rebars (mm)
c, c1 Cover thickness (mm)



Determination of minimum anchoring length $L_{b,min}$:

$$L_{b,min} = \max(0{,}3.L_{b,rqd\ max} ; 10\ Ø ; 100\ mm)$$

$L_{b,rqd\ max}$ reference anchoring length for the maximum ultimate load

The anchoring length used must be the maximum value (L_{bd} ; $L_{b,min}$).

[1] In the absence of edge distances, and spacing distances greater than or equal to 7 Ø, coefficient $\alpha 2$ equals 0.7.

HA bar diameter	8	10	12	14	16	20	25	32
Distance between rebars ≥ 7.Ø	56	70	84	98	112	140	175	224

Adhesion design calculations

FIELD OF APPLICATION

With VIPER XTREM resins, the adhesion design calculations can be used to determine the anchoring lengths in the case of application without influence of edge or spacing distances.

Tensile tests are generally performed on site to validate the minimum anchoring lengths (see p 75).

NOTE

Ramset™

Principle

Ramset™

TRIGA Z XTREM

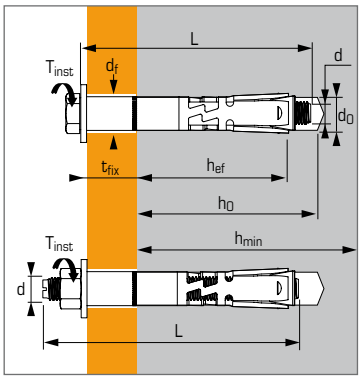
zinc coated steel version

High security, high performance fixing for use in cracked and non-cracked concrete

Product from spit

ETA European Technical Assessment

ETA Option 1- 05/0044



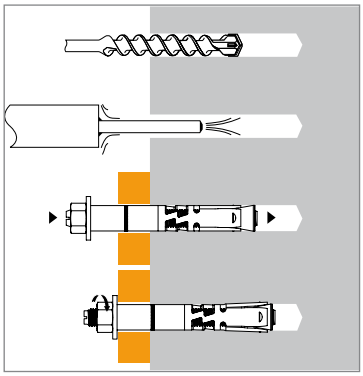
APPLICATION

- Safety critical loads
- Overhead crane rails
- Steel columns and walkways
- Wall plates
- Safety rail

MATERIAL

- **Bolt :** class 8.8 NF EN 20898-1
- **Threaded stud :** class 8.8 NF EN 20898-1
- **Nut :** class 8 NF EN 20898-2
- **Washer :** F12T4 as per NF A37501
- **Sleeve :** TS37-a BK extended as per NF A49341
- **Expansion cone :** 35 MF6Pb
- **Expansion sleeve :** 355 MC as per NF EN 10-149-2
- **Protection :** min. zinc coating 5 µm

INSTALLATION



Technical data

Anchor size	Min. anchor depth (mm) h_{ef}	Max. thick. of part to be fixed (mm) t_{fix}	Min. thick. of base material (mm) h_{min}	Thread diameter (mm) d	Drilling depth (mm) h_0	Drilling diameter (mm) d_0	Clearance diameter (mm) d_f	Total anchor length (mm) L	Tighten torque (Nm) T_{inst}	Code
V6-10/5		5						65		050673
V6-10/20	50	20	100	M6	70	10	12	80	15	050674
E6-10/50		50						117		050675
V8-12/1*		1						65		050677
V8-12/10		10						80		050678
V8-12/20		20						90		050679
V8-12/50		50						120		053001
E8-12/20	60	20	120	M8	80	12	14	99	25	050681
E8-12/35		35						114		050683
E8-12/55		55						134		050684
E8-12/95		95						174		050685
V10-15/1*		1						75		050687
V10-15/10		10						95		050688
V10-15/20		20						105		050689
V10-15/55		55						140		053003
E10-15/20	70	20	140	M10	90	15	17	114	50	050691
E10-15/35		35						129		050692
E10-15/55		55						149		050693
E10-15/100		100						194		050694
V12-18/10		10						105		050696
V12-18/25		25						120		050697
V12-18/55		55						150		053004
E12-18/25	80	25	160	M12	105	18	20	132	80	050698
E12-18/45		45						152		050699
E12-18/65		65						172		050701
E12-18/100		100						207		050702
V16-24/10		10						130		050704
V16-24/25		25						145		050705
V16-24/50		50						170		050710
E16-24/25	100	25	200	M16	131	24	26	159	120	050706
E16-24/55		55						189		050707
E16-24/100		100						234		050708
V20-28/25		25						170		050711
E20-28/25	125	25	250	M20	157	28	31	192	200	050712
E20-28/60		60						227		050713
E20-28/100		100						267		050714
TF V8-12/16	60	16	120	M8	80	12	14	85	25	050686
TF V8-12/26	60	26	120	M8	80	12	14	95	25	053002
TF V10-15/27	70	27	140	M10	90	15	17	105	50	050695
TF V12-18/40*	80	40	160	M12	105	18	20	130	80	050715
E12-18/0*	80	-	160	M12	105	18	-	120	80	050669
E12-18/A*	80	-	160	M12	105	18	-	162	80	050703
E12-18/QC*	80	-	160	M12	105	18	-	178	80	050671

* Do not belong to ETA

Anchor mechanical properties

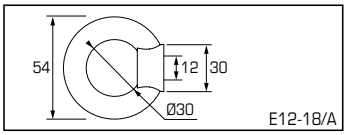
Anchor size		M6	M8	M10	M12	M16	M20
f_{uk} (N/mm²)	Min. tensile strength	800	800	800	800	800	830
f_{yk} (N/mm²)	Yield strength	640	640	640	640	640	660
$S_{eq,V}$ (mm²)	Equivalent stressed cross-section bolt version	39,2	76,1	108,8	175,3	335,1	520,2
$S_{eq,E}$ (mm²)	Equivalent stressed cross-section threaded stud version	35,2	61,8	82,0	104,1	183,3	277,3
W_{el} (mm³)	Elastic section modulus	12,7	31,2	62,3	109,2	277,5	541,0
$M^0_{rk,s}$ (Nm)	Characteristic bending moment	12,2	30,0	59,8	104,8	266,4	538,8
M (Nm)	Recommended bending moment	5,8	12,4	24,8	43,5	110,7	216,0

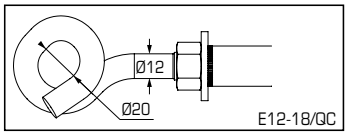
TRIGA Z XTREM

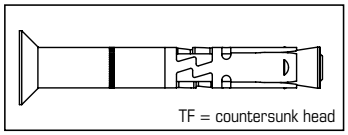
zinc coated steel version

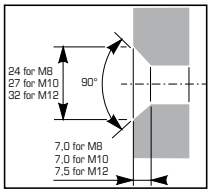
Ramset™

Special products









Recommended loads in kN			
Anchor size	**TENSILE ≥ C20/25**	**OBLIQUE ≥ C20/25**	**SHEAR ≥ C20/25**
E12-18/A	3,4	2,4* *(30≤ α ≤45°)	Not recommended
E12-18/QC	4,0	1,0	0,5
TF V8-12/16	The resistance given for the bolt version with the same diameter can be used		
TF V8-12/26			
TF V10-15/27			
TF V12-18/40			

For detail design, please refer to CC method in following page.

Ultimate ($N_{Ru,m}$, $V_{Ru,m}$) and characteristic loads (N_{Rk}, V_{Rk}) in kN

Mean Ultimate loads are derived from test results in admissible service conditions, and characteristic loads are statistically determined.

TENSILE

Anchor size	M6	M8	M10	M12	M16	M20
Non-cracked concrete (C20/25)						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
$N_{Ru,m}$	18,2	27,5	45,9	54,4	103,6	124,4
N_{Rk}	16,1	20,0	29,6	36,0	50,4	70,5
Cracked concrete (C20/25)						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
$N_{Ru,m}$	15,1	20,3	33,3	50,3	88,5	113,3
N_{Rk}	5,0	12,0	15,9	25,8	36,0	50,3

SHEAR

Anchor size		M6	M8	M10	M12	M16	M20
Non-cracked concrete (C20/25)							
Type V/T	$V_{Ru,m}$	29,2	41,7	68,0	95,7	159,0	228,2
	V_{Rk}	17,9	32,6	49,1	72,2	100,8	140,9
Type E	$V_{Ru,m}$	20,0	26,2	43,1	57,0	116,0	135,9
	V_{Rk}	14,3	19,0	31,0	47,4	93,1	109,9
Cracked concrete (C20/25)							
Type V/T	$V_{Ru,m}$	29,2	41,7	68,0	95,7	159,0	228,2
	V_{Rk}	12,8	32,6	42,2	51,5	72,0	100,7
Type E	$V_{Ru,m}$	20,0	26,2	43,1	57,0	116,0	135,9
	V_{Rk}	12,8	19,0	31,0	47,4	72,0	100,7

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

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

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

TENSILE

Anchor size	M6	M8	M10	M12	M16	M20
Non-cracked concrete (C20/25)						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
N_{Rd}	10,7	13,3	19,7	24,0	33,6	47,0
Cracked concrete (C20/25)						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
N_{Rd}	3,3	8,0	10,6	17,2	24,0	33,5

$\gamma_{Mc} = 1,5$

SHEAR

Anchor size		M6	M8	M10	M12	M16	M20
Non-cracked concrete (C20/25)							
Type V/T	V_{Rd}	14,3	26,1	39,3	57,7	80,6	112,7
Type E	V_{Rd}	11,4	15,2	24,8	37,9	74,5	87,9
Cracked & concrete (C20/25)							
Type V/T	V_{Rd}	10,2	26,1	33,7	41,2	57,6	80,5
Type E	V_{Rd}	10,2	15,2	24,8	37,9	57,6	80,5

$\gamma_{Ms} = 1,25$

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

$$N_{rec} = \frac{N_{Rk}}{3}$$

$$V_{rec} = \frac{N_{Rk}}{3}$$

TENSILE

Anchor size	M6	M8	M10	M12	M16	M20
Non-cracked concrete (C20/25)						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
N_{rec}	5,4	6,7	9,9	12,0	16,8	23,5
Cracked concrete (C20/25)						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
N_{rec}	1,7	4,0	5,3	8,6	12,0	16,8

$\gamma = 3$

SHEAR

Anchor size		M6	M8	M10	M12	M16	M20
Non-cracked concrete (C20/25)							
Type V/T	V_{rec}	6,0	10,9	16,4	24,1	33,6	47,0
Type E	V_{rec}	4,8	6,3	10,3	15,8	31,0	36,6
Cracked concrete (C20/25)							
Type V/T	V_{rec}	4,3	10,9	14,1	17,2	24,0	33,6
Type E	V_{rec}	4,3	6,3	10,3	15,8	24,0	36,6

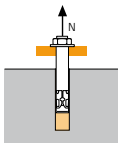
$\gamma = 3$

TRIGA Z XTREM

zinc coated steel version

SPIT CC Method (values issued from ETA)

TENSILE in kN

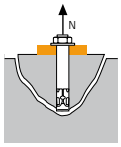


Pull-out resistance

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

$N^0_{Rd,p}$						Design pull-out resistance
Anchor size	M6	M8	M10	M12	M16	M20
Non-cracked concrete						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
$N^0_{Rd,p}$ (C20/25)	-	13,3	-	-	-	-
Cracked concrete						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
$N^0_{Rd,p}$ (C20/25)	3,3	8	10,6	-	-	-

$\gamma_{Mc} = 1,5$

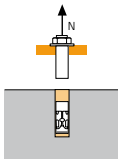


Concrete cone resistance

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

$N^0_{Rd,c}$						Design cone resistance
Anchor size	M6	M8	M10	M12	M16	M20
Non-cracked concrete						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
$N^0_{Rd,c}$ (C20/25)	11,9	15,6	19,7	24,0	33,6	47,0
Cracked concrete						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
$N^0_{Rd,c}$ (C20/25)	8,5	11,2	14,1	17,2	24,0	33,5

$\gamma_{Mc} = 1,5$

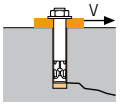


Steel resistance

$N_{Rd,s}$						Steel design tensile resistance
Anchor size	M6	M8	M10	M12	M16	M20
$N_{Rd,s}$	10,7	19,5	30,9	44,9	83,7	130,7

$\gamma_{Ms} = 1,5$

SHEAR in kN

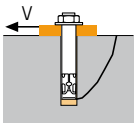


Concrete edge resistance

$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c}$						Design concrete edge resistance at minimum edge distance (C_{min})
Anchor size	M6	M8	M10	M12	M16	M20
Non-cracked concrete						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
C_{min}	50	60	70	80	100	150
S_{min}	100	100	160	200	220	300
$V^0_{Rd,c}$ (C20/25)	3,4	4,9	6,8	9,3	13,6	26,1
Cracked concrete						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
C_{min}	50	60	70	80	100	150
S_{min}	100	100	160	200	220	300
$V^0_{Rd,c}$ (C20/25)	2,4	3,5	4,8	6,6	9,7	18,7

$\gamma_{Mc} = 1,5$

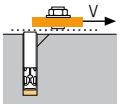


Pryout failure

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

$V^0_{Rd,cp}$						Design pryout resistance
Anchor size	M6	M8	M10	M12	M16	M20
Non-cracked concrete						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
$V^0_{Rd,cp}$ (C20/25)	11,9	31,2	39,4	48,1	67,2	93,9
Cracked concrete						
h_{ef}	**50**	**60**	**70**	**80**	**100**	**125**
$V^0_{Rd,cp}$ (C20/25)	8,5	22,3	28,1	34,3	48,0	67,1

$\gamma_{Mcp} = 1,5$



Steel resistance

$V_{Rd,s}$						Steel design shear resistance
Anchor size	M6	M8	M10	M12	M16	M20
$V_{Rd,s}$ (Type V/TF)	18,7	26,1	39,3	58,2	93,8	138,8
$V_{Rd,s}$ (Type E)	11,4	15,2	24,8	37,9	74,5	87,9

$\gamma_{Ms} = 1,25$

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

$\beta_N = N_{Sd} / N_{Rd} \leq 1$

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

$\beta_V = V_{Sd} / V_{Rd} \leq 1$

$$\beta_N + \beta_V \leq 1,2$$

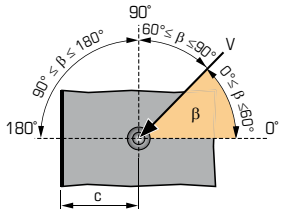
f_b INFLUENCE OF CONCRETE

Concrete class	Cube strength fcc	f_b	Concrete class	Cube strength fcc	f_b
C25/30	30	1,1	C40/50	50	1,41
C30/37	37	1,22	C45/55	55	1,48
C35/45	45	1,34	C50/60	60	1,55

$$f_b = \sqrt{\frac{fcc}{25}}$$

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

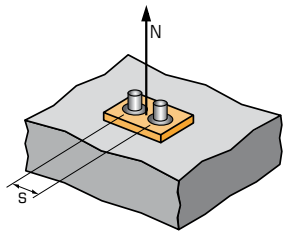
Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



Ramset™

SPIT CC Method (values issued from ETA)

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0{,}5 + \frac{s}{6.h_{ef}}$$

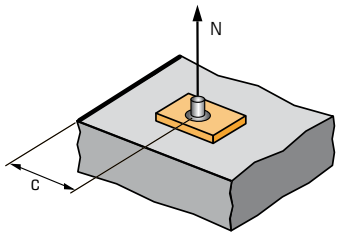
$s_{min} < s < s_{cr,N}$

$s_{cr,N} = 3.h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group.

SPACING S						Reduction factor Ψ_s Cracked & non-cracked concrete
Anchor size	M6	M8	M10	M12	M16	M20
50	0,67					
60	0,70	0,67				
70	0,73	0,69	0,67			
80	0,77	0,72	0,69	0,67		
100	0,83	0,78	0,74	0,71	0,67	
125	0,92	0,85	0,80	0,76	0,71	0,67
150	1,00	0,92	0,86	0,81	0,75	0,70
180		1,00	0,93	0,88	0,80	0,74
210			1,00	0,94	0,85	0,78
240				1,00	0,90	0,82
300					1,00	0,90
375						1,00

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



$$\Psi_{c,N} = 0{,}25 + 0{,}5 \cdot \frac{c}{h_{ef}}$$

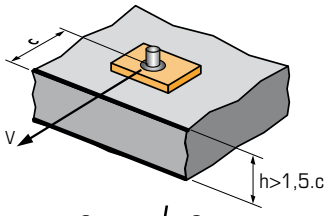
$c_{min} < c < c_{cr,N}$

$c_{cr,N} = 1{,}5.h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group.

EDGE C						Reduction factor $\Psi_{c,N}$ Cracked & non-cracked concrete
Anchor size	M6	M8	M10	M12	M16	M20
50	0,75					
60	0,85	0,75				
70	0,95	0,83	0,75			
80	1,00	0,92	0,82	0,75		
90		1,00	0,89	0,81		
100			0,96	0,88	0,75	
120				1,00	0,85	
150					1,00	0,85
170						0,93
190						1,00

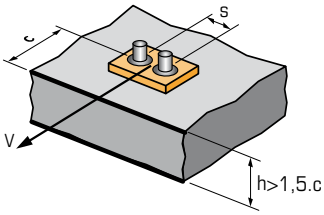
$\Psi_{s\text{-}c,V}$ INFLUENCE OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



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

For single anchor fastening

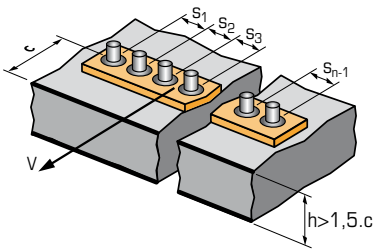
												Reduction factor $\Psi_{s\text{-}c,V}$ Cracked & non-cracked concrete
$\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
$\Psi_{s\text{-}c,V}$	1,00	1,31	1,66	2,02	2,41	2,83	3,26	3,72	4,19	4,69	5,20	5,72



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

For 2 anchors fastening

												Reduction factor $\Psi_{s\text{-}c,V}$ Cracked & non-cracked concrete
$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
1,0	0,67	0,84	1,03	1,22	1,43	1,65	1,88	2,12	2,36	2,62	2,89	3,16
1,5	0,75	0,93	1,12	1,33	1,54	1,77	2,00	2,25	2,50	2,76	3,03	3,31
2,0	0,83	1,02	1,22	1,43	1,65	1,89	2,12	2,38	2,63	2,90	3,18	3,46
2,5	0,92	1,11	1,32	1,54	1,77	2,00	2,25	2,50	2,77	3,04	3,32	3,61
3,0	1,00	1,20	1,42	1,64	1,88	2,12	2,37	2,63	2,90	3,18	3,46	3,76
3,5		1,30	1,52	1,75	1,99	2,24	2,50	2,76	3,04	3,32	3,61	3,91
4,0			1,62	1,86	2,10	2,36	2,62	2,89	3,17	3,46	3,75	4,05
4,5				1,96	2,21	2,47	2,74	3,02	3,31	3,60	3,90	4,20
5,0					2,33	2,59	2,87	3,15	3,44	3,74	4,04	4,35
5,5						2,71	2,99	3,28	3,71	4,02	4,33	4,65
6,0						2,83	3,11	3,41	3,71	4,02	4,33	4,65

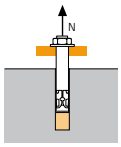


For 3 anchors fastening and more

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

SPIT CC Method (values issued from ETA - Seismic category C1)

TENSILE in kN

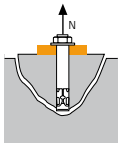


Pull-out resistance

$$N_{Rd,p,C1} = N^0_{Rd,p,C1} \cdot f_b$$

$N^0_{Rd,p,C1}$		Design pull-out resistance	
Anchor size	M10	M12	M16
Category C1 - Single anchor			
h_{ef}	**70**	**80**	**100**
$N^0_{Rd,p,C1}$ (C20/25)	6,1	17,2	24,0
Category C1 - Group of anchors [1]			
h_{ef}	**70**	**80**	**100**
$N^0_{Rd,p,C1}$ (C20/25)	5,2	14,6	20,4

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

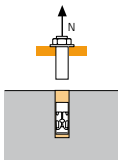


Concrete cone resistance

$$N_{Rd,c,C1} = N^0_{Rd,c,C1} \cdot f_b \cdot \Psi_s \cdot \Psi_{c,N}$$

$N^0_{Rd,c,C1}$		Design cone resistance	
Anchor size	M10	M12	M16
Category C1 - Single anchor			
h_{ef}	**70**	**80**	**100**
$N^0_{Rd,c,C1}$ (C20/25)	11,9	14,6	20,4
Category C1 - Group of anchors [1]			
h_{ef}	**70**	**80**	**100**
$N^0_{Rd,c,C1}$ (C20/25)	10,5	12,9	18,0

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

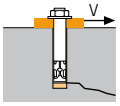


Steel resistance

$N_{Rd,s,C1}$		Steel design tensile resistance	
Anchor size	M10	M12	M16
$N_{Rd,s,C1}$	30,7	44,7	84,0

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Ms} = 1,5$

SHEAR in kN

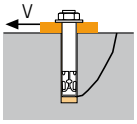


Concrete edge resistance

$$V_{Rd,c,C1} = V^0_{Rd,c,C1} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S-C,V}$$

$V^0_{Rd,c,C1}$		Design concrete edge resistance at minimum edge distance (C_{min})	
Anchor size	M10	M12	M16
Category C1 - Single anchor			
h_{ef}	**70**	**80**	**100**
C_{min}	70	80	100
S_{min}	160	200	220
$V^0_{Rd,c,C1}$ (C20/25)	4,6	6,1	9,7
Category C1 - Group of anchors [1]			
h_{ef}	**70**	**80**	**100**
C_{min}	70	80	100
S_{min}	160	200	220
$V^0_{Rd,c,C1}$ (C20/25)	3,9	5,2	8,3

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$

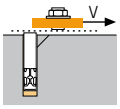


Pryout failure

$$V_{Rd,cp,C1} = V^0_{Rd,cp,C1} \cdot f_b \cdot \Psi_s \cdot \Psi_{c,N}$$

$V^0_{Rd,cp,C1}$		Design pryout resistance	
Anchor size	M10	M12	M16
Category C1 - Single anchor			
h_{ef}	**70**	**80**	**100**
$V^0_{Rd,cp,C1}$ (C20/25)	23,9	29,2	40,8
Category C1 - Group of anchors [1]			
h_{ef}	**70**	**80**	**100**
$V^0_{Rd,cp,C1}$ (C20/25)	21,1	25,8	36,0

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$



Steel resistance [2]

$V_{Rd,s,C1}$		Steel design shear resistance	
Anchor size	M10	M12	M16
Category C1 - Single anchor			
$V_{Rd,s,C1}$	13,7	22,7	48,4
Category C1 - Group of anchors [1]			
$V_{Rd,s,C1}$	11,6	19,3	41,2

[1] when more than one anchor of the group is submitted to shear load
[2] In case of no hole clearance between anchor and fixture
$\gamma_{Ms} = 1,25$

$$N_{Rd,C1} = \min(N_{Rd,p,C1} \; ; \; N_{Rd,c,C1} \; ; \; N_{Rd,s,C1})$$
$$\beta_N = N_{Sd} / N_{Rd,C1} \leq 1$$

$$V_{Rd,C1} = \min(V_{Rd,c,C1} \; ; \; V_{Rd,cp,C1} \; ; \; V_{Rd,s,C1})$$
$$\beta_V = V_{Sd} / V_{Rd,C1} \leq 1$$

$$\beta_N + \beta_V \leq 1,2$$

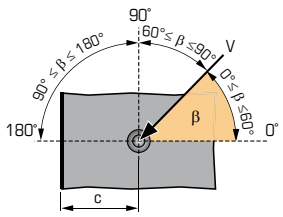
f_b INFLUENCE OF CONCRETE

Concrete class	Cube strength fcc	f_b	Concrete class	Cube strength fcc	f_b
C25/30	30	1,1	C40/50	50	1,41
C30/37	37	1,22	C45/55	55	1,48
C35/45	45	1,34	C50/60	60	1,55

$$f_b = \sqrt{\frac{fcc}{25}}$$

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

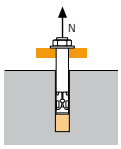
Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



Ramset™

SPIT CC Method (values issued from ETA - Seismic category C2)

TENSILE in kN

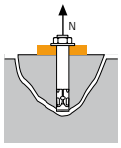


Pull-out resistance

$N_{Rd,p,C2} = N^0_{Rd,p,C2} \cdot f_b$

$N^0_{Rd,p,C2}$		Design pull-out resistance	
Anchor size	M10	M12	M16
Category C2 - Single anchor			
h_{ef}	**70**	**80**	**100**
$N^0_{Rd,p,C2}$ (C20/25)	3,5	6,3	11,0
Category C2 - Group of anchors [1]			
h_{ef}	**70**	**80**	**100**
$N^0_{Rd,p,C2}$ (C20/25)	3,0	5,3	9,4

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

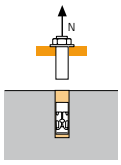


Concrete cone resistance

$N_{Rd,c,C2} = N^0_{Rd,c,C2} \cdot f_b \cdot \Psi_s \cdot \Psi_{c,N}$

$N^0_{Rd,c,C2}$		Design cone resistance	
Anchor size	M10	M12	M16
Category C2 - Single anchor			
h_{ef}	**70**	**80**	**100**
$N^0_{Rd,c,C2}$ (C20/25)	9,5	11,9	16,0
Category C2 - Group of anchors [1]			
h_{ef}	**70**	**80**	**100**
$N^0_{Rd,c,C2}$ (C20/25)	8,4	10,5	14,1

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

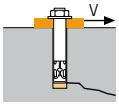


Steel resistance

$N_{Rd,s,C2}$		Steel design tensile resistance	
Anchor size	M10	M12	M16
$N_{Rd,s,C2}$	30,7	44,7	84,0

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Ms} = 1,5$

SHEAR in kN

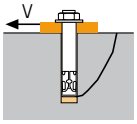


Concrete edge resistance

$V_{Rd,c,C2} = V^0_{Rd,c,C2} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c,C2}$		Design concrete edge resistance at minimum edge distance (C_{min})	
Anchor size	M10	M12	M16
Category C2 - Single anchor			
h_{ef}	**70**	**80**	**100**
C_{min}	65	100	100
S_{min}	50	100	100
$V^0_{Rd,c,C2}$ (C20/25)	4,0	5,3	8,4
Category C2 - Group of anchors [1]			
h_{ef}	**70**	**80**	**100**
C_{min}	70	80	100
S_{min}	50	100	100
$V^0_{Rd,c,C2}$ (C20/25)	3,4	4,5	7,1

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$

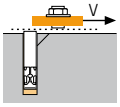


Pryout failure

$V_{Rd,cp,C2} = V^0_{Rd,cp,C2} \cdot f_b \cdot \Psi_s \cdot \Psi_{c,N}$

$V^0_{Rd,cp,C2}$		Design pryout resistance	
Anchor size	M10	M12	M16
Category C2 - Single anchor			
h_{ef}	**70**	**80**	**100**
$V^0_{Rd,cp,C2}$ (C20/25)	19,0	23,9	32,0
Category C2 - Group of anchors [1]			
h_{ef}	**70**	**80**	**100**
$V^0_{Rd,cp,C2}$ (C20/25)	16,7	21,1	28,2

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$



Steel resistance [2]

$V_{Rd,s,C2}$		Steel design shear resistance	
Anchor size	M10	M12	M16
Category C2 - Single anchor			
$V_{Rd,s,C2}$	11,6	22,7	46,5
Category C2 - Group of anchors [1]			
$V_{Rd,s,C2}$	9,9	19,3	39,5

[1] when more than one anchor of the group is submitted to shear load
[2] In case of no hole clearance between anchor and fixture
$\gamma_{Ms} = 1,25$

$N_{Rd,C2} = \min(N_{Rd,p,C2} ; N_{Rd,c,C2} ; N_{Rd,s,C2})$

$\beta_N = N_{Sd} / N_{Rd,C2} \leq 1$

$V_{Rd,C2} = \min(V_{Rd,c,C2} ; V_{Rd,cp,C2} ; V_{Rd,s,C2})$

$\beta_V = V_{Sd} / V_{Rd,C2} \leq 1$

$$\beta_N + \beta_V \leq 1,2$$

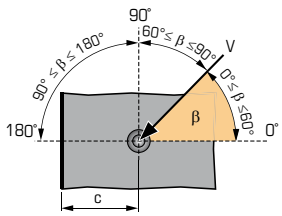
f_b INFLUENCE OF CONCRETE

Concrete class	Cube strength fcc	f_b	Concrete class	Cube strength fcc	f_b
C25/30	30	1,1	C40/50	50	1,41
C30/37	37	1,22	C45/55	55	1,48
C35/45	45	1,34	C50/60	60	1,55

$$f_b = \sqrt{\frac{fcc}{25}}$$

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

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



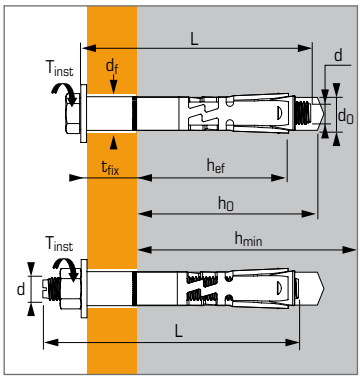
Ramset™

TRIGA Z - A4

stainless steel version

High security, high performance fixing for use in cracked and non-cracked concrete

Product from Spit



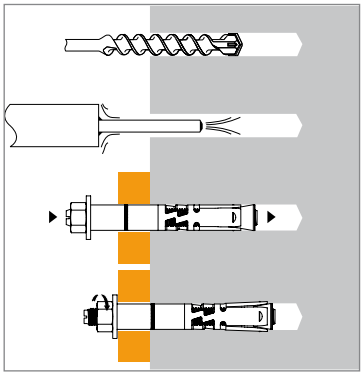
APPLICATION

- Safety critical loads
- Overhead crane rails
- Steel columns and walkways
- Wall plates
- Safety rail

MATERIAL

- **Bolt :** class 80 NF EN ISO 3506-1
- **Threaded stud :** class 70 NF E 25100-0
- **Nut :** class 80 NF E 25100-4
- **Washer :** X5CrNiMo 17-12-2
- **Expansion cone :** X2CrNiMo 17-12-2
- **Expansion sleeve:** X2CrNiMo 17-12-2

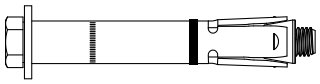
INSTALLATION



Technical data

Anchor size	Min. anchor depth (mm) h_{ef}	Max. thick. of part to be fixed (mm) t_{fix}	Min. thick. of base material (mm) h_{min}	Thread diameter (mm) d	Drilling depth (mm) h_0	Drilling diameter (mm) d_0	Clearance diameter (mm) d_f	Total anchor length (mm) L	Tighten torque (Nm) T_{inst}	Code
V6-10/10	50	10	100	M6	70	10	12	70	10	050694
V8-12/10		10						80		050595
V8-12/30	60	30	120	M8	80	12	14	100	25	050596
E8-12/45		45						124		050598
V10-15/25		25						115		050601
E10-15/45	70	45	140	M10	90	15	17	139	50	050604
V12-18/25		25						120		050605
E12-18/15	80	15	160	M12	105	18	20	122	80	050606
E12-18/45		45						152		050608
E16-24/25	95	25	200	M16	130	24	26	157	120	052940

* Special design for E16-24/25



Anchor mechanical properties

Anchor size		M6	M8	M10	M12	M16
Type V						
f_{uk} (N/mm²)	Min. tensile strength	800	800	800	800	800
f_{yk} (N/mm²)	Yield strength	600	600	600	600	600
$M^0_{rk,s}$ (Nm)	Characteristic bending moment	12,2	30,0	59,8	104,8	266,4
M (Nm)	Recommended bending moment	5,8	12,4	24,8	43,5	110,7
Type E						
f_{uk} (N/mm²)	Min. tensile strength	700	700	700	700	700
f_{yk} (N/mm²)	Yield strength	350	350	350	350	350
$M^0_{rk,s}$ (Nm)	Characteristic bending moment	10,6	26,2	52,3	91,7	233,1
M (Nm)	Recommended bending moment	4,4	10,9	21,8	38,2	97,1
Type V and type E						
$S_{eq,V}$ (mm²)	Equivalent stressed cross-section bolt version	39,2	76,1	108,8	175,3	335,1
$S_{eq,E}$ (mm²)	Equivalent stressed cross-section threaded stud version	35,2	61,8	82,0	104,1	183,3
W_{el} (mm³)	Elastic section modulus	12,7	31,2	62,3	109,2	277,5

TRIGA Z - A4

stainless steel version

Ramset™

For detail design, please refer to CC method in following page.

Ultimate ($N_{Ru,m}$, $V_{Ru,m}$) and characteristic loads (N_{Rk}, V_{Rk}) in kN

Mean Ultimate loads are derived from test results in admissible service conditions, and characteristic loads are statistically determined.

TENSILE

Anchor size	M6	M8	M10	M12	M16
Non-cracked concrete (C20/25)					
h_{ef}	**50**	**60**	**70**	**80**	**95**
$N_{Ru,m}$	19,1	25,9	36,2	47,0	64,2
N_{Rk}	15,0	15,9	20,9	24,9	46,6
Cracked concrete (C20/25)					
h_{ef}	**50**	**60**	**70**	**80**	**95**
$N_{Ru,m}$	19,1	25,9	36,2	47,0	64,2
N_{Rk}	5,0	9,0	15,9	25,8	33,3

SHEAR

Anchor size		M6	M8	M10	M12	M16
Non-cracked concrete (C20/25)						
Type V/T	$V_{Ru,m}$	26,8	37,6	70,1	67,4	140,7
	V_{Rk}	17,9	31,4	49,1	60,1	93,3
Type E	$V_{Ru,m}$	17,5	22,9	37,7	49,9	101,5
	V_{Rk}	12,6	16,6	27,2	41,4	81,4
Cracked concrete (C20/25)						
Type V/T	$V_{Ru,m}$	26,8	37,6	70,1	67,4	140,7
	V_{Rk}	12,8	31,4	42,2	51,5	66,6
Type E	$V_{Ru,m}$	17,5	22,9	37,7	49,9	101,5
	V_{Rk}	12,6	16,6	27,2	41,4	66,6

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

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

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

TENSILE

Anchor size	M6	M8	M10	M12	M16
Non-cracked concrete (C20/25)					
h_{ef}	**50**	**60**	**70**	**80**	**95**
N_{Rd}	10,0	10,6	13,3	16,6	25,9
Cracked concrete (C20/25)					
h_{ef}	**50**	**60**	**70**	**80**	**95**
N_{Rd}	3,3	6,0	10,6	17,2	18,5

γ_{Mc} = 1,5 for M8-M12 and γ_{Mc} = 1,8 for M16

SHEAR

Anchor size		M6	M8	M10	M12	M16
Non-cracked concrete (C20/25)						
Type V/T	V_{Rd}	13,4	23,6	36,9	45,2	70,2
Type E	V_{Rd}	6,3	8,3	13,6	20,7	40,7
Cracked & concrete (C20/25)						
Type V/T	V_{Rd}	9,6	23,6	31,7	38,7	50,1
Type E	V_{Rd}	6,3	8,3	13,6	20,7	33,3

γ_{Ms} = 1,33 for Type V and γ_{Ms} = 2,0 for Type E

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

$$N_{rec} = \frac{N_{Rk}}{3}$$

$$V_{rec} = \frac{N_{Rk}}{3}$$

TENSILE

Anchor size	M6	M8	M10	M12	M16
Non-cracked concrete (C20/25)					
h_{ef}	**50**	**60**	**70**	**80**	**95**
N_{rec}	5,0	5,3	6,7	8,3	15,5
Cracked concrete (C20/25)					
h_{ef}	**50**	**60**	**70**	**80**	**95**
N_{rec}	1,7	3,0	5,3	8,6	11,1

$\gamma = 3$

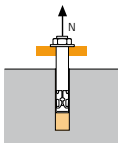
SHEAR

Anchor size		M6	M8	M10	M12	M16
Non-cracked concrete (C20/25)						
Type V/T	V_{rec}	6,0	10,5	16,4	20,0	31,1
Type E	V_{rec}	4,2	5,5	9,1	13,8	27,1
Cracked concrete (C20/25)						
Type V/T	V_{rec}	4,3	10,5	14,1	17,2,	22,2
Type E	V_{rec}	4,2	5,5	9,1	13,8	22,2

$\gamma = 3$

SPIT CC Method

TENSILE in kN

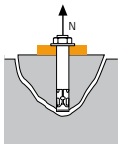


Pull-out resistance

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

$N^0_{Rd,p}$					Design pull-out resistance
Anchor size	M6	M8	M10	M12	M16
Non-cracked concrete					
h_{ef}	50	60	70	80	95
$N^0_{Rd,p}$ (C20/25)	-	10,6	13,3	16,6	-
Cracked concrete					
h_{ef}	50	60	70	80	95
$N^0_{Rd,p}$ (C20/25)	3,3	6	10,6	-	-

γ_{Mc} = 1,5 for M6-M12

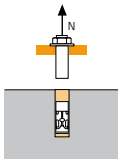


Concrete cone resistance

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

$N^0_{Rd,c}$					Design cone resistance
Anchor size	M6	M8	M10	M12	M16
Non-cracked concrete					
h_{ef}	50	60	70	80	95
$N^0_{Rd,c}$ (C20/25)	11,9	15,6	19,7	24,0	25,9
Cracked concrete					
h_{ef}	50	60	70	80	95
$N^0_{Rd,c}$ (C20/25)	8,5	11,2	14,1	17,2	18,5

γ_{Mc} = 1,5 for M6-M12 and γ_{Mc} = 1,8 for M16

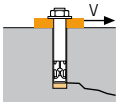


Steel resistance

$N_{Rd,s}$					Steel design tensile resistance
Anchor size	M6	M8	M10	M12	M16
$N_{Rd,s}$ (Type V)	10,0	18,2	28,8	42,0	78,9
$N_{Rd,s}$ (Type E)	5,8	10,6	16,8	24,4	45,9

γ_{Ms} = 1,6 for Type V and γ_{Ms} = 2,4 for Type E

SHEAR in kN

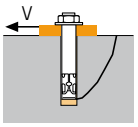


Concrete edge resistance

$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c}$					Design concrete edge resistance at minimum edge distance (C_{min})
Anchor size	M6	M8	M10	M12	M16
Non-cracked concrete					
h_{ef}	50	60	70	80	95
C_{min}	50	60	70	80	100
S_{min}	100	100	160	200	220
$V^0_{Rd,c}$ (C20/25)	3,4	4,9	6,8	9,3	13,6
Cracked concrete					
h_{ef}	50	60	70	80	95
C_{min}	50	60	70	80	100
S_{min}	100	100	160	200	220
$V^0_{Rd,c}$ (C20/25)	2,4	3,5	4,8	6,6	9,7

γ_{Mc} = 1,5

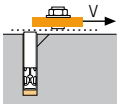


Pryout failure

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

$V^0_{Rd,cp}$					Design pryout resistance
Anchor size	M6	M8	M10	M12	M16
Non-cracked concrete					
h_{ef}	50	60	70	80	95
$V^0_{Rd,cp}$ (C20/25)	11,9	31,2	39,4	48,1	62,2
Cracked concrete					
h_{ef}	50	60	70	80	95
$V^0_{Rd,cp}$ (C20/25)	8,5	22,3	28,1	34,3	44,4

γ_{Mcp} = 1,5



Steel resistance

$V_{Rd,s}$					Steel design shear resistance
Anchor size	M6	M8	M10	M12	M16
$V_{Rd,s}$ (Type V)	16,2	23,6	36,9	45,2	88,2
$V_{Rd,s}$ (Type E)	6,3	8,3	13,6	20,7	40,7

γ_{Ms} = 1,33 for Type V and γ_{Ms} = 2,0 for Type E

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

$\beta_N = N_{Sd} / N_{Rd} \leq 1$

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

$\beta_V = V_{Sd} / V_{Rd} \leq 1$

$$\beta_N + \beta_V \leq 1{,}2$$

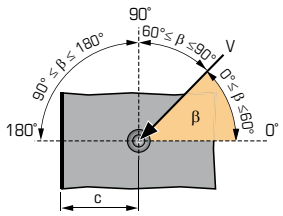
f_b INFLUENCE OF CONCRETE

Concrete class	Cube strength fcc	f_b	Concrete class	Cube strength fcc	f_b
C25/30	30	1,1	C40/50	50	1,41
C30/37	37	1,22	C45/55	55	1,48
C35/45	45	1,34	C50/60	60	1,55

$$f_b = \sqrt{\frac{fcc}{25}}$$

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

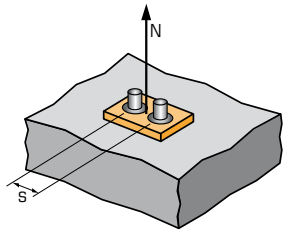
Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



Ramset™

SPIT CC Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0{,}5 + \frac{s}{6.h_{ef}}$$

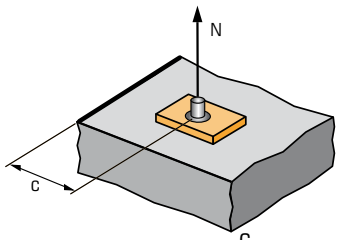
$s_{min} < s < s_{cr,N}$

$s_{cr,N} = 3.h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group.

SPACING S					Reduction factor Ψ_s Cracked & non-cracked concrete
Anchor size	M6	M8	M10	M12	M16
50	0,67				
60	0,70	0,67			
70	0,73	0,69	0,67		
80	0,77	0,72	0,69	0,67	
100	0,83	0,78	0,74	0,71	0,67
125	0,92	0,85	0,80	0,76	0,71
150	1,00	0,92	0,86	0,81	0,75
180		1,00	0,93	0,88	0,80
210			1,00	0,94	0,85
240				1,00	0,90
300					1,00

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



$$\Psi_{c,N} = 0{,}25 + 0{,}5 \cdot \frac{c}{h_{ef}}$$

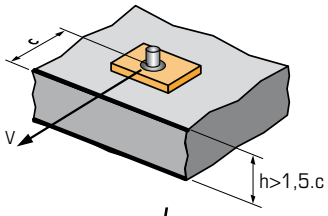
$c_{min} < c < c_{cr,N}$

$c_{cr,N} = 1{,}5.h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group.

EDGE C					Reduction factor $\Psi_{c,N}$ Cracked & non-cracked concrete
Anchor size	M6	M8	M10	M12	M16
50	0,75				
60	0,85	0,75			
70	0,95	0,83	0,75		
80	1,00	0,92	0,82	0,75	
90		1,00	0,89	0,81	
105			1,00	0,91	0,80
120				1,00	0,88
150					1,00

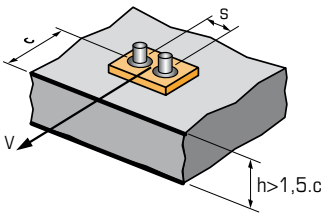
$\Psi_{s\text{-}c,V}$ INFLUENCE OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



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

For single anchor fastening

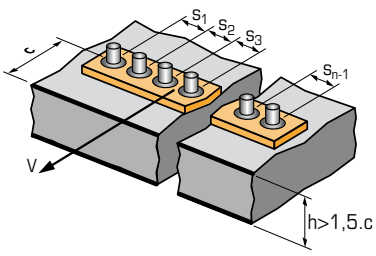
												Reduction factor $\Psi_{s\text{-}c,V}$ Cracked & non-cracked concrete
$\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
$\Psi_{s\text{-}c,V}$	1,00	1,31	1,66	2,02	2,41	2,83	3,26	3,72	4,19	4,69	5,20	5,72



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

For 2 anchors fastening

												Reduction factor $\Psi_{s\text{-}c,V}$ Cracked & non-cracked concrete
$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
1,0	0,67	0,84	1,03	1,22	1,43	1,65	1,88	2,12	2,36	2,62	2,89	3,16
1,5	0,75	0,93	1,12	1,33	1,54	1,77	2,00	2,25	2,50	2,76	3,03	3,31
2,0	0,83	1,02	1,22	1,43	1,65	1,89	2,12	2,38	2,63	2,90	3,18	3,46
2,5	0,92	1,11	1,32	1,54	1,77	2,00	2,25	2,50	2,77	3,04	3,32	3,61
3,0	1,00	1,20	1,42	1,64	1,88	2,12	2,37	2,63	2,90	3,18	3,46	3,76
3,5		1,30	1,52	1,75	1,99	2,24	2,50	2,76	3,04	3,32	3,61	3,91
4,0			1,62	1,86	2,10	2,36	2,62	2,89	3,17	3,46	3,75	4,05
4,5				1,96	2,21	2,47	2,74	3,02	3,31	3,60	3,90	4,20
5,0					2,33	2,59	2,87	3,15	3,44	3,74	4,04	4,35
5,5						2,71	2,99	3,28	3,71	4,02	4,33	4,65
6,0						2,83	3,11	3,41	3,71	4,02	4,33	4,65



For 3 anchors fastening and more

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

Ramset™

FIX Z XTREM

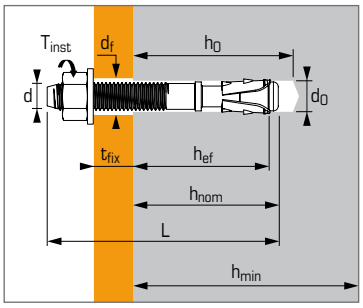
zinc coated steel version

Torque controlled expansion anchor, for use in cracked and non-cracked concrete

Product from spit

ETA European Technical Assessment

ETA Option 1- 15/0388



APPLICATION

- Steel and timber framework and beams
- Lift guide rails
- Industrial doors and gates
- Brickwork support angles
- Storage systems

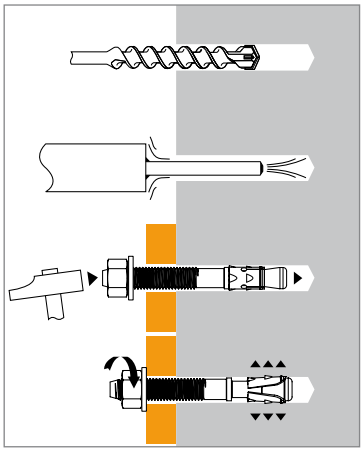
MATERIAL

- **Body :** cold formed steel, DIN 1654, part 2 or 4 / Zinc electroplated Zn5C/Fe (5 µm), NFA 91102
- **Sleeve :** S355 MC as per NF EN 10-149-2
- **Nut :** steel strength grade 6 or 8, ISO 898-2
- **Washer :** steel, NF E 25513

Technical data

Anchor size	Letter marking	Min. anchor depth (mm) h_{ef}	Embed. depth (mm) h_{nom}	Max. thick. of part to be fixed (mm) t_{fix}	Drilling depth (mm) h_0	Min. thick. of base material (mm) h_{min}	Thread diameter (mm) d	Drilling diameter (mm) d_0	Clearance diameter (mm) d_f	Total anchor length (mm) L	Tighten torque (Nm) T_{inst}	Code
8X65/5	B			5						68		057763
8X75/15	D			15						78		057764
8X90/30	E	46	51	30	60	100	8	8	9	93	20	057765
8X120/60	G			60						123		057766
8X130/70	I			70						133		057788
10X85/5	D			5						85		057768
10X90/10	E			10						90		057769
10X100/20	F	60	68	20	75	120	10	10	12	100	45	057770
10X120/40	G			40						120		057771
10X140/60	I			60						140		057772
10X160/80	-			80						160		057773
12X100/5	E			5						100		057774
12X105/10	F			10						105		057775
12X115/20	G	70	80	20	90	140	12	12	14	115	60	057776
12X135/40	I			40						135		057777
12X155/60	J			60						155		057778
12X180/85	L			85						180		057779
16X145/25	I			25						143		057781
16X170/50	K	85	98	50	110	170	16	16	18	168	110	057782
16X180/60	L			60						178		057783
20X170/30	K			30						168		057785
20X200/60	M	100	113	60	130	200	20	20	22	198	160	057786
20X220/80	O			80						218		057787

INSTALLATION



Anchor mechanical properties

Anchor size		M8	M10	M12	M16	M20
Cross-section above cone						
f_{uk} (N/mm²)	Min. tensile strength	900	830	830	720	600
f_{yk} (N/mm²)	Yield strength	800	670	670	580	580
As (mm²)	Stressed cross-section	22,9	35,3	45,4	88,2	165,1
Threaded part						
f_{uk} (N/mm²)	Min. tensile strength	750	730	730	600	500
f_{yk} (N/mm²)	Yield strength	680	580	580	480	410
As (mm²)	Stressed cross-section	36,6	58	84,3	156	245
W_{el} (mm³)	Elastic section modulus	31,23	62,3	109,17	277,47	540,9
$M^0_{rk,s}$ (Nm)	Characteristic bending moment	21	36	63	133	222
M (Nm)	Recommended bending moment	8,7	14,7	25,8	54,4	90,5

FIX Z XTREM

zinc coated steel version

Ramset™

For detail design, please refer to CC method in following page.

Ultimate ($N_{Ru,m}$, $V_{Ru,m}$) and characteristic loads (N_{Rk}, V_{Rk}) in kN

Mean Ultimate loads are derived from test results in admissible service conditions, and characteristic loads are statistically determined.

TENSILE

Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete (C20/25)					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$N_{Ru,m}$	15,8	26,1	35,5	47,5	60,1
N_{Rk}	9,0	20,0	29,6	39,5	50,4
Cracked concrete (C20/25)					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$N_{Ru,m}$	10,7	16,9	25,7	38,9	60,9
N_{Rk}	5,0	9,0	16,1	20,0	30,0

SHEAR

Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete (C20/25)					
$V_{Ru,m}$	16,1	19,6	26,6	55,4	85,0
V_{Rk}	13,7	16,0	23,0	45,0	61,1
Cracked concrete (C20/25)					
$V_{Ru,m}$	16,1	19,6	26,6	55,4	85,0
V_{Rk}	11,3	16,0	23,0	45,0	61,1

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

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

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

TENSILE

Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete (C20/25)					
h_{ef}	**46**	**60**	**70**	**85**	**100**
N_{Rd}	6,0	13,3	19,7	26,3	33,6
Cracked concrete (C20/25)					
h_{ef}	**46**	**60**	**70**	**85**	**100**
N_{Rd}	3,3	6,0	10,7	13,3	20,0

$\gamma_{Mc} = 1,5$

SHEAR

Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete (C20/25)					
V_{Rd}	11,0	12,8	18,4	36,0	40,7
Cracked concrete (C20/25)					
V_{Rd}	9,0	12,8	18,4	36,0	40,7

$\gamma_{Ms} = 1,25$ for M8 to M16 and $\gamma_{Ms} = 1,5$ for M20

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

$$N_{rec} = \frac{N_{Rk}}{3}$$

$$V_{rec} = \frac{N_{Rk}}{3}$$

TENSILE

Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete (C20/25)					
h_{ef}	**46**	**60**	**70**	**85**	**100**
N_{rec}	3,0	6,7	9,9	13,2	16,8
Cracked concrete (C20/25)					
h_{ef}	**46**	**60**	**70**	**85**	**100**
N_{rec}	1,7	3,0	5,4	6,7	10,0

$\gamma = 3$

SHEAR

Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete (C20/25)					
V_{rec}	4,6	5,3	7,7	15,0	20,4
Cracked concrete (C20/25)					
V_{rec}	3,8	5,3	7,7	15,0	20,4

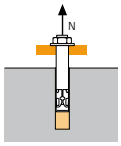
$\gamma = 3$

FIX Z XTREM

zinc coated steel version

SPIT CC Method (values issued from ETA)

TENSILE in kN

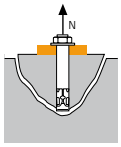


Pull-out resistance

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

$N^0_{Rd,p}$					Design pull-out resistance
Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete					
h_{ef}	46	60	70	85	100
$N^0_{Rd,p}$ (C20/25)	6,0	13,3	20,0	26,7	-
Cracked concrete					
h_{ef}	46	60	70	85	100
$N^0_{Rd,p}$ (C20/25)	3,3	6,0	10,7	13,3	20,0

$\gamma_{Mc} = 1,5$

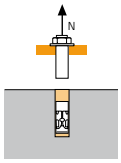


Concrete cone resistance

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

$N^0_{Rd,c}$					Design cone resistance
Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete					
h_{ef}	46	60	70	85	100
$N^0_{Rd,c}$ (C20/25)	10,5	15,6	19,7	26,3	33,6
Cracked concrete					
h_{ef}	46	60	70	85	100
$N^0_{Rd,c}$ (C20/25)	7,5	11,2	14,1	18,8	24,0

$\gamma_{Mc} = 1,5$

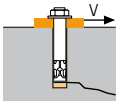


Steel resistance

$N_{Rd,s}$					Steel design tensile resistance
Anchor size	M8	M10	M12	M16	M20
$N_{Rd,s}$	11,3	19,8	25,8	43,7	66,1

$\gamma_{Ms} = 1,4$ for M8, $\gamma_{Mc} = 1,48$ for M10 to M16 and $\gamma_{Mc} = 1,5$ for M20

SHEAR in kN

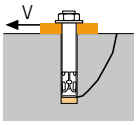


Concrete edge resistance

$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c}$					Design concrete edge resistance at minimum edge distance (C_{min})
Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete					
h_{ef}	46	60	70	85	100
C_{min}	50	60	60	90	100
S_{min}	75	120	145	140	160
$V^0_{Rd,c}$ (C20/25)	3,0	4,4	4,8	10,0	13,0
Cracked concrete					
h_{ef}	46	60	70	85	100
C_{min}	50	55	60	80	100
S_{min}	75	90	145	110	130
$V^0_{Rd,c}$ (C20/25)	2,1	2,8	3,4	6,0	9,3

$\gamma_{Mc} = 1,5$

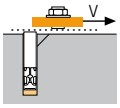


Pryout failure

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

$V^0_{Rd,cp}$					Design pryout resistance
Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete					
h_{ef}	46	60	70	85	100
$V^0_{Rd,cp}$ (C20/25)	10,5	31,2	39,4	52,7	67,2
Cracked concrete					
h_{ef}	46	60	70	85	100
$V^0_{Rd,cp}$ (C20/25)	7,5	22,3	28,1	37,6	48,0

$\gamma_{Mcp} = 1,5$



Steel resistance

$V_{Rd,s}$					Steel design shear resistance
Anchor size	M8	M10	M12	M16	M20
$V_{Rd,s}$	10,8	12,6	18,1	36,0	40,7

$\gamma_{Ms} = 1,27$ for M8 to M12, $\gamma_{Mc} = 1,25$ for M16 and $\gamma_{Mc} = 1,5$ for M20

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

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

$$\beta_N + \beta_V \leq 1,2$$

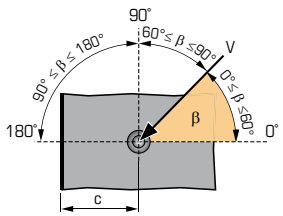
f_b INFLUENCE OF CONCRETE

Concrete class	Cube strength fcc	f_b	Concrete class	Cube strength fcc	f_b
C25/30	30	1,1	C40/50	50	1,41
C30/37	37	1,22	C45/55	55	1,48
C35/45	45	1,34	C50/60	60	1,55

$$f_b = \sqrt{\frac{fcc}{25}}$$

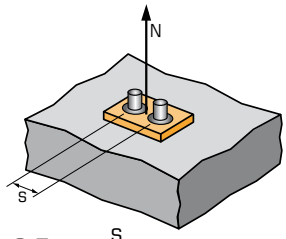
$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



SPIT CC Method (values issued from ETA)

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0{,}5 + \frac{s}{6.h_{ef}}$$

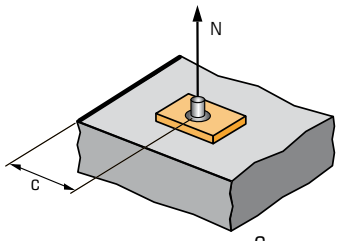
$s_{min} < s < s_{cr,N}$

$s_{cr,N} = 3.h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

SPACING S					Reduction factor Ψ_s Cracked & non-cracked concrete
Anchor size	M8	M10	M12	M16	M20
50	0,68				
55	0,70	0,65			
75	0,77	0,71			
100	0,86	0,78			
120	0,93	0,83	0,79	0,74	0,70
140	1,00	0,89	0,83	0,77	0,73
180		1,00	0,93	0,85	0,80
210			1,00	0,91	0,85
255				1,00	0,93
280					0,97
300					1,00

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



$$\Psi_{c,N} = 0{,}26 + 0{,}49 \cdot \frac{c}{h_{ef}}$$

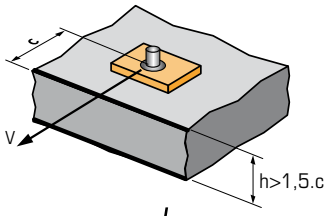
$c_{min} < c < c_{cr,N}$

$c_{cr,N} = 1{,}5.h_{ef}$

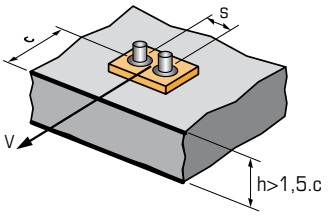
$\Psi_{c,N}$ must be used for each distance influenced the anchors group.

EDGE C					Reduction factor $\Psi_{c,N}$ Cracked & non-cracked concrete
Anchor size	M8	M10	M12	M16	M20
50	0,79				
55	0,85	0,71			
60	0,90	0,75	0,68		
70	1,00	0,83	0,75		
80		0,91	0,82	0,72	
90		1,00	0,89	0,78	
100			0,96	0,84	0,75
105			1,00	0,87	0,77
130				1,00	0,90
150					1,00

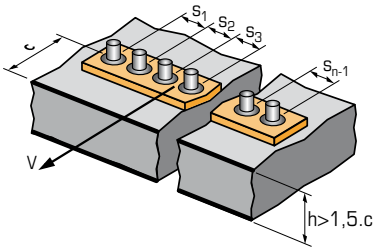
$\Psi_{s-c,V}$ INFLUENCE OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



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



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



For single anchor fastening

												Reduction factor $\Psi_{s-c,V}$ Cracked & non-cracked concrete
$\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
$\Psi_{s-c,V}$	1,00	1,31	1,66	2,02	2,41	2,83	3,26	3,72	4,19	4,69	5,20	5,72

For 2 anchors fastening

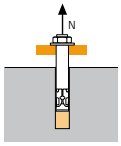
												Reduction factor $\Psi_{s-c,V}$ Cracked & non-cracked concrete
$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
1,0	0,67	0,84	1,03	1,22	1,43	1,65	1,88	2,12	2,36	2,62	2,89	3,16
1,5	0,75	0,93	1,12	1,33	1,54	1,77	2,00	2,25	2,50	2,76	3,03	3,31
2,0	0,83	1,02	1,22	1,43	1,65	1,89	2,12	2,38	2,63	2,90	3,18	3,46
2,5	0,92	1,11	1,32	1,54	1,77	2,00	2,25	2,50	2,77	3,04	3,32	3,61
3,0	1,00	1,20	1,42	1,64	1,88	2,12	2,37	2,63	2,90	3,18	3,46	3,76
3,5		1,30	1,52	1,75	1,99	2,24	2,50	2,76	3,04	3,32	3,61	3,91
4,0			1,62	1,86	2,10	2,36	2,62	2,89	3,17	3,46	3,75	4,05
4,5				1,96	2,21	2,47	2,74	3,02	3,31	3,60	3,90	4,20
5,0					2,33	2,59	2,87	3,15	3,44	3,74	4,04	4,35
5,5						2,71	2,99	3,28	3,71	4,02	4,33	4,65
6,0						2,83	3,11	3,41	3,71	4,02	4,33	4,65

For 3 anchors fastening and more

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

SPIT CC Method (values issued from ETA - Seismic category C1)

TENSILE in kN

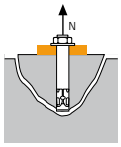


Pull-out resistance

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

$N^0_{Rd,p,C1}$					Design pull-out resistance
Anchor size	M8	M10	M12	M16	M20
Category C1 - Single anchor					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$N^0_{Rd,p,C1}$ (C20/25)	3,1	4,9	10,7	13,3	-
Category C1 - Group of anchors [1]					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$N^0_{Rd,p,C1}$ (C20/25)	2,7	4,2	9,1	11,3	17,0

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

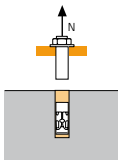


Concrete cone resistance

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

$N^0_{Rd,c,C1}$					Design cone resistance
Anchor size	M8	M10	M12	M16	M20
Category C1 - Single anchor					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$N^0_{Rd,c,C1}$ (C20/25)	6,2	9,5	11,9	16,0	20,4
Category C1 - Group of anchors [1]					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$N^0_{Rd,c,C1}$ (C20/25)	5,4	8,4	10,5	14,1	18,0

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

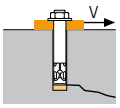


Steel resistance

$N_{Rd,s,C1}$					Steel design tensile resistance
Anchor size	M8	M10	M12	M16	M20
$N_{Rd,s,C1}$	13,2	19,8	25,8	43,7	66,1

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Ms} = 1,4$ for M8, $\gamma_{Mc} = 1,48$ for M10 to M16, and $\gamma_{Mc} = 1,5$ for M20

SHEAR in kN

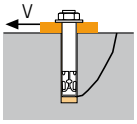


Concrete edge resistance

$$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$$

$V^0_{Rd,c,C1}$					Design concrete edge resistance at minimum edge distance (C_{min})
Anchor size	M8	M10	M12	M16	M20
Category C1 - Single anchor					
h_{ef}	**46**	**60**	**70**	**85**	**100**
C_{min}	50	55	60	80	100
S_{min}	75	120	145	140	160
$V^0_{Rd,c,C1}$ (C20/25)	2,1	3,6	7,4	8,4	11,4
Category C1 - Group of anchors [1]					
h_{ef}	**46**	**60**	**70**	**85**	**100**
C_{min}	50	65	100	100	115
S_{min}	75	90	145	110	130
$V^0_{Rd,c,C1}$ (C20/25)	1,8	3,0	6,3	7,1	9,7

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$

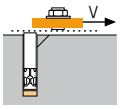


Pryout failure

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

$V^0_{Rd,cp,C1}$					Design pryout resistance
Anchor size	M8	M10	M12	M16	M20
Category C1 - Single anchor					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$V^0_{Rd,cp,C1}$ (C20/25)	6,2	19,0	23,9	32,0	40,8
Category C1 - Group of anchors [1]					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$V^0_{Rd,cp,C1}$ (C20/25)	5,4	16,7	21,1	28,2	36,0

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$



Steel resistance [2]

$V_{Rd,s,C1}$					Steel design shear resistance
Anchor size	M8	M10	M12	M16	M20
Category C1 - Single anchor					
$V_{Rd,s,C1}$	4,8	12,6	18,1	36,0	40,7
Category C1 - Group of anchors [1]					
$V_{Rd,s,C1}$	4,1	10,7	15,4	30,6	34,6

[1] when more than one anchor of the group is submitted to shear load
[2] In case of no hole clearance between anchor and fixture
$\gamma_{Ms} = 1,25$ for M8 and M16, $\gamma_{Mc} = 1,27$ for M10 and M12, and $\gamma_{Mc} = 1,5$ for M20

$$N_{Rd,C1} = \min(N_{Rd,p,C1} ; N_{Rd,c,C1} ; N_{Rd,s,C1})$$
$$\beta_N = N_{Sd} / N_{Rd,C1} \leq 1$$

$$V_{Rd,C1} = \min(V_{Rd,c,C1} ; V_{Rd,cp,C1} ; V_{Rd,s,C1})$$
$$\beta_V = V_{Sd} / V_{Rd,C1} \leq 1$$

$$\beta_N + \beta_V \leq 1,2$$

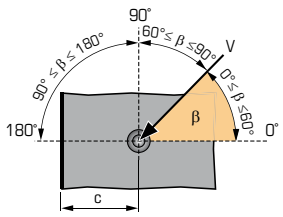
f_b INFLUENCE OF CONCRETE

Concrete class	Cube strength fcc	f_b	Concrete class	Cube strength fcc	f_b
C25/30	30	1,1	C40/50	50	1,41
C30/37	37	1,22	C45/55	55	1,48
C35/45	45	1,34	C50/60	60	1,55

$$f_b = \sqrt{\frac{fcc}{25}}$$

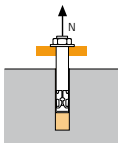
$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



SPIT CC Method (values issued from ETA - Seismic category C2)

TENSILE in kN

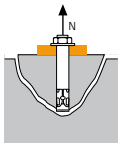


Pull-out resistance

$$N_{Rd,p,C2} = N^0_{Rd,p,C2} \cdot f_b$$

$N^0_{Rd,p,C2}$					Design pull-out resistance
Anchor size	M8	M10	M12	M16	M20
Category C2 - Single anchor					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$N^0_{Rd,p,C2}$ (C20/25)	NA	1,9	4,0	12,0	17,1
Category C2 - Group of anchors [1]					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$N^0_{Rd,p,C2}$ (C20/25)	NA	1,6	3,4	10,2	14,5

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

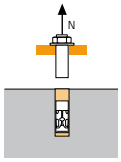


Concrete cone resistance

$$N_{Rd,c,C2} = N^0_{Rd,c,C2} \cdot f_b \cdot \Psi_s \cdot \Psi_{c,N}$$

$N^0_{Rd,c,C2}$					Design cone resistance
Anchor size	M8	M10	M12	M16	M20
Category C2 - Single anchor					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$N^0_{Rd,c,C2}$ (C20/25)	NA	9,5	11,9	16,0	20,4
Category C2 - Group of anchors [1]					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$N^0_{Rd,c,C2}$ (C20/25)	NA	8,4	10,5	14,1	18,0

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

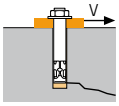


Steel resistance

$N_{Rd,s,C2}$					Steel design tensile resistance
Anchor size	M8	M10	M12	M16	M20
$N_{Rd,s,C2}$	NA	19,5	25,5	43,1	66,1

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Ms} = 1,5$ for M10, $\gamma_{Mc} = 1,48$ for M12 and M16, and $\gamma_{Mc} = 1,5$ for M20

SHEAR in kN

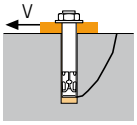


Concrete edge resistance

$$V_{Rd,c,C2} = V^0_{Rd,c,C2} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$$

$V^0_{Rd,c,C2}$					Design concrete edge resistance at minimum edge distance (C_{min})
Anchor size	M8	M10	M12	M16	M20
Category C2 - Single anchor					
h_{ef}	**46**	**60**	**70**	**85**	**100**
C_{min}	50	55	60	80	100
S_{min}	40	50	100	100	100
$V^0_{Rd,c,C2}$ (C20/25)	NA	3,6	7,4	8,4	11,4
Category C2 - Group of anchors [1]					
h_{ef}	**46**	**60**	**70**	**85**	**100**
C_{min}	50	65	100	100	115
S_{min}	40	50	100	100	100
$V^0_{Rd,c,C2}$ (C20/25)	NA	3,0	6,3	7,1	9,7

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$

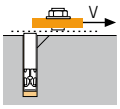


Pryout failure

$$V_{Rd,cp,C2} = V^0_{Rd,cp,C2} \cdot f_b \cdot \Psi_s \cdot \Psi_{c,N}$$

$V^0_{Rd,cp,C2}$					Design pryout resistance
Anchor size	M8	M10	M12	M16	M20
Category C2 - Single anchor					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$V^0_{Rd,cp,C2}$ (C20/25)	NA	19,0	23,9	32,0	40,8
Category C2 - Group of anchors [1]					
h_{ef}	**46**	**60**	**70**	**85**	**100**
$V^0_{Rd,cp,C2}$ (C20/25)	NA	16,7	21,1	28,2	36,0

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$



Steel resistance [2]

$V_{Rd,s,C2}$					Steel design shear resistance
Anchor size	M8	M10	M12	M16	M20
Category C2 - Single anchor					
$V_{Rd,s,C2}$	NA	7,6	11,0	27,1	29,8
Category C2 - Group of anchors [1]					
$V_{Rd,s,C2}$	NA	6,5	9,4	23,1	25,3

[1] when more than one anchor of the group is submitted to shear load
[2] In case of no hole clearance between anchor and fixture
$\gamma_{Ms} = 1,27$ for M10 and M12, $\gamma_{Mc} = 1,25$ for M16, and $\gamma_{Mc} = 1,5$ for M20

$$N_{Rd,C2} = \min(N_{Rd,p,C2} ; N_{Rd,c,C2} ; N_{Rd,s,C2})$$
$$\beta_N = N_{Sd} / N_{Rd,C2} \leq 1$$

$$V_{Rd,C2} = \min(V_{Rd,c,C2} ; V_{Rd,cp,C2} ; V_{Rd,s,C2})$$
$$\beta_V = V_{Sd} / V_{Rd,C2} \leq 1$$

$$\beta_N + \beta_V \leq 1,2$$

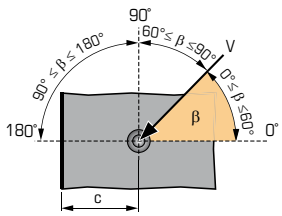
f_b INFLUENCE OF CONCRETE

Concrete class	Cube strength fcc	f_b	Concrete class	Cube strength fcc	f_b
C25/30	30	1,1	C40/50	50	1,41
C30/37	37	1,22	C45/55	55	1,48
C35/45	45	1,34	C50/60	60	1,55

$$f_b = \sqrt{\frac{fcc}{25}}$$

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

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



Ramset™

FIX Z - A4

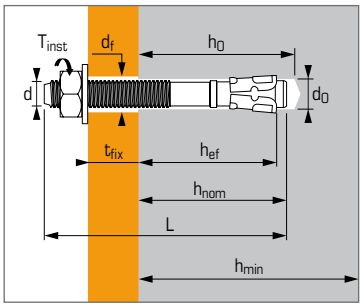
stainless steel version

Torque controlled expansion anchor, for use in cracked and non-cracked concrete

Product from spit

ETA European Technical Assessment
ETA Option 1- 04/0010

FM APPROVED
FIX Z A4 M10



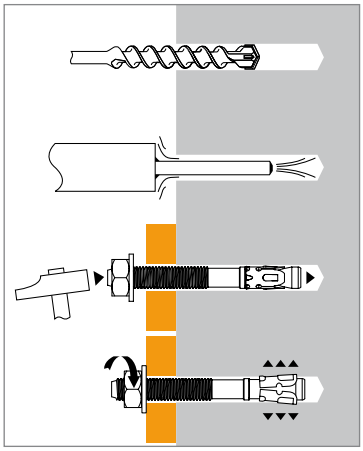
APPLICATION

- Steel and timber framework and beams
- Lift guide rails
- Industrial doors and gates
- Brickwork support angles
- Storage systems

MATERIAL

- **Body :**
steel N° 1.4404 (A4), 1.4578, NF EN 10088.3
- **Sleeve :**
cold laminated steel N° 1.4404, NF EN 10088.3
- **Nut :**
stainless steel A4-80, NF EN 20898-2
- **Washer :**
stainless steel A4, NF EN 20898

INSTALLATION



Technical data

Anchor size	Letter marking	Minimum anchorage depth: min. anchor depth (mm) h_{ef}	Embed. depth (mm) h_{nom}	Max. thick. of part to be fixed (mm) t_{fix}	Drilling depth (mm) h_0	Min. thick. of base material (mm) h_{min}	Maximum anchorage depth: max. anchor depth (mm) h_{ef}	Embed. depth (mm) h_{nom}	Max. thick. of part to be fixed (mm) t_{fix}	Drilling depth (mm) h_0	Min. thick. of base material (mm) h_{min}	Thread diameter (mm) d	Drilling diameter (mm) d_0	Clearance diameter (mm) d_f	Total anchor length (mm) L	Tighten torque (Nm) T_{inst}	Code
8X55/5	-	35	42	5	52	100	48	55	-	65	100	8	8	9	55	20	050441
8X70/20-7	C			20					7						70		054610
8X90/40-27	E			40					27						90		055343
8X130/80-67	H			80					67						130		050367
10X65/5	-	42	50	5	62	100	58	66	-	78	116	10	10	12	65	35	050466
10X75/15	C			15					-						75		054630
10X95/35-20	E			35					20						95		054640
10X120/60-45	G			60					45						120		050442
12X80/5	-	50	60	5	75	100	70	80	-	95	140	12	12	14	80	50	055344
12X100/25-6	E			25					6						100		055345
12X115/40-21	G			40					21						115		055394
12X140/65-46	I			65					46						140		054680
16X125/30-8	G			30					8						125		050443
16X150/55-33	I	64	70	55	95	128	86	100	33	117	172	16	16	18	150	100	054700
16X170/75-53	K			75					53						170		050444

Anchor mechanical properties

Anchor size		M6	M8	M10	M12	M16
Cross-section above cone						
f_{uk} (N/mm²)	Min. tensile strength	900	900	900	900	880
f_{yk} (N/mm²)	Yield strength	780	780	780	780	750
As (mm²)	Stressed cross-section	-	24,6	41,9	58,1	107,5
Threaded part						
f_{uk} (N/mm²)	Min. tensile strength	620	620	620	620	580
f_{yk} (N/mm²)	Yield strength	420	420	420	420	330
As (mm²)	Stressed cross-section	20,1	36,6	58	84,3	157
W_{el} (mm³)	Elastic section modulus	12,71	31,23	62,3	109,17	277,47
$M^0_{rk,s}$ (Nm)	Characteristic bending moment	9,45	23	46	81	193
M (Nm)	Recommended bending moment	3,7	9,4	18,8	33,1	78,8

FIX Z - A4

stainless steel version

Ramset™

For detail design, please refer to CC method in following page.

Ultimate ($N_{Ru,m}$, $V_{Ru,m}$) and characteristic loads (N_{Rk}, V_{Rk}) in kN

Mean Ultimate loads are derived from test results in admissible service conditions, and characteristic loads are statistically determined.

TENSILE

Anchor size	M8	M10	M12	M16
Non-cracked concrete (C20/25)				
$h_{ef,min}$	**35**	**42**	**50**	**64**
$N_{Ru,m}$	12,5	13,3	20,1	33,1
N_{Rk}	9,0	9,0	12,0	20,0
$h_{ef,max}$	**48**	**58**	**70**	**86**
$N_{Ru,m}$	20,0	23,0	26,3	53,6
N_{Rk}	12,0	16,1	16,1	30,0
Cracked concrete (C20/25)				
$h_{ef,min}$	**35**	**42**	**50**	**64**
$N_{Ru,m}$	9,0	13,1	15,3	24,5
N_{Rk}	3,0	6,0	7,5	12,0
$h_{ef,max}$	**48**	**58**	**70**	**86**
$N_{Ru,m}$	12,1	18,2	19,0	25,2
N_{Rk}	4,1	7,5	9,0	16,1

SHEAR

Anchor size	M8	M10	M12	M16
Non-cracked concrete (C20/25)				
$V_{Ru,m}$	18,2	29,2	43,2	69,1
$V_{Rk,min}$	10,5	13,7	17,9	45,5
$V_{Rk,max}$	12,3	19,7	28,4	46,4
Cracked concrete (C20/25)				
$V_{Ru,m}$	18,2	29,2	43,2	69,1
$V_{Rk,min}$	7,5	9,8	12,8	36,9
$V_{Rk,max}$	12,0	15,9	27,4	46,4

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

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

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

TENSILE

Anchor size	M8	M10	M12	M16
Non-cracked concrete (C20/25)				
$h_{ef,min}$	**35**	**42**	**50**	**64**
N_{Rd}	6,0	6,0	8,0	13,3
$h_{ef,max}$	**48**	**58**	**70**	**86**
N_{Rd}	8,0	10,7	10,7	20,0
Cracked concrete (C20/25)				
$h_{ef,min}$	**35**	**42**	**50**	**64**
N_{Rd}	2,0	4,0	5,0	8,0
$h_{ef,max}$	**48**	**58**	**70**	**86**
N_{Rd}	2,7	5,0	6,0	10,7

$\gamma_{Mc} = 1,5$

SHEAR

Anchor size	M8	M10	M12	M16
Non-cracked concrete (C20/25)				
$V_{Rd,min}$	7,0	9,1	11,9	25,8
$V_{Rd,max}$	8,2	13,1	18,9	25,8
Cracked concrete (C20/25)				
$V_{Rd,min}$	5,0	6,5	8,5	20,5
$V_{Rd,max}$	8,0	10,6	18,9	25,8

$\gamma_{Ms} = 1,5$ for M6 to M12 and $\gamma_{Ms} = 1,8$ for M16

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

$$N_{rec} = \frac{N_{Rk}}{3}$$

$$V_{rec} = \frac{N_{Rk}}{3}$$

TENSILE

Anchor size	M8	M10	M12	M16
Non-cracked concrete (C20/25)				
$h_{ef,min}$	**35**	**42**	**50**	**64**
N_{rec}	3,0	3,0	4,0	6,7
$h_{ef,max}$	**48**	**58**	**70**	**86**
N_{rec}	4,0	5,4	5,4	10,0
Cracked concrete (C20/25)				
$h_{ef,min}$	**35**	**42**	**50**	**64**
N_{rec}	1,0	2,0	2,5	4,0
$h_{ef,max}$	**48**	**58**	**70**	**86**
N_{rec}	1,4	2,5	3,0	5,4

$\gamma = 3$

SHEAR

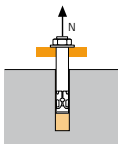
Anchor size	M8	M10	M12	M16
Non-cracked concrete (C20/25)				
$V_{rec,min}$	3,5	4,6	6,0	15,5
$V_{rec,max}$	4,1	6,6	9,5	15,5
Cracked concrete (C20/25)				
$V_{rec,min}$	2,5	3,3	4,3	12,3
$V_{rec,max}$	4,0	5,3	9,5	15,5

$\gamma = 3$

FIX Z - A4
stainless steel version

SPIT CC Method (values issued from ETA)

TENSILE in kN

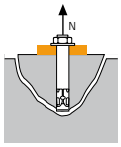


Pull-out resistance

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

$N^0_{Rd,p}$				Design pull-out resistance	
Anchor size		M8	M10	M12	M16
$h_{ef,min}$		**35**	**42**	**50**	**64**
$h_{ef,max}$		**48**	**58**	**70**	**86**
Non-cracked concrete (C20/25)					
$N^0_{Rd,p}$	$(h_{ef,min})$	6,0	6,0	8,0	13,3
$N^0_{Rd,p}$	$(h_{ef,max})$	8,0	10,7	10,7	20,0
Cracked concrete (C20/25)					
$N^0_{Rd,p}$	$(h_{ef,min})$	2,0	4,0	5,0	8,0
$N^0_{Rd,p}$	$(h_{ef,max})$	2,7	5,0	6,0	10,7

$\gamma_{Mc} = 1,5$

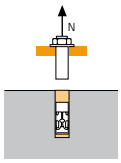


Concrete cone resistance

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

$N^0_{Rd,c}$				Design cone resistance	
Anchor size		M8	M10	M12	M16
$h_{ef,min}$		**35**	**42**	**50**	**64**
$h_{ef,max}$		**48**	**58**	**70**	**86**
Non-cracked concrete (C20/25)					
$N^0_{Rd,c}$	$(h_{ef,min})$	7,0	9,1	11,9	17,2
$N^0_{Rd,c}$	$(h_{ef,max})$	11,2	14,8	19,7	26,8
Cracked concrete (C20/25)					
$N^0_{Rd,c}$	$(h_{ef,min})$	5,0	6,5	8,5	12,3
$N^0_{Rd,c}$	$(h_{ef,max})$	8,0	10,6	14,1	19,1

$\gamma_{Mc} = 1,5$

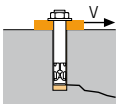


Steel resistance

$N_{Rd,s}$				Steel design tensile resistance
Anchor size	M8	M10	M12	M16
$N_{Rd,s}$	8,5	14,4	20,0	29,7

$\gamma_{Ms} = 1,8$ for M8 to M12 and $\gamma_{Ms} = 2,1$ for M16

SHEAR in kN

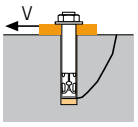


Concrete edge resistance

$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c}$			Design concrete edge resistance at minimum edge distance (C_{min})	
Anchor size	M8	M10	M12	M16
Non-cracked concrete C20/25)				
$h_{ef,min}$	**35**	**42**	**50**	**64**
C_{min}	60	65	100	100
S_{min}	60	75	170	150
$V^0_{Rd,c}$	3,3	4,1	8,7	10,1
Cracked concrete C20/25)				
$h_{ef,max}$	**48**	**58**	**70**	**86**
C_{min}	60	65	90	105
S_{min}	50	55	75	90
$V^0_{Rd,c}$	3,7	4,4	8,2	11,8

$\gamma_{Mc} = 1,5$

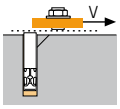


Pryout failure

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

$V^0_{Rd,cp}$				Design pryout resistance
Anchor size	M8	M10	M12	M16
Non-cracked concrete (C20/25)				
$h_{ef,min}$	**35**	**42**	**50**	**64**
$V^0_{Rd,cp}$	7,0	9,1	11,9	34,4
$h_{ef,\ max}$	**48**	**58**	**70**	**86**
$V^0_{Rd,cp}$	11,2	14,8	39,4	53,6
Cracked concrete (C20/25)				
$h_{ef,min}$	**35**	**42**	**50**	**64**
$V^0_{Rd,cp}$	5,0	6,5	8,5	24,6
$h_{ef,\ max}$	**48**	**58**	**70**	**86**
$V^0_{Rd,cp}$	8,0	10,6	28,1	38,3

$\gamma_{Mcp} = 1,5$



Steel resistance

$V_{Rd,s}$				Steel design shear resistance
Anchor size	M8	M10	M12	M16
$V_{Rd,s}$	8,2	13,1	18,9	25,8

$\gamma_{Ms} = 1,5$ for M8 to M12 and $\gamma_{Ms} = 1,8$ for M16

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

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

$$\beta_N + \beta_V \leq 1,2$$

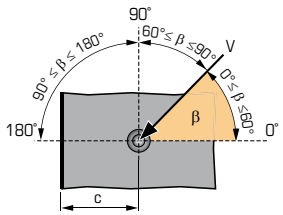
f_b INFLUENCE OF CONCRETE

Concrete class	Cube strength fcc	f_b	Concrete class	Cube strength fcc	f_b
C25/30	30	1,1	C40/50	50	1,41
C30/37	37	1,22	C45/55	55	1,48
C35/45	45	1,34	C50/60	60	1,55

$$f_b = \sqrt{\frac{fcc}{25}}$$

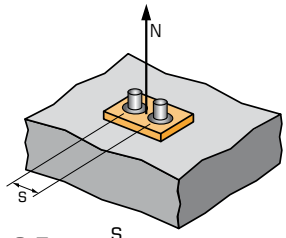
$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



SPIT CC Method (values issued from ETA)

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0{,}5 + \frac{s}{6.h_{ef}}$$

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

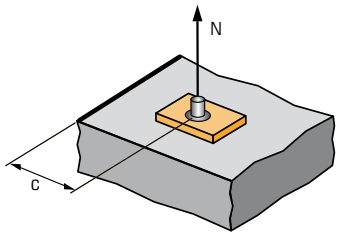
$s_{cr,N} = 3.h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

SPACING S	Reduction factor Ψ_s Minimum anchorage depth			
Anchor size	M8	M10	M12	M16
60	0,78			
75	0,86	0,80		
100	0,98	0,90	0,83	0,76
105	1,00	0,92	0,85	0,77
110		0,94	0,87	0,79
125		1,00	0,92	0,83
150			1,00	0,89
170				0,94
192				1,00

SPACING S	Reduction factor Ψ_s Maximum anchorage depth			
Anchor size	M8	M10	M12	M16
50	0,67			
55	0,69	0,66		
75	0,76	0,72	0,68	
90	0,81	0,76	0,71	0,67
110	0,88	0,82	0,76	0,71
130	0,95	0,87	0,81	0,75
145	1,00	0,92	0,85	0,78
155		0,95	0,87	0,80
175		1,00	0,92	0,84
205			0,99	0,90
210			1,00	0,91
258				1,00

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



$$\Psi_{c,N} = 0{,}23 + 0{,}51 \cdot \frac{c}{h_{ef}}$$

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

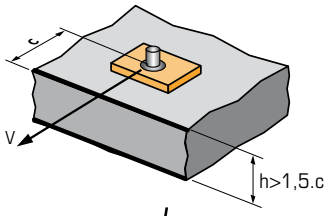
$c_{cr,N} = 1{,}5.h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group.

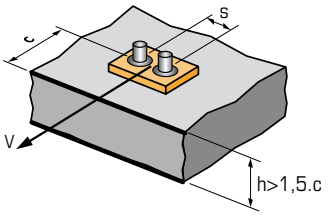
EDGE C	Reduction factor $\Psi_{c,N}$ Minimum anchorage depth			
Anchor size	M8	M10	M12	M16
60	1,00			
65		1,00		
76			1,00	
100				1,00

EDGE C	Reduction factor $\Psi_{c,N}$ Maximum anchorage depth			
Anchor size	M8	M10	M12	M16
60	0,87			
65	0,92	0,80		
75	1,00	0,89		
90		1,00	0,89	
110			1,00	0,88
130				1,00

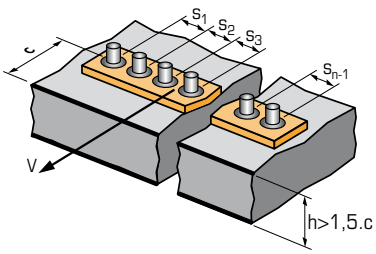
$\Psi_{s\text{-}c,V}$ INFLUENCE OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



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



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



For single anchor fastening

	Reduction factor $\Psi_{s\text{-}c,V}$ Cracked & non-cracked concrete											
$\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
$\Psi_{s\text{-}c,V}$	1,00	1,31	1,66	2,02	2,41	2,83	3,26	3,72	4,19	4,69	5,20	5,72

For 2 anchors fastening

	Reduction factor $\Psi_{s\text{-}c,V}$ Cracked & non-cracked concrete											
$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
1,0	0,67	0,84	1,03	1,22	1,43	1,65	1,88	2,12	2,36	2,62	2,89	3,16
1,5	0,75	0,93	1,12	1,33	1,54	1,77	2,00	2,25	2,50	2,76	3,03	3,31
2,0	0,83	1,02	1,22	1,43	1,65	1,89	2,12	2,38	2,63	2,90	3,18	3,46
2,5	0,92	1,11	1,32	1,54	1,77	2,00	2,25	2,50	2,77	3,04	3,32	3,61
3,0	1,00	1,20	1,42	1,64	1,88	2,12	2,37	2,63	2,90	3,18	3,46	3,76
3,5		1,30	1,52	1,75	1,99	2,24	2,50	2,76	3,04	3,32	3,61	3,91
4,0			1,62	1,86	2,10	2,36	2,62	2,89	3,17	3,46	3,75	4,05
4,5				1,96	2,21	2,47	2,74	3,02	3,31	3,60	3,90	4,20
5,0					2,33	2,59	2,87	3,15	3,44	3,74	4,04	4,35
5,5						2,71	2,99	3,28	3,71	4,02	4,33	4,65
6,0						2,83	3,11	3,41	3,71	4,02	4,33	4,65

For 3 anchors fastening and more

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

Ramset™

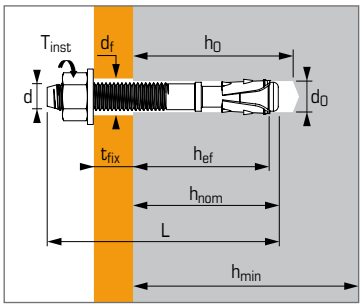
FIX3

zinc coated steel version

Torque controlled expansion anchor, for use in non-cracked concrete

Product from spit

ETA Option 7- 13/0005



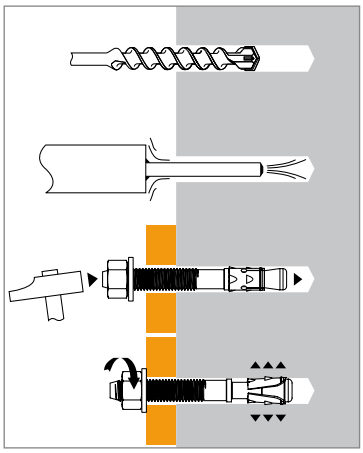
APPLICATION

- Steel and timber framework and beams
- Lift guide rails
- Industrial doors and gates
- Brickwork support angles
- Storage systems

MATERIAL

- **Body M6-M20 :** cold formed steel, NFA 35-053 / zinc electroplated (5 µm)
- **Sleeve :** cold formed steel, NFA 35-231
- **Nut :** steel strength grade 6 or 8, ISO 898-2
- **Washer :** steel, NF E 25513

INSTALLATION



Technical data

Anchor size	Letter marking	Minimum anchorage depth: min. anchor depth (mm) h_{ef}	Embed. depth (mm) h_{nom}	Max. thick. of part to be fixed (mm) t_{fix}	Drilling depth (mm) h_0	Min. thick. of base material (mm) h_{min}	Maximum anchorage depth: max. anchor depth (mm) h_{ef}	Embed. depth (mm) h_{nom}	Max. thick. of part to be fixed (mm) t_{fix}	Drilling depth (mm) h_0	Min. thick. of base material (mm) h_{min}	Thread diameter (mm) d	Drilling diameter (mm) d_0	Clearance diameter (mm) d_f	Total anchor length (mm) L	Tighten torque (Nm) T_{inst}	Code
6X45/5*	-			5					-						45		050510
6X55/15*	-	25,6	35	20	41	100	35	45	15	51	100	6	6	8	55	10	050520
6X85/45*	-			50					45						85		050530
6X64 percée*	-			-					-						64		056100
8X55/5	-		-	5					-						52		057450
8X70/20-10	C			20					10						67		057451
8X90/40-30	E			40					30						87		057452
8X100/50-40	F	30	38	50	50	80	40	48	40	60	80	8	8	9	97	15	057453
8X115/65-55	G			65					55						112		057454
8X130/80-70	H			80					70						127		057455
8X160/110-100	J			110					100						157		057456
10X65/5	-			5					-						66		057460
10X75/15-5	C			15					5						76		057461
10X85/25-15	D			25					15						86		057462
10X95/36-26	E	40	50	36	60	100	50	60	26	70	100	10	10	12	97	30	057463
10X110/50-40	F			50					40						111		057464
10X125/65-55	G			65					55						126		057465
10X140/80-70	I			80					70						141		057466
10X160/100-90	J			100					90						161		057467
12X80/5	-			5					-						81		057470
12X100/25-10	F			25					10						101		057471
12x115/40-25	G			40					25						116		057472
12x125/50-35	H	50	62	50	75	100	65	77	35	90	130	12	12	14	126	50	057473
12X140/65-50	I			65					50						141		057474
12X160/85-70	J			85					70						161		057475
12X180/105-90	L			105					90						181		057576
12X220/145-130	O			145					130						222		057477
16X100/5	-			5					-						104		057480
16X125/30-15	G			30					15						129		057481
16X150/55-40	I	65	80	55	95	130	80	95	40	110	160	16	16	18	154	100	057482
16X170/75-60	K			75					60						174		057483
16X185/90-75	L			90					75						189		057484
20X125/10	-			10					-						150		057490
20X165/50-25	J	75	93	50	110	150	100	118	25	135	200	20	20	22	170	160	057491
20X220/105-80	N			105					80						220		057492

* Do not belong to ETA

Anchor mechanical properties

Anchor size		M6	M8	M10	M12	M16	M20
Cross-section above cone							
f_{uk} (N/mm²)	Min. tensile strength	700	750	750	750	700	600
f_{yk} (N/mm²)	Yield strength	580	600	600	600	570	570
As (mm²)	Stressed cross-section	-	23,8	34,7	56,1	103,9	172
Threaded part							
f_{uk} (N/mm²)	Min. tensile strength	600	650	650	650	600	580
f_{yk} (N/mm²)	Yield strength	420	420	420	420	480	330
As (mm²)	Stressed cross-section	20,1	36,6	58	84,3	157	245
W_{el} (mm³)	Elastic section modulus	12,7	31,2	62,3	109,2	277,5	540,9
$M^0_{rk,s}$ (Nm)	Characteristic bending moment	9	24	49	85	200	376
M (Nm)	Recommended bending moment	3,7	9,8	20,0	34,7	81,6	153,5

FIX3

zinc coated steel version

Ramset™

For detail design, please refer to CC method in following page.

Ultimate ($N_{Ru,m}$, $V_{Ru,m}$) and characteristic loads (N_{Rk}, V_{Rk}) in kN

Mean Ultimate loads are derived from test results in admissible service conditions, and characteristic loads are statistically determined.

TENSILE

Anchor size	M8	M10	M12	M16	M20
Minimum anchorage depth					
h_{ef}	**30**	**40**	**50**	**65**	**75**
$N_{Ru,m}$	11,5	17,3	26,1	43,6	45,4
N_{Rk}	7,5	12,8	17,9	26,4	32,7
Maximum anchorage depth					
h_{ef}	**40**	**50**	**65**	**80**	**100**
$N_{Ru,m}$	17,4	24,6	37,8	52,7	77,1
N_{Rk}	12,8	17,9	26,4	36,0	50,4

SHEAR

Anchor size	M8	M10	M12	M16	M20
$V_{Ru,m}$	14,3	22,6	32,8	56,5	85,2
$V_{Rk,min}$	8,3	12,8	17,9	36,5	65,4
$V_{Rk,max}$	10,0	13,8	27,4	36,5	71,1

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

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

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

TENSILE

Anchor size	M8	M10	M12	M16	M20
Minimum anchorage depth					
h_{ef}	**30**	**40**	**50**	**65**	**75**
N_{Rd}	5,0	8,5	11,9	17,6	21,8
Maximum anchorage depth					
h_{ef}	**40**	**50**	**65**	**80**	**100**
N_{Rd}	8,5	11,9	17,6	24,0	33,6

$\gamma_{Mc} = 1,5$

SHEAR

Anchor size	M8	M10	M12	M16	M20
$V_{Rd,min}$	6,6	10,2	14,3	29,2	43,6
$V_{Rd,max}$	8,0	11,0	21,9	29,2	47,4

$\gamma_{Ms} = 1,25$ for M6 to M16 and $\gamma_{Ms} = 1,5$ for M20

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

$$N_{rec} = \frac{N_{Rk}}{3}$$

$$V_{rec} = \frac{N_{Rk}}{3}$$

TENSILE

Anchor size	M8	M10	M12	M16	M20
Minimum anchorage depth					
h_{ef}	**30**	**40**	**50**	**65**	**75**
N_{rec}	2,5	4,3	6,0	8,8	10,9
Maximum anchorage depth					
h_{ef}	**40**	**50**	**65**	**80**	**100**
N_{rec}	4,3	6,0	8,8	12,0	16,8

$\gamma = 3$

SHEAR

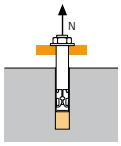
Anchor size	M8	M10	M12	M16	M20
$V_{rec,min}$	2,8	4,3	6,0	12,2	21,8
$V_{rec,max}$	3,3	4,6	9,1	12,2	23,7

$\gamma = 3$

FIX3
zinc coated steel version

SPIT CC Method (values issued from ETA)

TENSILE in kN

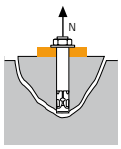


Pull-out resistance

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

$N^0_{Rd,p}$					Design pull-out resistance	
Anchor size		M8	M10	M12	M16	M20
Minimum anchorage depth						
h_{ef}		30	40	50	65	75
$N^0_{Rd,p}$	(C20/25)	5,0	-	-	-	-
Maximum anchorage depth						
h_{ef}		40	50	65	80	100
$N^0_{Rd,p}$	(C20/25)	-	-	-	-	-

$\gamma_{Mc} = 1,5$

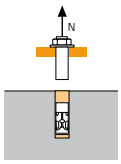


Concrete cone resistance

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

$N^0_{Rd,c}$					Design cone resistance	
Anchor size		M8	M10	M12	M16	M20
Minimum anchorage depth						
h_{ef}		30	40	50	65	75
$N^0_{Rd,c}$	(C20/25)	5,5	8,5	11,9	17,6	21,8
Maximum anchorage depth						
h_{ef}		40	50	65	80	100
$N^0_{Rd,c}$	(C20/25)	8,5	11,9	17,6	24,0	33,6

$\gamma_{Mc} = 1,5$

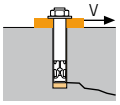


Steel resistance

$V_{Rd,s}$					Steel design tensile resistance	
Anchor size		M8	M10	M12	M16	M20
$V_{Rd,s}$		11,9	17,3	28,1	48,5	73,7

$\gamma_{Ms} = 1,5$ for M8 to M16 and $\gamma_{Ms} = 1,4$ for M20

SHEAR in kN

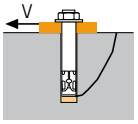


Concrete edge resistance

$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c}$					Design concrete edge resistance at minimum edge distance (C_{min})	
Anchor size		M8	M10	M12	M16	M20
Minimum anchorage depth						
h_{ef}		30	40	50	65	75
C_{min}		50	65	100	100	115
S_{min}		40	50	100	100	100
$V^0_{Rd,c}$	(C20/25)	2,7	4,6	9,7	11,1	15,1
Maximum anchorage depth						
h_{ef}		40	50	65	80	100
C_{min}		55	65	70	105	120
S_{min}		45	60	70	90	100
$V^0_{Rd,c}$	(C20/25)	3,3	4,8	6,0	12,5	17,0

$\gamma_{Mc} = 1,5$

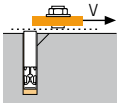


Pryout failure

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

$V^0_{Rd,cp}$					Design pryout resistance	
Anchor size		M8	M10	M12	M16	M20
Minimum anchorage depth						
h_{ef}		30	40	50	65	75
$V^0_{Rd,cp}$	(C20/25)	5,5	8,5	11,9	35,2	43,6
Maximum anchorage depth						
h_{ef}		40	50	65	80	100
$V^0_{Rd,cp}$	(C20/25)	8,5	11,9	35,2	48,0	67,2

$\gamma_{Mcp} = 1,5$



Steel resistance

$V_{Rd,s}$					Steel design shear resistance	
Anchor size		M8	M10	M12	M16	M20
$V_{Rd,s}$		8,0	11,0	21,9	29,2	47,4

$\gamma_{Ms} = 1,25$ for M8 to M16 and $\gamma_{Ms} = 1,5$ for M20

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

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

$$\beta_N + \beta_V \leq 1,2$$

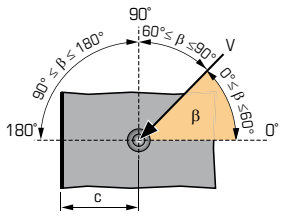
f_b INFLUENCE OF CONCRETE

Concrete class	Cube strength fcc	f_b	Concrete class	Cube strength fcc	f_b
C25/30	30	1,1	C40/50	50	1,41
C30/37	37	1,22	C45/55	55	1,48
C35/45	45	1,34	C50/60	60	1,55

$$f_b = \sqrt{\frac{fcc}{25}}$$

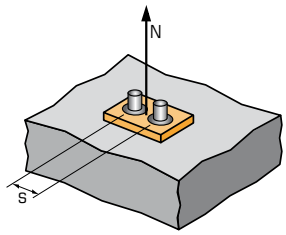
$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



SPIT CC Method (values issued from ETA)

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0{,}5 + \frac{s}{6.h_{ef}}$$

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

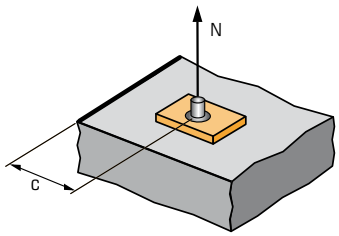
$s_{cr,N} = 3.h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

SPACING S	Reduction factor Ψ_s Minimum anchorage depth				
Anchor size	M8	M10	M12	M16	M20
40	0,72				
50	0,78	0,71			
65	0,86	0,77			
90	1,00	0,88			
100		0,92	0,83	0,76	0,72
120		1,00	0,90	0,81	0,77
150			1,00	0,88	0,83
180				0,96	0,90
195				1,00	0,93
225					1,00

SPACING S	Reduction factor Ψ_s Maximum anchorage depth				
Anchor size	M8	M10	M12	M16	M20
45	0,69				
60	0,75	0,70			
70	0,79	0,73	0,68		
90	0,88	0,80	0,73	0,69	
100	0,92	0,83	0,76	0,71	0,67
120	1,00	0,90	0,81	0,75	0,70
150		1,00	0,88	0,81	0,75
195			1,00	0,91	0,83
220				0,96	0,87
240				1,00	0,90
300					1,00

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



$$\Psi_{c,N} = 0{,}23 + 0{,}51 \cdot \frac{c}{h_{ef}}$$

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

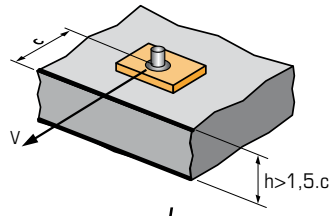
$c_{cr,N} = 1{,}5.h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group.

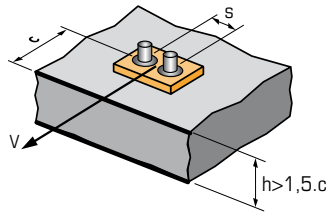
EDGE C	Reduction factor $\Psi_{c,N}$ Minimum anchorage depth				
Anchor size	M8	M10	M12	M16	M20
50	1,00				
65		1,00			
100			1,00		
100				1,00	
115					1,00

EDGE C	Reduction factor $\Psi_{c,N}$ Maximum anchorage depth				
Anchor size	M8	M10	M12	M16	M20
55	0,93				
60	1,00				
65		0,89			
70		0,94	0,78		
75		1,00	0,82		
100			1,00		
105				0,90	
110				0,93	
120				1,00	0,84
130					0,89
150					1,00

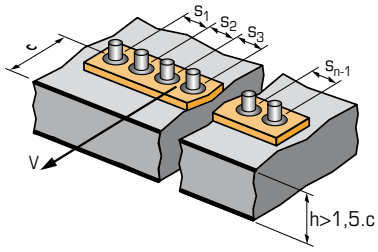
$\Psi_{s\text{-}c,V}$ INFLUENCE OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



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



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



For single anchor fastening

	Reduction factor $\Psi_{s\text{-}c,V}$ Non-cracked concrete											
$\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
$\Psi_{s\text{-}c,V}$	1,00	1,31	1,66	2,02	2,41	2,83	3,26	3,72	4,19	4,69	5,20	5,72

For 2 anchors fastening

	Reduction factor $\Psi_{s\text{-}c,V}$ Non-cracked concrete											
$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
1,0	0,67	0,84	1,03	1,22	1,43	1,65	1,88	2,12	2,36	2,62	2,89	3,16
1,5	0,75	0,93	1,12	1,33	1,54	1,77	2,00	2,25	2,50	2,76	3,03	3,31
2,0	0,83	1,02	1,22	1,43	1,65	1,89	2,12	2,38	2,63	2,90	3,18	3,46
2,5	0,92	1,11	1,32	1,54	1,77	2,00	2,25	2,50	2,77	3,04	3,32	3,61
3,0	1,00	1,20	1,42	1,64	1,88	2,12	2,37	2,63	2,90	3,18	3,46	3,76
3,5		1,30	1,52	1,75	1,99	2,24	2,50	2,76	3,04	3,32	3,61	3,91
4,0			1,62	1,86	2,10	2,36	2,62	2,89	3,17	3,46	3,75	4,05
4,5				1,96	2,21	2,47	2,74	3,02	3,31	3,60	3,90	4,20
5,0					2,33	2,59	2,87	3,15	3,44	3,74	4,04	4,35
5,5						2,71	2,99	3,28	3,71	4,02	4,33	4,65
6,0						2,83	3,11	3,41	3,71	4,02	4,33	4,65

For 3 anchors fastening and more

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

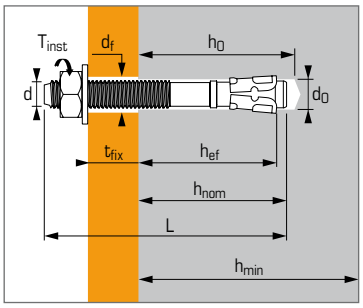
Ramset™

FIX II - HDG

hot dip galvanised version

Torque controlled expansion anchor, for use in non-cracked concrete

Product from spit



APPLICATION

- Steel and timber framework and beams
- Lift guide rails
- Industrial doors and gates
- Brickwork support angles
- Storage systems

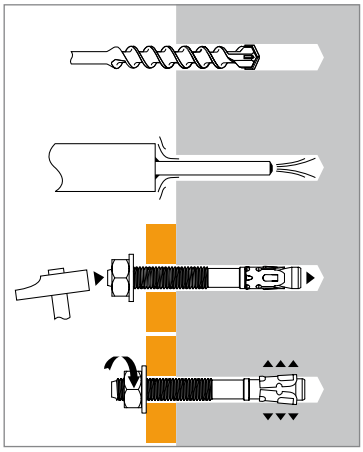
MATERIAL

- Hot dip galvanised: 45 µm
  NF EN ISO 1460 -1461
  Salt spray: >350 hours

Technical data

Anchor size	Letter marking	Minimum anchorage depth					Maximum anchorage depth					Thread diameter	Drilling diameter	Clearance diameter	Total anchor length	Tighten torque	Code
		min. anchor depth (mm) h_{ef}	Embed. depth (mm) h_{nom}	Max. thick. of part to be fixed (mm) t_{fix}	Drilling depth (mm) h_0	Min. thick. of base material (mm) h_{min}	max. anchor depth (mm) h_{ef}	Embed. depth (mm) h_{nom}	Max. thick. of part to be fixed (mm) t_{fix}	Drilling depth (mm) h_0	Min. thick. of base material (mm) h_{min}	(mm) d	(mm) d_0	(mm) d_f	(mm) L	(Nm) T_{inst}	
8X70/20-7	C			20					7						70		050310
8X90/40-27	E	35	42	40	52	100	48	55	27	65	100	8	8	9	90	15	050320
8X110/60-47	F			60					47						110		050329
8X130/80-67	H			80					67						130		050330
10X75/15-5	C			15					5						75		050350
10X95/36-26	E			36					26						96		050360
10X120/60-50	G	42	50	60	62	100	52	60	50	72	104	10	10	12	120	30	050340
10X140/80-70	I			80					70						140		050370
10X160/100-90	J			100					90						160		050341
12X80/5	-			5					-						80		055351
12X100/25-8	E			25					8						100		055352
12X115/40-23	G	50	60	40	75	100	68	78	23	93	136	12	12	14	115	50	055395
12X140/65-48	I			65					48						140		050400
12X180//105-88	L			105					88						180		050410
16X125/30-8	G			30					8						125		050440
16X150/55-33	I	64	78	55	95	128	86	100	33	117	172	16	16	18	150	100	050354
16X170/75-53	K			75					53						170		050450

INSTALLATION



Anchor mechanical properties

Anchor size		M8	M10	M12	M16
Cross-section above cone					
f_{uk} (N/mm²)	Min. tensile strength	700	700	700	600
f_{yk} (N/mm²)	Yield strength	580	580	580	500
As (mm²)	Stressed cross-section	23,8	40,7	55,4	103,9
Threaded part					
f_{uk} (N/mm²)	Min. tensile strength	600	600	600	500
f_{yk} (N/mm²)	Yield strength	480	480	480	400
As (mm²)	Stressed cross-section	36,6	58	84,3	157
W_{el} (mm³)	Elastic section modulus	31,2	62,3	109,2	277,5
$M^0_{rk,s}$ (Nm)	Characteristic bending moment	22	45	79	166
M (Nm)	Recommended bending moment	9,0	18,4	32,2	67,8

FIX II - HDG

hot dip galvanised version

Ramset™

For detail design, please refer to CC method in following page.

Ultimate ($N_{Ru,m}$, $V_{Ru,m}$) and characteristic loads (N_{Rk}, V_{Rk}) in kN

Mean Ultimate loads are derived from test results in admissible service conditions, and characteristic loads are statistically determined.

TENSILE

Anchor size	M8	M10	M12	M16
Minimum anchorage depth				
h_{ef}	**35**	**42**	**50**	**64**
$N_{Ru,m}$	13,4	14,0	23,6	30,6
N_{Rk}	5,9	9,0	16,0	25,0
Maximum anchorage depth				
h_{ef}	**48**	**52**	**68**	**86**
$N_{Ru,m}$	17,8	18,7	32,7	51,0
N_{Rk}	9,0	12,1	20,0	40,0

SHEAR

Anchor size	M8	M10	M12	M16
$V_{Ru,m}$	10,8	18,2	30,8	44,7
$V_{Rk,min}$	4,8	13,7	17,9	23,6
$V_{Rk,max}$	4,8	14,0	22,8	23,6

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

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

*Derived from test results

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

TENSILE

Anchor size	M8	M10	M12	M16
Minimum anchorage depth				
h_{ef}	**35**	**42**	**50**	**60**
N_{Rd}	3,3	5,0	8,9	13,9
Maximum anchorage depth				
h_{ef}	**48**	**52**	**68**	**86**
N_{Rd}	5,0	6,7	11,1	22,2

$\gamma_{Mc} = 1,8$

SHEAR

Anchor size	M8	M10	M12	M16
$V_{Rd,min}$	3,8	10,9	14,3	18,9
$V_{Rd,max}$	3,8	11,2	18,2	18,9

$\gamma_{Ms} = 1,25$

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

$$N_{rec} = \frac{N_{Rk}\,^{*}}{3}$$

*Derived from test results

$$V_{rec} = \frac{N_{Rk}\,^{*}}{3}$$

TENSILE

Anchor size	M8	M10	M12	M16
Minimum anchorage depth				
h_{ef}	**35**	**42**	**50**	**64**
N_{rec}	2,0	3,0	5,3	8,3
Maximum anchorage depth				
h_{ef}	**48**	**52**	**68**	**86**
N_{rec}	3,0	4,0	6,7	13,3

$\gamma = 3$

SHEAR

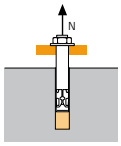
Anchor size	M8	M10	M12	M16
$V_{rec,min}$	1,6	4,6	6,0	7,9
$V_{rec,max}$	1,6	4,7	7,6	7,9

$\gamma = 3$

FIX II - HDG
hot dip galvanised version

SPIT CC Method

TENSILE in kN

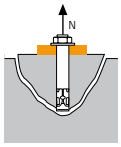


Pull-out resistance

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

$N^0_{Rd,p}$				Design pull-out resistance	
Anchor size		M8	M10	M12	M16
Minimum anchorage depth					
h_{ef}		35	42	50	64
$N^0_{Rd,p}$	(C20/25)	3,3	5,0	8,9	13,9
Maximum anchorage depth					
h_{ef}		48	52	68	86
$N^0_{Rd,p}$	(C20/25)	5,0	6,7	11,1	22,2

$\gamma_{Mc} = 1,8$

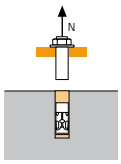


Concrete cone resistance

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

$N^0_{Rd,c}$				Design cone resistance	
Anchor size		M8	M10	M12	M16
Minimum anchorage depth					
h_{ef}		35	42	50	64
$N^0_{Rd,c}$	(C20/25)	5,8	7,6	9,9	14,3
Maximum anchorage depth					
h_{ef}		48	52	68	86
$N^0_{Rd,c}$	(C20/25)	9,3	10,5	15,7	22,3

$\gamma_{Mc} = 1,8$

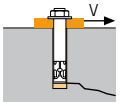


Steel resistance

$V_{Rd,s}$		Steel design tensile resistance		
Anchor size	M8	M10	M12	M16
$V_{Rd,s}$	9,3	16	22	34

$\gamma_{Ms} = 1,5$

SHEAR in kN

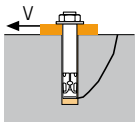


Concrete edge resistance

$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c}$				Design concrete edge resistance at minimum edge distance (C_{min})	
Anchor size		M8	M10	M12	M16
Minimum anchorage depth					
h_{ef}		35	42	50	64
C_{min}		55	75	100	100
S_{min}		45	65	100	100
$V^0_{Rd,c}$	(C20/25)	2,9	5,1	8,7	10,1
Maximum anchorage depth					
h_{ef}		48	52	68	86
C_{min}		60	65	90	105
S_{min}		50	55	75	90
$V^0_{Rd,c}$	(C20/25)	3,7	4,4	8,2	11,8

$\gamma_{Mc} = 1,5$

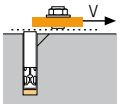


Pryout failure

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

$V^0_{Rd,cp}$				Design pryout resistance	
Anchor size		M8	M10	M12	M16
Minimum anchorage depth					
h_{ef}		35	42	50	64
$V^0_{Rd,cp}$	(C20/25)	7,0	9,1	11,9	34,4
Maximum anchorage depth					
h_{ef}		48	52	68	86
$V^0_{Rd,cp}$	(C20/25)	11,2	12,6	37,7	53,6

$\gamma_{Mcp} = 1,5$



Steel resistance

$V_{Rd,s}$		Steel design shear resistance		
Anchor size	M8	M10	M12	M16
$V_{Rd,s}$	3,8	11,2	18,2	18,9

$\gamma_{Ms} = 1,25$

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

$\beta_N = N_{Sd} / N_{Rd} \leq 1$

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

$\beta_V = V_{Sd} / V_{Rd} \leq 1$

$$\beta_N + \beta_V \leq 1,2$$

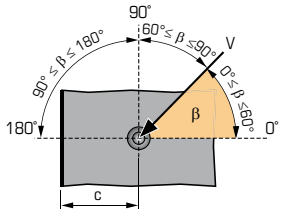
f_b INFLUENCE OF CONCRETE

Concrete class	Cube strength fcc	f_b	Concrete class	Cube strength fcc	f_b
C25/30	30	1,1	C40/50	50	1,41
C30/37	37	1,22	C45/55	55	1,48
C35/45	45	1,34	C50/60	60	1,55

$$f_b = \sqrt{\frac{fcc}{25}}$$

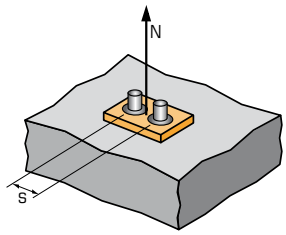
$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



SPIT CC Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0{,}5 + \frac{s}{6.h_{ef}}$$

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

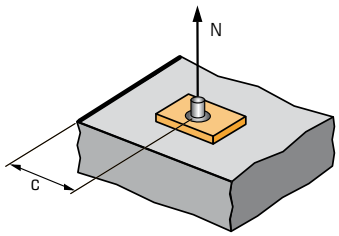
$s_{cr,N} = 3.h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group

SPACING S	Reduction factor Ψ_s Minimum anchorage depth			
Anchor size	M8	M10	M12	M16
45	0,71			
65	0,81	0,76		
100	0,98	0,90	0,83	0,76
110	1,00	0,94	0,87	0,79
125		1,00	0,92	0,83
150			1,00	0,89
180				0,97
192				1,00

SPACING S	Reduction factor Ψ_s Maximum anchorage depth			
Anchor size	M8	M10	M12	M16
50	0,67			
55	0,69	0,68		
75	0,76	0,74	0,68	
90	0,81	0,79	0,72	0,67
105	0,86	0,84	0,76	0,70
145	1,00	0,96	0,86	0,78
180		1,00	0,94	0,85
205			1,00	0,90
240				0,97
280				1,00

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



$$\Psi_{c,N} = 0{,}23 + 0{,}51 \cdot \frac{c}{h_{ef}}$$

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

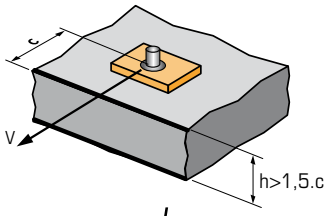
$c_{cr,N} = 1{,}5.h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group.

EDGE C	Reduction factor $\Psi_{c,N}$ Minimum anchorage depth			
Anchor size	M8	M10	M12	M16
h_{ef}	**35**	**42**	**50**	**64**
55	1,00			
65		1,00		
75			1,00	
100				1,00

EDGE C	Reduction factor $\Psi_{c,N}$ Maximum anchorage depth			
Anchor size	M8	M10	M12	M16
h_{ef}	**48**	**52**	**68**	**86**
60	0.87			
65	0.92	0.87		
75	1.00	0.97		
80		1.00	0.83	
90			0.91	
105			1.00	0.85
120				0.94
130				1.00

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

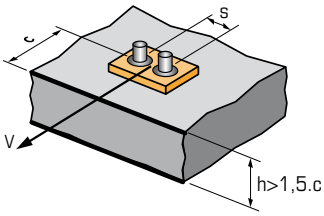


$$\Psi_{s\text{-}c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

For single anchor fastening

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

$\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
$\Psi_{s\text{-}c,V}$	1,00	1,31	1,66	2,02	2,41	2,83	3,26	3,72	4,19	4,69	5,20	5,72

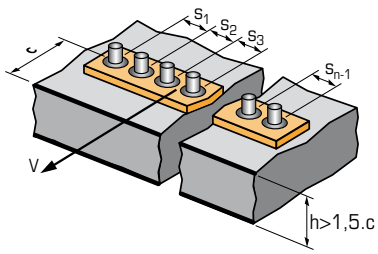


$$\Psi_{s\text{-}c,V} = \frac{3.c + s}{6.c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

For 2 anchors fastening

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

$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
1,0	0,67	0,84	1,03	1,22	1,43	1,65	1,88	2,12	2,36	2,62	2,89	3,16
1,5	0,75	0,93	1,12	1,33	1,54	1,77	2,00	2,25	2,50	2,76	3,03	3,31
2,0	0,83	1,02	1,22	1,43	1,65	1,89	2,12	2,38	2,63	2,90	3,18	3,46
2,5	0,92	1,11	1,32	1,54	1,77	2,00	2,25	2,50	2,77	3,04	3,32	3,61
3,0	1,00	1,20	1,42	1,64	1,88	2,12	2,37	2,63	2,90	3,18	3,46	3,76
3,5		1,30	1,52	1,75	1,99	2,24	2,50	2,76	3,04	3,32	3,61	3,91
4,0			1,62	1,86	2,10	2,36	2,62	2,89	3,17	3,46	3,75	4,05
4,5				1,96	2,21	2,47	2,74	3,02	3,31	3,60	3,90	4,20
5,0					2,33	2,59	2,87	3,15	3,44	3,74	4,04	4,35
5,5						2,71	2,99	3,28	3,71	4,02	4,33	4,65
6,0						2,83	3,11	3,41	3,71	4,02	4,33	4,65



For 3 anchors fastening and more

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

Ramset™

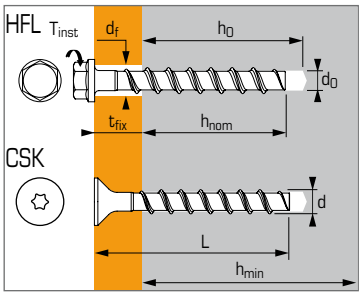
TAPCON XTREM

zinc coated & stainless steel version

Concrete screw anchor for use in cracked and non-cracked concrete

Product from spit

ETA European Technical Assessment
ETA Option 1- 16/0276



APPLICATION

- Channel, cable tray
- Brackets
- E-Clips, cowhorn
- TRH clip, rod hanging
- Trunking
- Push-pull bars
- Formwork / shuttering

MATERIAL

Zinc coated steel version:
Min. tensile strength: 700 N/mm²
- **HFL version:**

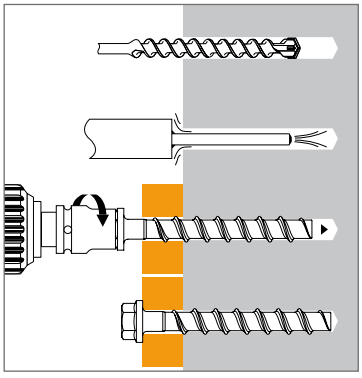
Zinc flake coating 5 µm, EN ISO 10683
Salt spray: 500 hours
- **CSK version:**

Min. zinc coated steel 5 µm

Stainless steel version:
Min. tensile strength: 700 N/mm²
- **HFL&CSK versions:**

Stainless steel A4

INSTALLATION



Technical data

Versions	Anchor size	Minimum embedment depth: Embed. depth min. (h_{nom}) (mm)	Max. thick. of part to be fixed (t_{fix}) (mm)	Drilling depth (h_0) (mm)	Min. thick. of base material (h_{min}) (mm)	Maximum embedment depth: Embed. depth max. (h_{nom}) (mm)	Max. thick. of part to be fixed (t_{fix}) (mm)	Drilling depth (h_0) (mm)	Min. thick. of base material (h_{min}) (mm)	Thread Ø (d) (mm)	Drilling Ø (d_0) (mm)	Total anchor length (L) (mm)	Tighten torque (T_{inst}) (Nm)	Code
Zinc coated versions														
HFL	8X50/5	45	5	55	100	-	-	-	-	10,6	8	50	*	058733
	8X60/15		15			-	-	-	-			60		058734
	8X70/25-5		25			65	5	75	120			70		058735
	8X80/35-15		35			65	15	75	120			80		058736
	8X100/55-35		55			65	35	75	120			100		058737
	8X120/75-55		75			65	55	75	120			120		058738
	8X140/95-75		95			65	75	75	120			140		058739
	10X60/5	55	5	65	100	-	-	-	-	12,6	10	60	*	058740
	10X70/15		15			-	-	-	-			70		058741
	10X90/35-5		35			85	5	95	130			90		058742
	10X100/45-15		45			85	15	95	130			100		058743
	10X120/65-35		65			85	35	95	130			120		058744
	10X140/85-55		85			85	55	95	130			140		058745
	10X160/105-75		105			85	75	95	130			160		058746
	12X80/15	65	15	75	120	-	-	-	-	14,6	12	80	*	058747
	12X110/45-10		45			100	10	110	150			110		058748
	14X80/5	75	5	85	130	-	-	-	-	16,6	14	80	*	058766
	14X110/35		35			-	-	-	-			110		058767
	14X130/55-15		55			115	15	125	170			130		058768
	14X150/75-35		75			115	35	125	170			150		058769
CSK	8X80/35-15	45	35	55	100	65	15	75	120	10,6	8	80	*	058778
Stainless steel A4 versions														
HFL	8X70/25-5	45	25	55	100	65	5	75	120	10,6	8	70	*	058809
	8X80/35-15		35				15					80		058810
	10X90/35-5	55	35	65	100	85	5	95	130	12,6	10	90	*	058811
	10X100/45-15		45				15					100		058812
	10X120/65-35		65				35					120		058813
CSK	8X80/35-15	45	35	55	100	65	15	75	120	10,6	8	80	*	058814
	10X90/35-5	55	35	65	100	85	5	95	130	12,6	10	90	*	058815

* Stop tightening immediately when it meets the part to be fixed

Anchor mechanical properties

Anchor size Zinc coated & A4		Ø8	Ø10	Ø12	Ø14
As (mm²)	Stressed cross-section	39,6	65,0	97,7	134,0
W_{el} (mm³)	Elastic section modulus	35,1	74,0	134,0	220,0
$M^0_{rk,s}$ (Nm)	Characteristic bending moment	26,0	56,0	123,0	200,0
M (Nm)	Recommended bending moment	13,0	28,0	61,5	100,0

TAPCON XTREM

zinc coated & stainless steel version

Ramset™

For detail design, please refer to CC method in following page.

Characteristic loads (N_{Rk}, V_{Rk}) in kN

Mean Ultimate loads are derived from test results in admissible service conditions, and characteristic loads are statistically determined.

TENSILE

Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Non-cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
N_{Rk}	7,5	9,0	16,1	22,4
$h_{nom,max}$	**65**	**85**	**100**	**115**
N_{Rk}	16,1	25,1	36,2	44,6
Cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
N_{Rk}	5,0	5,0	12,0	15,9
$h_{nom,max}$	**65**	**85**	**100**	**115**
N_{Rk}	12,0	20,3	25,8	31,8

SHEAR

Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Non-cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
V_{Rk}	10,5	14,3	17,9	22,4
$h_{nom,max}$	**65**	**85**	**100**	**115**
V_{Rk}	18,0	34,1	42,0	64,1
Cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
V_{Rk}	7,5	10,2	12,8	15,9
$h_{nom,max}$	**65**	**85**	**100**	**115**
V_{Rk}	13,5	34,1	42,0	63,6

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

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

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

TENSILE

Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Non-cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
N_{Rd}	5,0	6,0	10,7	14,9
$h_{nom,max}$	**65**	**85**	**100**	**115**
N_{Rd}	10,7	16,7	24,1	29,7
Cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
N_{Rd}	3,3	3,3	8,0	10,6
$h_{nom,max}$	**65**	**85**	**100**	**115**
N_{Rd}	8,0	13,5	17,2	21,2

$\gamma_{Mc} = 1,5$

SHEAR

Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Non-cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
V_{Rd}	7,0	9,5	11,9	14,9
$h_{nom,max}$	**65**	**85**	**100**	**115**
V_{Rd}	12,0	22,7	28,0	42,7
Cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
V_{Rd}	5,0	6,8	8,5	10,6
$h_{nom,max}$	**65**	**85**	**100**	**115**
V_{Rd}	9,0	22,7	28,0	42,4

$\gamma_{Mc} = 1,5$

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

$$N_{rec} = \frac{N_{Rk}}{3}$$

$$V_{rec} = \frac{N_{Rk}}{3}$$

TENSILE

Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Non-cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
N_{rec}	2,5	3,0	5,4	7,5
$h_{nom,max}$	**65**	**85**	**100**	**115**
N_{rec}	5,4	8,4	12,1	14,9
Cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
N_{rec}	1,7	1,7	4,0	5,3
$h_{nom,max}$	**65**	**85**	**100**	**115**
N_{rec}	4,0	6,8	8,6	10,6

$\gamma = 3$

SHEAR

Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Non-cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
V_{rec}	3,5	4,8	6,0	7,5
$h_{nom,max}$	**65**	**85**	**100**	**115**
V_{rec}	6,0	11,4	14,0	21,4
Cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
V_{rec}	2,5	3,4	4,3	5,3
$h_{nom,max}$	**65**	**85**	**100**	**115**
V_{rec}	4,5	11,4	14,0	21,2

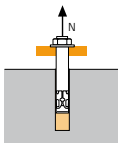
$\gamma = 3$

TAPCON XTREM

zinc coated & stainless steel version

SPIT CC Method

TENSILE in kN

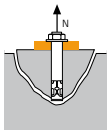


Pull-out resistance

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

$N^0_{Rd,p}$				Design pull-out resistance
Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Non-cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
$N^0_{Rd,p}$	5,0	6,0	10,7	-
$h_{nom,max}$	**65**	**85**	**100**	**115**
$N^0_{Rd,p}$	10,7	16,7	-	-
Cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
$N^0_{Rd,p}$	3,3	3,3	8,0	-
$h_{nom,max}$	**65**	**85**	**100**	**115**
$N^0_{Rd,p}$	8,0	-	-	-

$\gamma_{Mc} = 1,5$

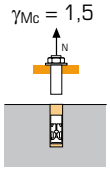


Concrete cone resistance

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

$N^0_{Rd,c}$				Design cone resistance
Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Non-cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
$N^0_{Rd,c}$	7,0	9,5	11,9	14,9
$h_{nom,max}$	**65**	**85**	**100**	**115**
$N^0_{Rd,c}$	12,6	18,9	24,1	29,7
Cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
$N^0_{Rd,c}$	5,0	6,8	8,5	10,6
$h_{nom,max}$	**65**	**85**	**100**	**115**
$N^0_{Rd,c}$	9,0	13,5	17,2	21,2

$\gamma_{Mc} = 1,5$

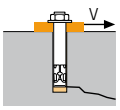


Steel resistance

$N_{Rd,s}$				Steel design tensile resistance
Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
$N_{Rd,s}$	17,9	30,0	45,7	73,6

$\gamma_{Ms} = 1,4$

SHEAR in kN

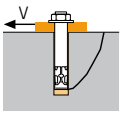


Concrete edge resistance

$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c}$				Design concrete edge resistance at minimum edge distance (C_{min})
Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
$h_{nom,min}$	**45**	**55**	**65**	**75**
C_{min}	40	50	50	50
S_{min}	40	50	50	50
$V^0_{Rd,c,non\text{-}cracked}$	3,2	4,6	4,9	5,1
$V^0_{Rd,c,cracked}$	2,3	3,3	3,4	3,6
$h_{nom,max}$	**65**	**85**	**100**	**115**
C_{min}	50	50	70	70
S_{min}	50	50	70	70
$V^0_{Rd,c,non\text{-}cracked}$	4,6	5,0	8,3	8,8
$V^0_{Rd,c,cracked}$	3,3	3,6	5,9	6,2

$\gamma_{Mc} = 1,5$

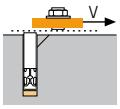


Pryout failure

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

$V^0_{Rd,cp}$				Design pryout resistance
Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Non-cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
$V^0_{Rd,cp}$	7,0	9,5	11,9	14,9
$h_{nom,max}$	**65**	**85**	**100**	**115**
$V^0_{Rd,cp}$	12,6	37,8	48,2	59,4
Cracked concrete (C20/25)				
$h_{nom,min}$	**45**	**55**	**65**	**75**
$V^0_{Rd,cp}$	5,0	6,8	8,5	10,6
$h_{nom,max}$	**65**	**85**	**100**	**115**
$V^0_{Rd,cp}$	9,0	26,9	34,3	42,4

$\gamma_{Mc} = 1,5$



Steel resistance

$V_{Rd,s}$				Steel design shear resistance
Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
$V_{Rd,s}$	12,0	22,7	28,0	42,7

$\gamma_{Ms} = 1,5$

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

$\beta_N = N_{Sd} / N_{Rd} \leq 1$

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

$\beta_V = V_{Sd} / V_{Rd} \leq 1$

$$\beta_N + \beta_V \leq 1,2$$

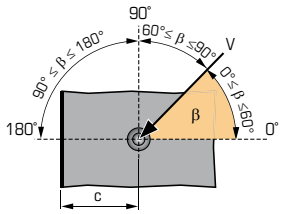
f_b INFLUENCE OF CONCRETE

Concrete class	Cube strength fcc	f_b	Concrete class	Cube strength fcc	f_b
C25/30	30	1,1	C40/50	50	1,41
C30/37	37	1,22	C45/55	55	1,48
C35/45	45	1,34	C50/60	60	1,55

$$f_b = \sqrt{\frac{fcc}{25}}$$

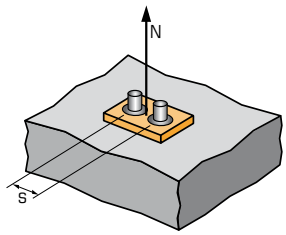
$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



SPIT CC Method

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0{,}5 + \frac{s}{6.h_{ef}}$$

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

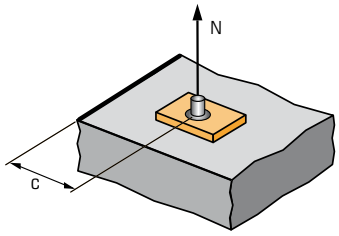
$s_{cr,N} = 3.h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group.

SPACING S	Reduction factor Ψ_s Minimum anchor depth			
Anchor size	Ø8	Ø10	Ø12	Ø14
40	0,69			
50	0,74	0,69	0,67	0,64
70	0,83	0,77	0,73	0,70
95	0,95	0,87	0,82	0,77
105	1,00	0,91	0,85	0,80
115		0,95	0,88	0,83
130		1,00	0,93	0,87
150			1,00	0,93
175				1,00

SPACING S	Reduction factor Ψ_s Maximum anchor depth			
Anchor size	Ø8	Ø10	Ø12	Ø14
50	0,66	0,62		
70	0,72	0,67	0,65	0,63
100	0,82	0,75	0,71	0,68
130	0,92	0,82	0,77	0,74
155	1,00	0,88	0,82	0,78
200		1,00	0,92	0,86
240			1,00	0,93
275				1,00

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



$$\Psi_{c,N} = 0{,}27 + 0{,}48 \cdot \frac{c}{h_{ef}}$$

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

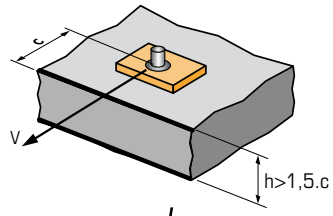
$c_{cr,N} = 1{,}5.h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group.

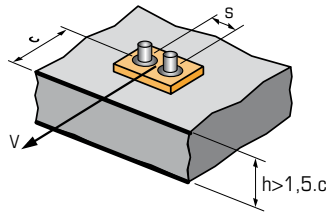
EDGE C	Reduction factor $\Psi_{c,N}$ Minimum anchor depth			
Anchor size	Ø8	Ø10	Ø12	Ø14
50	0,96	0,83	0,75	0,68
55	1,00	0,88	0,80	0,73
60		0,94	0,85	0,77
65		1,00	0,89	0,81
75			1,00	0,89
90				1,00

EDGE C	Reduction factor $\Psi_{c,N}$ Maximum anchor depth			
Anchor size	Ø8	Ø10	Ø12	Ø14
50	0,73	0,62		
65	0,87	0,73		
70	0,92	0,76	0,69	0,64
80	1,00	0,83	0,75	0,69
100		1,00	0,87	0,79
120			1,00	0,90
140				1,00

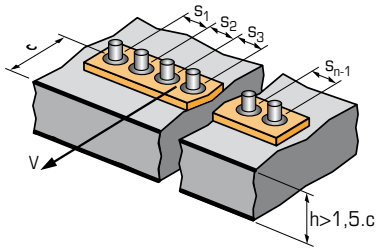
$\Psi_{s-c,V}$ INFLUENCE OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



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



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



For single anchor fastening

	Reduction factor $\Psi_{s-c,V}$ Cracked & non-cracked concrete											
$\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
$\Psi_{s-c,V}$	1,00	1,31	1,66	2,02	2,41	2,83	3,26	3,72	4,19	4,69	5,20	5,72

For 2 anchors fastening

	Reduction factor $\Psi_{s-c,V}$ Cracked & non-cracked concrete											
$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
1,0	0,67	0,84	1,03	1,22	1,43	1,65	1,88	2,12	2,36	2,62	2,89	3,16
1,5	0,75	0,93	1,12	1,33	1,54	1,77	2,00	2,25	2,50	2,76	3,03	3,31
2,0	0,83	1,02	1,22	1,43	1,65	1,89	2,12	2,38	2,63	2,90	3,18	3,46
2,5	0,92	1,11	1,32	1,54	1,77	2,00	2,25	2,50	2,77	3,04	3,32	3,61
3,0	1,00	1,20	1,42	1,64	1,88	2,12	2,37	2,63	2,90	3,18	3,46	3,76
3,5		1,30	1,52	1,75	1,99	2,24	2,50	2,76	3,04	3,32	3,61	3,91
4,0			1,62	1,86	2,10	2,36	2,62	2,89	3,17	3,46	3,75	4,05
4,5				1,96	2,21	2,47	2,74	3,02	3,31	3,60	3,90	4,20
5,0					2,33	2,59	2,87	3,15	3,44	3,74	4,04	4,35
5,5						2,71	2,99	3,28	3,71	4,02	4,33	4,65
6,0						2,83	3,11	3,41	3,71	4,02	4,33	4,65

For 3 anchors fastening and more

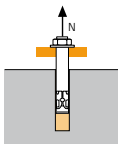
$$\Psi_{s-c,V} = \frac{3.c + s_1 + s_2 + s_3 + \ldots + s_{n-1}}{3.n.c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

TAPCON XTREM

zinc coated & stainless steel version

SPIT CC Method (values issued from ETA - Seismic category C1)

TENSILE in kN

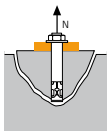


Pull-out resistance

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

$N^0_{Rd,p,C1}$				Design pull-out resistance
Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Category C1 - Single anchor				
h_{nom}	**65**	**85**	**100**	**115**
$N^0_{Rd,p,C1}$	8,0	-	-	-
Category C1 - Group of anchors (1)				
h_{nom}	**65**	**85**	**100**	**115**
$N^0_{Rd,p,C1}$	6,8	-	-	-

(1) when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

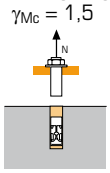


Concrete cone resistance

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

$N^0_{Rd,c,C1}$				Design cone resistance
Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Category C1 - Single anchor				
h_{nom}	**65**	**85**	**100**	**115**
$N^0_{Rd,c,C1}$	7,6	11,4	14,6	18,0
Category C1 - Group of anchors (1)				
h_{nom}	**65**	**85**	**100**	**115**
$N^0_{Rd,c,C1}$	6,7	10,1	12,9	15,9

$\gamma_{Mc} = 1,5$
(1) when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

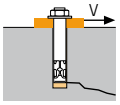


Steel resistance

$N_{Rd,s,C1}$				Steel design tensile resistance
Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
$N_{Rd,s,C1}$	17,9	30,0	45,7	73,6

(1) when more than one anchor of the group is submitted to tensile load
$\gamma_{Ms} = 1,4$

SHEAR in kN

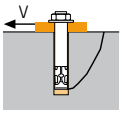


Concrete edge resistance

$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c,C1}$				Design concrete edge resistance at minimum edge distance (C_{min})
Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Category C1 - Single anchor				
h_{nom}	**65**	**85**	**100**	**115**
C_{min}	50	50	70	70
S_{min}	50	50	70	70
$V^0_{Rd,c,C1}$	2,3	3,2	3,3	3,3
Category C1 - Group of anchors (1)				
h_{nom}	**65**	**85**	**100**	**115**
C_{min}	50	50	70	70
S_{min}	50	50	70	70
$V^0_{Rd,c,C1}$	1,9	2,7	2,8	2,8

(1) when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$

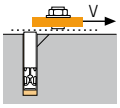


Pryout failure

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

$V^0_{Rd,cp,C1}$				Design pryout resistance
Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Category C1 - Single anchor				
h_{nom}	**65**	**85**	**100**	**115**
$V^0_{Rd,cp,C1}$	15,3	22,9	29,2	36,0
Category C1 - Group of anchors (1)				
h_{nom}	**65**	**85**	**100**	**115**
$V^0_{Rd,cp,C1}$	13,5	20,2	25,8	31,8

$\gamma_{Mc} = 1,5$
(1) when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$



Steel resistance (2)

$V_{Rd,s,C1}$				Steel design shear resistance
Anchor size Zinc coated & A4	Ø8	Ø10	Ø12	Ø14
Category C1 - Single anchor				
$V_{Rd,s,C1}$	6,0	10,2	14,0	17,1
Category C1 - Group of anchors (1)				
$V_{Rd,s,C1}$	5,1	8,7	11,9	14,5

(1) when more than one anchor of the group is submitted to shear load
(2) In case of no hole clearance between anchor and fixture
$\gamma_{Ms} = 1,5$

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

$\beta_N = N_{Sd} / N_{Rd} \leq 1$

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

$\beta_V = V_{Sd} / V_{Rd} \leq 1$

$$\beta_N + \beta_V \leq 1,2$$

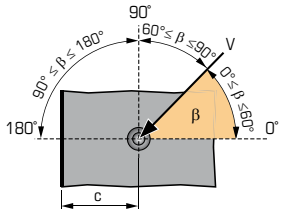
f_b INFLUENCE OF CONCRETE

Concrete class	Cube strength fcc	f_b	Concrete class	Cube strength fcc	f_b
C25/30	30	1,1	C40/50	50	1,41
C30/37	37	1,22	C45/55	55	1,48
C35/45	45	1,34	C50/60	60	1,55

$$f_b = \sqrt{\frac{fcc}{25}}$$

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

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



NOTE

Ramset™

VIPER XTREM TR

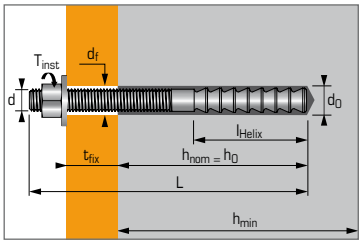
XTREM anchor rod - Zinc coated steel version

Vinylester resin - For use in cracked & non-cracked concrete and seismic performance C1& C2 categories

Product from spit

ETA European Technical Assessment

ETA Option 1- 17/0514



APPLICATION

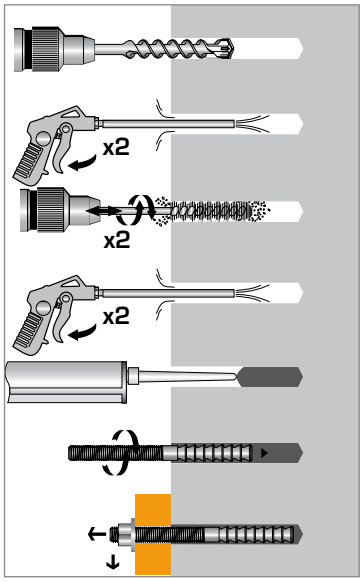
- Steel profiles
- Fixing machinery (resistant to vibration)
- Storage tanks, pipes
- Signs
- Guard rails
- Electrical insulated fixings

MATERIAL

XTREM anchor rod zinc coated steel version:

- **Anchor rod :** Steel grade 8.8 cold form steel NF A35-053
- **Nut :** Steel grade 6 or 8 NF EN 20898-2
- **Washer :** Steel DIN 513
- **Protection :** zinc coated 5 µm min. NF E25-009

INSTALLATION*



***Premium cleaning :**

- 2 blowing with compressed air
- 2 brushing with brushed fitted on a drilling machine
- 2 blowing with compressed air

Technical data

Anchor size	Anchor depth (mm) h_{ef} min.	Anchor depth (mm) h_{ef} max.	Thickness of part to be fixed (mm) t_{fix} max.	Thickness of part to be fixed (mm) t_{fix} min.	Min. thick. of base material (mm) h_{min}	Thread Ø (mm) d	Drilling Ø (mm) d_0	Clearance Ø (mm) d_f	Total anchor length (mm) L	Tighten torque (Nm) T_{inst}	Code* tige multicône XTREM version zinguée
M12X150	60	108	90	42	h_{ef} +30 mm	12	14	14	150	30	060191
M12X205	60	144	145	61		12	14	14	205	30	060192
M16X200	95	144	105	56	h_{ef} +2d_0	16	18	18	200	50	060193
M16X250	95	192	153	44		16	18	18	248	50	060194
M20X270	100	180	170	90		20	22	22	270	150	060195
M20X330	100	240	230	90		20	22	22	330	150	060196
VIPER Vinylester resin, dual component cartridge 410 ml											060201

* For other size, please contact Ramset Technical Department

Anchor mechanical properties

Anchor size		M12	M16	M20
XTREM anchor rod				
f_{uk} (N/mm²)	Min. tensile strength	800	800	800
f_{yk} (N/mm²)	Yield strength	640	640	640
$M^0_{rk,s}$ (Nm)	Characteristic bending moment	105	266	519
M (Nm)	Recommended bending moment	42	106	207

Setting time

Ambient temperature	Max. time for installation	Curing time
5°C	60 min.	240 min.
6°C ▶ 10°C	40 min.	180 min.
11°C ▶ 20°C	15 min.	120 min.
21°C ▶ 30°C	8 min.	60 min.
31°C ▶ 40°C	4 min.	60 min.

Chemical resistance of the SPIT VIPER resin

Chemical substances	Concentration (%)	Resistance
Acetic acid	50-75	(o)
Acetic acid	0-50	(+)
Acetone	10	(+)
Ammonium hydroxide or Ammoniac	20	(o)
Ammonium hydroxide or Ammoniac	5	(+)
Bromine water	5	(+)
Chlorine water	0-100	(+)
Citric acid	0-100	(+)
Concentrated phosphoric acid	100	(+)
Deionized water	0-100	(+)
Demineralized water		(+)
Diesel fuel	0-100	(+)
Ethyl alcohol (Ethanol)	10	(o)
Ethylene glycol	0-100	(+)
Formic acid	10	(+)
Fuel	100	(+)
Heavy motor oil	100	(+)

Chemical substances	Concentration (%)	Resistance
Heptane	100	(+)
Hexane	100	(o)
Hydrochloric acid	25	(o)
Hydrochloric acid	15	(+)
Lactic acid	0-100	(+)
Nitric acid	feb-15	(o)
Phosphoric acid	80	(+)
Phosphoric acid, vapor and condensed		(+)
Sea water	0-100	(+)
Sodium carbonate	10	(+)
Sodium chloride	0-100	(+)
Sodium hydroxide (or Caustic soda)	25	(o)
Sulfuric acid	71-75	(o)
Sulfuric acid	0-70	(+)
Sulfuric acid	Fumes	(+)
Sulfuric acid / Phosphoric acid	10:20	(+)
Turpentine (oil)		(o)

Resistant (+): the samples in contact with the substances did not show any Screwible damage such as cracks, attacked surfaces, burst corners nor large swelling. **Sensitive (o):** use with care regarding exposure of the field of usage, precautions to be taken. The samples in contact with the substance slightly attacked the material.

VIPER XTREM TR

XTREM anchor rod - Zinc coated steel version

Ramset™

For detail design, please refer to CC method in following page.

Number of sealings per cartridge

Anchor size	M12	M16	M20
Drilling diameter (mm)	14	18	22
Drilling depth (mm)	80	90	110
Number of sealings per cartridge			
VIPER 410 ml	38	24	13

Ultimate ($N_{Ru,m}$, $V_{Ru,m}$) and characteristic loads (N_{Rk}, V_{Rk}) in kN

Mean Ultimate loads are derived from test results in admissible service conditions, and characteristic loads are statistically determined.

TENSILE

Anchor size	M12	M16	M20
Non-cracked concrete (C20/25)			
h_{ef}	**60**	**96**	**100**
$N_{Ru,m}$	33,5	66,5	82,6
N_{Rk}	23,4	47,4	50,4
Cracked concrete (C20/25)			
h_{ef}	**60**	**96**	**100**
$N_{Ru,m}$	31,2	56,4	63,6
N_{Rk}	16,8	33,9	36

SHEAR

Anchor size	M12	M16	M20
Cracked & non-cracked concrete (C20/25)			
$V_{Ru,m}$	37	70	108
V_{Rk}	34	63	98

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

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

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

TENSILE

Anchor size	M12	M16	M20
Non-cracked concrete (C20/25)			
h_{ef}	**60**	**96**	**100**
N_{Rd}	15,6	31,6	33,6
Cracked concrete (C20/25)			
h_{ef}	**60**	**96**	**100**
N_{Rd}	11,2	22,6	24

$\gamma_{Mc} = 1,5$

SHEAR

Anchor size	M12	M16	M20
Cracked & non-cracked concrete (C20/25)			
V_{Rd}	27	50,4	78,4

$\gamma_{Ms} = 1,25$

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

$$N_{rec} = \frac{N_{Rk}}{3}$$

$$V_{rec} = \frac{V_{Rk}}{3}$$

TENSILE

Anchor size	M12	M16	M20
Non-cracked concrete (C20/25)			
h_{ef}	**60**	**96**	**100**
N_{rec}	7,8	15,8	16,8
Cracked concrete (C20/25)			
h_{ef}	**60**	**96**	**100**
N_{rec}	5,6	11,3	12

$\gamma = 3$

SHEAR

Anchor size	M12	M16	M20
Cracked & non-cracked concrete (C20/25)			
V_{rec}	11,3	21	32,6

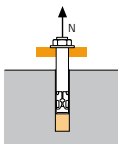
$\gamma = 3$

VIPER XTREM TR

XTREM anchor rod - Zinc coated steel version

SPIT CC Method (values issued from ETA)

TENSILE in kN

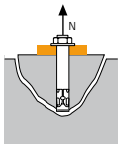


Pull-out resistance for dry and wet concrete [1]

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

$N^0_{Rd,p}$		Design pull-out resistance	
Anchor size	M12	M16	M20
$h_{ef,\ min}$	**60**	**96**	**100**
$h_{ef,\ max}$	**144**	**192**	**240**
Non-cracked concrete (C20/25)			
$N^0_{Rd,p}$	25,6	54,7	71,2
Cracked concrete (C20/25)			
$N^0_{Rd,p}$	25,6	51,5	58,6

$\gamma_{Mc} = 1,5$

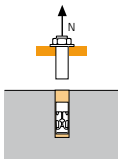


Concrete cone resistance for dry and wet concrete [1]

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

$N^0_{Rd,c}$		Design cone resistance	
Anchor size	M12	M16	M20
$h_{ef,\ min}$	**60**	**96**	**100**
$h_{ef,\ max}$	**144**	**192**	**240**
Non-cracked concrete (C20/25)			
$N^0_{Rd,c}$ ($h_{ef,min}$)	15,6	31,6	33,6
$N^0_{Rd,c}$ ($h_{ef,max}$)	58,1	89,4	124,9
Cracked concrete (C20/25)			
$N^0_{Rd,c}$ ($h_{ef,min}$)	11,2	22,6	24,0
$N^0_{Rd,c}$ ($h_{ef,max}$)	41,5	63,9	89,2

$\gamma_{Mc} = 1,5$



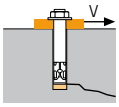
Steel resistance

$N_{Rd,s}$		Steel design tensile resistance	
Anchor size	M12	M16	M20
Xtrem anchor rod Zn.	33,3	59,3	93,3

$\gamma_{Ms} = 1,5$

[1] The concrete in the area of the anchorage is water statured. The anchor may be installed in flooded holes, but the figures above cannot be used, you must use the values given in the ETA for the category 2.

SHEAR in kN

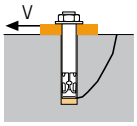


Concrete edge resistance

$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c}$		Design concrete edge resistance at minimum edge distance (C_{min})	
Anchor size	M12	M16	M20
$h_{ef,\ min}$	**60**	**96**	**100**
$h_{ef,\ max}$	**144**	**192**	**240**
C_{min}	55	60	120
S_{min}	55	60	120
Non-cracked concrete (C20/25)			
$V^0_{Rd,c}$ ($h_{ef,min}$)	3,5	5,6	17,0
$V^0_{Rd,c}$ ($h_{ef,max}$)	4,5	6,9	21,7
Cracked concrete (C20/25)			
$V^0_{Rd,c}$ ($h_{ef,min}$)	2,5	4,0	12,2
$V^0_{Rd,c}$ ($h_{ef,max}$)	3,2	4,9	15,5

$\gamma_{Mc} = 1,5$

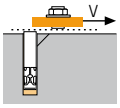


Pryout failure

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

$V^0_{Rd,cp}$		Design pryout resistance	
Anchor size	M12	M16	M20
$h_{ef,\ min}$	**60**	**96**	**100**
$h_{ef,\ max}$	**144**	**192**	**240**
Non-cracked concrete (C20/25)			
$V^0_{Rd,cp}$ ($h_{ef,min}$)	31,2	63,2	67,2
$V^0_{Rd,cp}$ ($h_{ef,max}$)	39,2	83,6	108,9
Cracked concrete (C20/25)			
$V^0_{Rd,cp}$ ($h_{ef,min}$)	15,1	35,4	48,0
$V^0_{Rd,cp}$ ($h_{ef,max}$)	15,1	35,4	50,3

$\gamma_{Mcp} = 1,5$



Steel resistance

$V_{Rd,s}$		Steel design shear resistance	
Anchor size	M12	M16	M20
Xtrem anchor rod Zn.	27,2	50,4	78,4

$\gamma_{Ms} = 1,25$

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

$\beta_N = N_{Sd} / N_{Rd} \leq 1$

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

$\beta_V = V_{Sd} / V_{Rd} \leq 1$

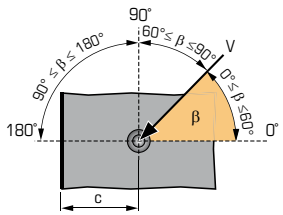
$$\beta_N + \beta_V \leq 1,2$$

f_b INFLUENCE OF CONCRETE

Concrete class	f_b Cracked & non-cracked concrete		
	M12	M16	M20
C25/30	1,02	1,02	1,07
C30/37	1,08	1,08	1,17
C40/50	1,15	1,15	1,32
C50/60	1,19	1,19	1,42

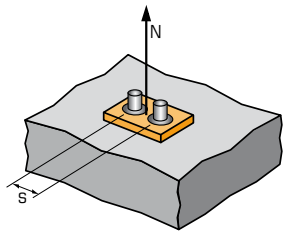
$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



SPIT CC Method (values issued from ETA)

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0{,}5 + \frac{s}{6.h_{ef}}$$

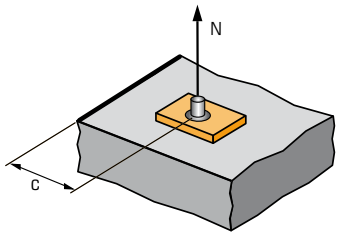
$s_{min} < s < s_{cr,N}$

$s_{cr,N} = 3.h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group.

SPACING S	Reduction factor Ψ_s Cracked & non-cracked concrete		
Anchor size	M12	M16	M20
40	0,61		
50	0,64		
60	0,67	0,60	
80	0,72	0,64	
100	0,78	0,67	0,67
150	0,92	0,76	0,75
200	1,00	0,85	0,83
240	1,00	0,92	0,90
300	1,00	1,00	1,00
360		1,00	1,00
480			1,00
600			1,00

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



$$\Psi_{c,N} = 0{,}25 + 0{,}5 \cdot \frac{c}{h_{ef}}$$

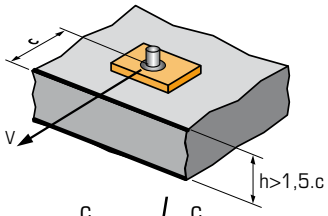
$c_{min} < c < c_{cr,N}$

$c_{cr,N} = 1{,}5.h_{ef}$

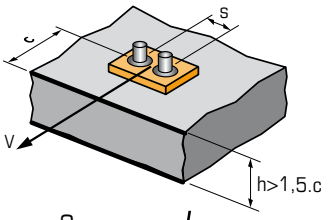
$\Psi_{c,N}$ must be used for each distance influenced the anchors group.

EDGE C	Reduction factor $\Psi_{c,N}$ Cracked & non-cracked concrete		
Anchor size	M12	M16	M20
40	0,58		
45	0,63	0,48	
50	0,67	0,51	0,50
65	0,79	0,59	0,58
80	0,92	0,67	0,65
120	1,00	0,88	0,85
150		1,00	1,00
180		1,00	1,00
240			1,00
300			1,00

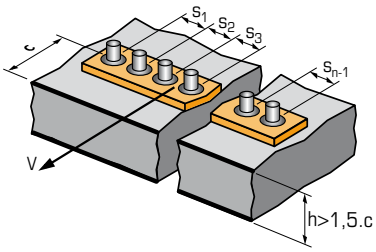
$\Psi_{s-c,V}$ INFLUENCE OF SPACING AND EDGE DISTANCE FOR CONCRETE EDGE RESISTANCE IN SHEAR LOAD



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



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



For single anchor fastening

Reduction factor $\Psi_{s-c,V}$ Cracked & non-cracked concrete

$\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
$\Psi_{s-c,V}$	1,00	1,31	1,66	2,02	2,41	2,83	3,26	3,72	4,19	4,69	5,20	5,72

For 2 anchors fastening

Reduction factor $\Psi_{s-c,V}$ Cracked & non-cracked concrete

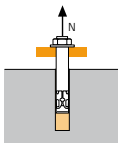
$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
1,0	0,67	0,84	1,03	1,22	1,43	1,65	1,88	2,12	2,36	2,62	2,89	3,16
1,5	0,75	0,93	1,12	1,33	1,54	1,77	2,00	2,25	2,50	2,76	3,03	3,31
2,0	0,83	1,02	1,22	1,43	1,65	1,89	2,12	2,38	2,63	2,90	3,18	3,46
2,5	0,92	1,11	1,32	1,54	1,77	2,00	2,25	2,50	2,77	3,04	3,32	3,61
3,0	1,00	1,20	1,42	1,64	1,88	2,12	2,37	2,63	2,90	3,18	3,46	3,76
3,5		1,30	1,52	1,75	1,99	2,24	2,50	2,76	3,04	3,32	3,61	3,91
4,0			1,62	1,86	2,10	2,36	2,62	2,89	3,17	3,46	3,75	4,05
4,5				1,96	2,21	2,47	2,74	3,02	3,31	3,60	3,90	4,20
5,0					2,33	2,59	2,87	3,15	3,44	3,74	4,04	4,35
5,5						2,71	2,99	3,28	3,71	4,02	4,33	4,65
6,0						2,83	3,11	3,41	3,71	4,02	4,33	4,65

For 3 anchors fastening and more

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

SPIT CC Method (values issued from ETA - Seismic category C1)

TENSILE in kN

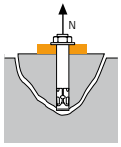


Pull-out resistance

$$N_{Rd,p,C1} = N^0_{Rd,p,C1} \cdot f_b$$

$N^0_{Rd,p,C1}$		Design pull-out resistance	
Anchor size	M12	M16	M20
Category C1 - Single anchor			
h_{ef}	**60**	**96**	**120**
$N^0_{Rd,p,C1}$ (C20/25)	25,6	43,8	49,8
Category C1 - Group of anchors [1]			
h_{ef}	**60**	**96**	**120**
$N^0_{Rd,p,C1}$ (C20/25)	21,8	37,2	42,4

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

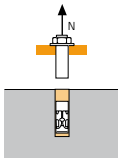


Concrete cone resistance

$$N_{Rd,c,C1} = N^0_{Rd,c,C1} \cdot f_b \cdot \Psi_s \cdot \Psi_{c,N}$$

$N^0_{Rd,c,C1}$		Design cone resistance	
Anchor size	M12	M16	M20
$h_{ef,\ min}$	**60**	**96**	**100**
$h_{ef,\ max}$	**144**	**192**	**240**
Category C1 - Single anchor			
$N^0_{Rd,c,C1}$ ($h_{ef,min}$)	9,5	19,2	20,4
$N^0_{Rd,c,C1}$ ($h_{ef,max}$)	35,3	54,3	75,8
Category C1 - Group of anchors [1]			
$N^0_{Rd,c,C1}$ ($h_{ef,min}$)	8,4	16,9	18,0
$N^0_{Rd,c,C1}$ ($h_{ef,max}$)	31,1	47,9	66,9

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$



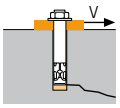
Steel resistance

$N_{Rd,s,C1}$		Steel design tensile resistance	
Anchor size	M12	M16	M20
Xtrem anchor rod Zn.	33,3	59,3	93,3

$\gamma_{Ms} = 1,5$

[1] The concrete in the area of the anchorage is water statured. The anchor may be installed in flooded holes, but the figures above cannot be used, you must use the values given in the ETA for the category 2.

SHEAR in kN

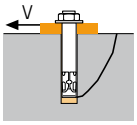


Concrete edge resistance

$$V_{Rd,c,C1} = V^0_{Rd,c,C1} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$$

$V^0_{Rd,c,C1}$		Design concrete edge resistance at minimum edge distance (C_{min})	
Anchor size	M12	M16	M20
$h_{ef,\ min}$	**60**	**96**	**100**
$h_{ef,\ max}$	**144**	**192**	**240**
C_{min}	50	60	120
S_{min}	50	60	120
Category C1 - Single anchor			
$V^0_{Rd,c,C1}$ ($h_{ef,min}$)	2,5	4,0	12,2
$V^0_{Rd,c,C1}$ ($h_{ef,max}$)	3,0	4,6	14,5
Category C1 - Group of anchors [1]			
$V^0_{Rd,c,C1}$ ($h_{ef,min}$)	2,2	3,4	10,3
$V^0_{Rd,c,C1}$ ($h_{ef,max}$)	2,6	3,9	12,3

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$

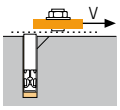


Pryout failure

$$V_{Rd,cp,C1} = V^0_{Rd,cp,C1} \cdot f_b \cdot \Psi_s \cdot \Psi_{c,N}$$

$V^0_{Rd,cp,C1}$		Design pryout resistance	
Anchor size	M12	M16	M20
Category C1 - Single anchor			
h_{ef}	**60**	**96**	**100**
$V^0_{Rd,cp,C1}$ (C20/25)	12,8	25,6	36,3
Category C1 - Group of anchors [1]			
h_{ef}	**60**	**96**	**100**
$V^0_{Rd,cp,C1}$ (C20/25)	12,8	25,6	36,0

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mcp} = 1,5$



Steel resistance

$V_{Rd,s,C1}$		Steel design tensile resistance	
Anchor size	M12	M16	M20
Category C1 - Single anchor			
Xtrem anchor rod Zn.	19,0	35,3	54,9
Category C1 - Group of anchors [1]			
Xtrem anchor rod Zn.	16,2	30,0	46,6

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Ms} = 1,25$

$$N_{Rd,C1} = \min(N_{Rd,p,C1}\ ;\ N_{Rd,c,C1}\ ;\ N_{Rd,s,C1})$$
$$\beta_N = N_{Sd} / N_{Rd,C1} \leq 1$$

$$V_{Rd,C1} = \min(V_{Rd,c,C1}\ ;\ V_{Rd,cp,C1}\ ;\ V_{Rd,s,C1})$$
$$\beta_V = V_{Sd} / V_{Rd,C1} \leq 1$$

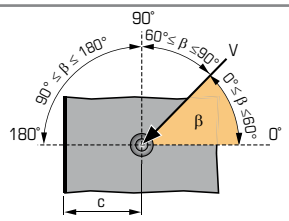
$$\beta_N + \beta_V \leq 1,2$$

f_b INFLUENCE OF CONCRETE

Concrete class	f_b Cracked & non-cracked concrete		
	M12	M16	M20
C25/30	1,02	1,02	1,07
C30/37	1,08	1,08	1,17
C40/50	1,15	1,15	1,32
C50/60	1,19	1,19	1,42

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

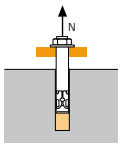
Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



Ramset™

SPIT CC Method (values issued from ETA - Seismic category C2)

TENSILE in kN

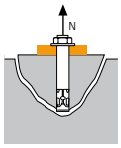


Résistance à la rupture extraction-glissement

$N_{Rd,p,C2} = N^0_{Rd,p,C2} \cdot f_b$

$N^0_{Rd,p,C2}$		Design pull-out resistance	
Anchor size	M12	M16	M20
Category C2 - Single anchor			
h_{ef}	**60**	**96**	**120**
$N^0_{Rd,p,C2}$ (C20/25)	10,6	30,6	29,3
Category C2 - Group of anchors [1]			
h_{ef}	**60**	**96**	**120**
$N^0_{Rd,p,C2}$ (C20/25)	9,0	26,0	24,9

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

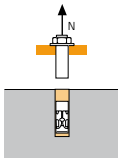


Concrete cone resistance

$N_{Rd,c,C2} = N^0_{Rd,c,C2} \cdot f_b \cdot \Psi_s \cdot \Psi_{c,N}$

$N^0_{Rd,c,C2}$		Design cone resistance	
Anchor size	M12	M16	M20
$h_{ef,\ min}$	**60**	**96**	**100**
$h_{ef,\ max}$	**144**	**192**	**240**
Category C2 - Single anchor			
$N^0_{Rd,c,C2}$ ($h_{ef,min}$)	9,5	19,2	20,4
$N^0_{Rd,c,C2}$ ($h_{ef,max}$)	35,3	54,3	75,8
Category C2 - Group of anchors [1]			
$N^0_{Rd,c,C2}$ ($h_{ef,min}$)	8,4	16,9	18,0
$N^0_{Rd,c,C2}$ ($h_{ef,max}$)	31,1	47,9	66,9

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$



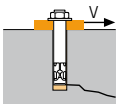
Steel resistance

$N_{Rd,s,C2}$		Steel design tensile resistance	
Anchor size	M12	M16	M20
Xtrem anchor rod Zn.	33,3	59,3	93,3

$\gamma_{Ms} = 1,5$

[1] The concrete in the area of the anchorage is water statured. The anchor may be installed in flooded holes, but the figures above cannot be used, you must use the values given in the ETA for the category 2.

SHEAR in kN

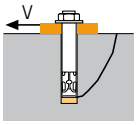


Concrete edge resistance

$V_{Rd,c,C2} = V^0_{Rd,c,C2} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c,C2}$		Design concrete edge resistance at minimum edge distance (C_{min})	
Anchor size	M12	M16	M20
$h_{ef,\ min}$	**60**	**96**	**100**
$h_{ef,\ max}$	**144**	**192**	**240**
C_{min}	50	60	120
S_{min}	50	60	120
Category C2 - Single anchor			
$V^0_{Rd,c,C2}$ ($h_{ef,min}$)	2,5	4,0	12,2
$V^0_{Rd,c,C2}$ ($h_{ef,max}$)	3,0	4,6	14,5
Category C2 - Group of anchors [1]			
$V^0_{Rd,c,C2}$ ($h_{ef,min}$)	2,2	3,4	10,3
$V^0_{Rd,c,C2}$ ($h_{ef,max}$)	2,6	3,9	12,3

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$

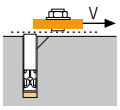


Pryout failure

$V_{Rd,cp,C2} = V^0_{Rd,cp,C2} \cdot f_b \cdot \Psi_s \cdot \Psi_{c,N}$

$V^0_{Rd,cp,C2}$		Design pryout resistance	
Anchor size	M12	M16	M20
Category C2 - Single anchor			
h_{ef}	**60**	**96**	**100**
$V^0_{Rd,cp,C2}$ (C20/25)	17,9	4,6	6,1
Category C2 - Group of anchors [1]			
h_{ef}	**60**	**96**	**100**
$V^0_{Rd,cp,C2}$ (C20/25)	16,7	4,6	6,1

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mcp} = 1,5$



Steel resistance

$V_{Rd,s,C2}$		Steel design shear resistance	
Anchor size	M12	M16	M20
Category C2 - Single anchor			
Xtrem anchor rod Zn.	19,0	35,3	54,9
Category C2 - Group of anchors [1]			
Xtrem anchor rod Zn.	16,2	30,0	46,6

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Ms} = 1,25$

$N_{Rd,C2} = \min(N_{Rd,p,C2}\ ;\ N_{Rd,c,C2}\ ;\ N_{Rd,s,C2})$
$\beta_N = N_{Sd} / N_{Rd,C2} \leq 1$

$V_{Rd,C2} = \min(V_{Rd,c,C2}\ ;\ V_{Rd,cp,C2}\ ;\ V_{Rd,s,C2})$
$\beta_V = V_{Sd} / V_{Rd,C2} \leq 1$

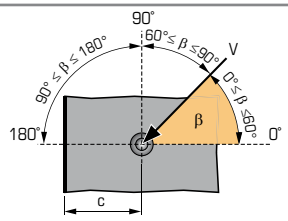
$$\beta_N + \beta_V \leq 1,2$$

f_b INFLUENCE OF CONCRETE

Concrete class	f_b Cracked & non-cracked concrete		
	M12	M16	M20
C25/30	1,02	1,02	1,07
C30/37	1,08	1,08	1,17
C40/50	1,15	1,15	1,32
C50/60	1,19	1,19	1,42

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

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



Chemical Anchors

Ramset™

VIPER XTREM TR

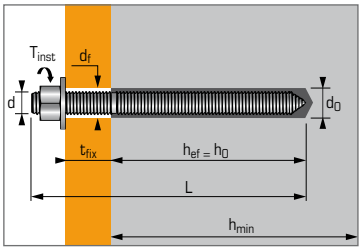
STANDARD EMBEDMENT - Zinc coated & stainless steel studs

Vinylester resin - For use in cracked & non-cracked concrete and seismic performance C1 category

Product from spit

ETA European Technical Assessment

ETA Option 1- 17/0514



APPLICATION

- Steel profiles
- Fixing machinery (resistant to vibration)
- Storage tanks, pipes
- Signs
- Guard rails
- Electrical insulated fixings

MATERIAL

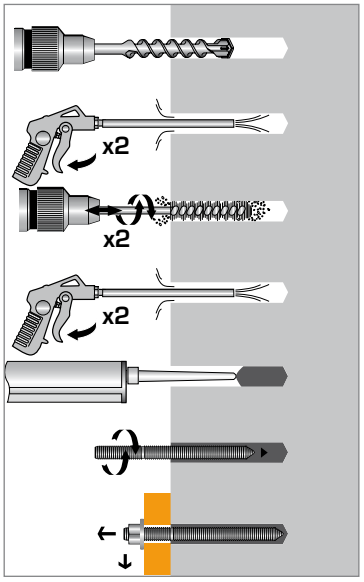
Zinc coated steel version :

- **Stud M8-M16 :** Steel cold form steel NF A35-053
- **Stud M20-M30 :** 11 SMnPb37 - NFA 35-561
- **Nut :** Steel grade 6 or 8 NF EN 20898-2
- **Washer :** Steel DIN 513
- **Protection :** zinc coated 5 µm min. NF E25-009

Stainless steel version :

- **Stud :** A4-70 as per ISO 3506-1
- **Nut :** Stainless steel A4-80, NF EN 10088-3
- **Washer :** Stainless steel A4, NF EN 20898-2

INSTALLATION*



***Premium cleaning :**

- 2 blowing with compressed air
- 2 brushing with brushed fitted on a drilling machine
- 2 blowing with compressed air

Technical data

Anchor size	Min. anchor depth (mm) h_{ef}	Max. thick. of part to be fixed (mm) t_{fix}	Min. thick. of base material (mm) h_{min}	Thread diameter (mm) d	Drilling depth (mm) h_0	Drilling diameter (mm) d_0	Clearance diameter (mm) d_f	Total anchor length (mm) L	Tighten torque (Nm) T_{inst}	Code* MAXIMA stud zinc coated st.	Code* MAXIMA stud stainless steel A4
M8X110	80	15	110	8	80	10	9	110	10	050950	052400
M10X130	90	20	120	10	90	12	12	130	20	050960	052410
M12X160	110	25	140	12	110	14	14	160	30	050970	052420
M16X190	125	35	160	16	125	18	18	190	60	050980	052440
M20X260	170	65	220	20	170	25	22	260	120	655220	052450
M24X300	210	63	265	24	210	28	26	300	200	655240	052470
M30X380	280	70	350	30	280	35	33	380	400	050940	-
VIPER Vinylester resin, dual component cartridge 410 ml										060201	

* These are Maxima studs, for standard studs (zinc coated or stainless steel versions) see catalogue.

Anchor mechanical properties

Anchor size		M8	M10	M12	M16	M20	M24	M30
MAXIMA stud - zinc coated steel version								
f_{uk} (N/mm²)	Min. tensile strength	600	600	600	600	520	520	520
f_{yk} (N/mm²)	Yield strength	420	420	420	420	420	420	420
$M^0_{rk,s}$ (Nm)	Characteristic bending moment	22	45	79	200	301	520	1052
M (Nm)	Recommended bending moment	11,0	22,5	39,5	100	150	160	525
MAXIMA stud - stainless steel A4 version								
f_{uk} (N/mm²)	Min. tensile strength	700	700	700	700	700	700	-
f_{yk} (N/mm²)	Yield strength	350	350	350	350	350	350	-
$M^0_{rk,s}$ (Nm)	Characteristic bending moment	26	52	92	233	454	786	-
M (Nm)	Recommended bending moment	12	23	42	122	206	357	-
As (mm²)	Stressed cross-section	36,6	58	84,3	157	227	326,9	-
W_{el} (mm³)	Elastic section modulus	31,2	62,3	109,2	277,5	482,4	833,7	-

Setting time

Ambient temperature	Max. time for installation	Curing time
5°C	60 min.	240 min.
6°C ▶ 10°C	40 min.	180 min.
11°C ▶ 20°C	15 min.	120 min.
21°C ▶ 30°C	8 min.	60 min.
31°C ▶ 40°C	4 min.	60 min.

Chemical resistance of the SPIT VIPER resin

Chemical substances	Concentration (%)	Resistance
Acetic acid	50-75	(o)
Acetic acid	0-50	(+)
Acetone	10	(+)
Ammonium hydroxide or Ammoniac	20	(o)
Ammonium hydroxide or Ammoniac	5	(+)
Bromine water	5	(+)
Chlorine water	0-100	(+)
Citric acid	0-100	(+)
Concentrated phosphoric acid	100	(+)
Deionized water	0-100	(+)
Demineralized water		(+)
Diesel fuel	0-100	(+)
Ethyl alcohol (Ethanol)	10	(o)
Ethylene glycol	0-100	(+)
Formic acid	10	(+)
Fuel	100	(+)
Heavy motor oil	100	(+)

Chemical substances	Concentration (%)	Resistance
Heptane	100	(+)
Hexane	100	(o)
Hydrochloric acid	25	(o)
Hydrochloric acid	15	(+)
Lactic acid	0-100	(+)
Nitric acid	feb-15	(o)
Phosphoric acid	80	(+)
Phosphoric acid, vapor and condensed		(+)
Sea water	0-100	(+)
Sodium carbonate	10	(+)
Sodium chloride	0-100	(+)
Sodium hydroxide (or Caustic soda)	25	(o)
Sulfuric acid	71-75	(o)
Sulfuric acid	0-70	(+)
Sulfuric acid	Fumes	(+)
Sulfuric acid/Phosphoric acid	10:20	(+)
Turpentine (oil)		(o)

Resistant (+): the samples in contact with the substances did not show any Screwible damage such as cracks, attacked surfaces, burst corners nor large swelling. **Sensitive (o):** use with care regarding exposure of the field of usage, precautions to be taken. The samples in contact with the substance slightly attacked the material.

VIPER XTREM TR

STANDARD EMBEDMENT - Zinc coated & stainless steel studs

Ramset™

For detail design, please refer to CC method in following page.

Number of sealings per cartridge

Anchor size	M8	M10	M12	M16	M20	M24	M30
Drilling diameter (mm)	10	12	14	18	25	28	35
Drilling depth (mm)	80	90	110	125	170	210	280
Number of sealings per cartridge							
VIPER 410 ml	87	59	38	24	8	5	3

Ultimate ($N_{Ru,m}$, $V_{Ru,m}$) and characteristic loads (N_{Rk}, V_{Rk}) in kN

Mean Ultimate loads are derived from test results in admissible service conditions, and characteristic loads are statistically determined.

TENSILE

Anchor size	M8	M10	M12	M16	M20	M24	M30
Non-cracked concrete (C20/25)							
h_{ef}	**80**	**90**	**110**	**125**	**170**	**210**	**280**
$N_{Ru,m}$	40,7	57,3	84,0	107,4	159,4	212,6	308,8
N_{Rk}	29,0	42,5	58,2	70,5	111,8	153,5	224,3
Cracked concrete (C20/25)							
h_{ef}	**80**	**90**	**110**	**125**	**170**	**210**	**280**
$N_{Ru,m}$	26,9	35,3	49,0	68,1	108,2	151,7	236,4
N_{Rk}	13,3	18,5	27,0	40,8	69,5	102,9	158,4

SHEAR

Anchor size	M8	M10	M12	M16	M20	M24	M30
Cracked & non-cracked concrete(C20/25)							
V_{Rk}	14,6	23,3	33,8	63,0	98,0	141,0	224,0

* Base on stud grade 8.8

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

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

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

TENSILE

Anchor size	M8	M10	M12	M16	M20	M24	M30
Non-cracked concrete (C20/25)							
h_{ef}	**80**	**90**	**110**	**125**	**170**	**210**	**280**
N_{Rd}	19,3	28,3	38,8	47,0	74,5	102,3	149,5
Cracked concrete (C20/25)							
h_{ef}	**80**	**90**	**110**	**125**	**170**	**210**	**280**
N_{Rd}	8,7	12,3	18,0	27,2	46,3	68,6	105,6

γ_{Mc} = 1,5

SHEAR

Anchor size	M8	M10	M12	M16	M20	M24	M30
Cracked & non-cracked concrete (C20/25)							
V_{Rd}	11,7	18,6	27,0	50,4	78,4	112,8	179,2

γ_{Ms} = 1,25

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

$$N_{rec} = \frac{N_{Rk}}{3}$$

$$V_{rec} = \frac{V_{Rk}}{3}$$

TENSILE

Anchor size	M8	M10	M12	M16	M20	M24	M30
Non-cracked concrete (C20/25)							
h_{ef}	**80**	**90**	**110**	**125**	**170**	**210**	**280**
N_{rec}	9,7	14,2	19,4	23,5	37,3	51,2	74,8
Cracked concrete (C20/25)							
h_{ef}	**80**	**90**	**110**	**125**	**170**	**210**	**280**
N_{rec}	4,4	6,2	9,0	13,6	23,3	34,3	52,8

γ = 3

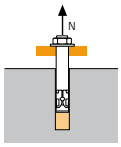
SHEAR

Anchor size	M8	M10	M12	M16	M20	M24	M30
Cracked & non-cracked concrete (C20/25)							
V_{rec}	4,9	7,8	11,3	21,0	32,7	47,0	74,7

γ = 3

SPIT CC Method (values issued from ETA)

TENSILE in kN

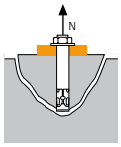


Pull-out resistance for dry and wet concrete (1)

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

$N^0_{Rd,p}$							Design pull-out resistance
Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef}	80	90	110	125	170	210	280
Non-cracked concrete	20,1	28,3	41,5	54,5	78,3	105,6	149,5
Cracked concrete	8,7	12,3	18,0	27,2	46,3	68,6	105,6

$\gamma_{Mc} = 1,5$

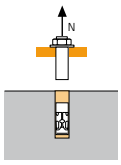


Concrete cone resistance for dry and wet concrete (1)

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

$N^0_{Rd,c}$							Design cone resistance
Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef}	80	90	110	125	170	210	280
Non-cracked concrete	24,0	28,7	38,8	47,0	74,5	102,3	157,4
Cracked concrete	17,2	20,5	27,7	33,5	53,2	73,0	112,4

$\gamma_{Mc} = 1,5$



Steel resistance

$N_{Rd,s}$							Steel design tensile resistance
Anchor size	M8	M10	M12	M16	M20	M24	M30
MAXIMA stud Zn.	12,9	20,5	29,8	55,6	79,2	114,1	182,6
MAXIMA stud A4	12,3	19,8	28,9	54,5	85,0	122,5	-
Std. stud grade 5.8*	12,0	19,3	28,0	52,0	81,3	118,0	186,7
Std. stud grade 8.8*	19,3	30,7	44,7	84,0	130,7	188,0	299,3
Std. stud grade 10.9*	26,4	41,4	60,0	112,1	175,0	252,1	400,7

MAXIMA stud Zn. : $\gamma_{Ms} = 1,71$ for M8 to M16 and $\gamma_{Ms} = 2,49$ for M20 to M30

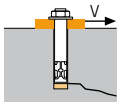
MAXIMA stud A4 : $\gamma_{Ms} = 1,87$

Std. stud grade 5.8 and 8.8 : $\gamma_{Ms} = 1,5$ and grade 10.9 : $\gamma_{Ms} = 1,4$

* Special grade available on request.

(1) The concrete in the area of the anchorage is water statured. The anchor may be installed in flooded holes, but the figures above cannot be used, you must use the values given in the ETA for the category 2.

SHEAR in kN

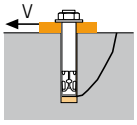


Concrete edge resistance

$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c}$							Design concrete edge resistance at minimum edge distance (C_{min})
Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef}	80	90	110	125	170	210	280
C_{min}	40	45	45	50	55	60	80
S_{min}	40	50	60	75	90	115	140
Non-cracked concrete	2,4	3,6	5,3	9,1	14,4	20,9	33,0
Cracked concrete	1,7	2,6	3,8	6,5	10,3	14,9	23,6

$\gamma_{Mc} = 1,5$

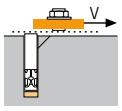


Pryout failure

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

$V^0_{Rd,cp}$							Design pryout resistance
Anchor size	M8	M10	M12	M16	M20	M24	M30
h_{ef}	80	90	110	125	170	210	280
Non-cracked concrete	40,2	56,5	77,5	93,9	149,0	204,5	299,1
Cracked concrete	17,4	24,5	35,9	54,5	92,6	137,2	211,1

$\gamma_{Mcp} = 1,5$



Steel resistance

$V_{Rd,s}$							Steel design shear resistance
Anchor size	M8	M10	M12	M16	M20	M24	M30
MAXIMA stud Zn.	7,7	12,2	17,7	32,9	39,3	56,7	90,7
MAXIMA stud A4	7,3	11,9	17,3	32,7	51,3	73,1	-
Std. stud grade 5.8*	7,4	11,6	16,9	31,2	48,8	70,4	112,0
Std. stud grade 8.8*	11,7	18,6	27,0	50,4	78,4	112,8	179,2
Std. stud grade 10.9*	12,2	19,3	28,1	52,0	81,3	117,3	186,7

MAXIMA stud Zn. : $\gamma_{Ms} = 1,43$ for M8 to M16 and $\gamma_{Ms} = 1,5$ for M20 to M30

MAXIMA stud A4 : $\gamma_{Ms} = 1,56$

Std. stud grade 5.8 and 8.8 : $\gamma_{Ms} = 1,25$ and grade 10.9 : $\gamma_{Ms} = 1,5$

* Special grade available on request.

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

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

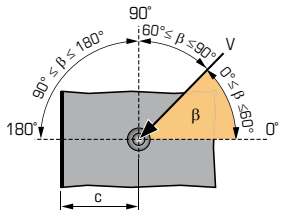
$$\beta_N + \beta_V \leq 1,2$$

f_b INFLUENCE OF CONCRETE

Concrete class	f_b Non-cracked concrete		f_b Cracked concrete
	M8-M16	M20-M30	M8-M30
C25/30	1,02	1,06	1,00
C30/37	1,04	1,12	1,00
C40/50	1,07	1,23	1,00
C50/60	1,09	1,30	1,00

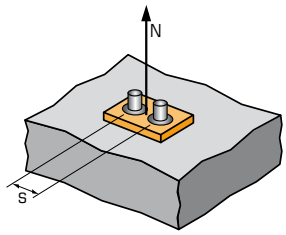
$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



SPIT CC Method (values issued from ETA)

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0{,}5 + \frac{s}{6.h_{ef}}$$

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

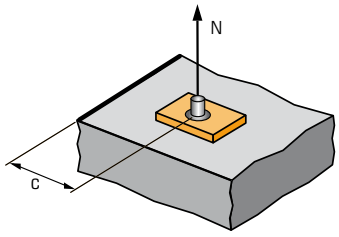
$s_{cr,N} = 3.h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group.

SPACING S	Reduction factor Ψ_s Cracked & non-cracked concrete			
Anchor size	M8	M10	M12	M16
40	0,58			
50	0,60	0,59		
60	0,63	0,61	0,59	
75	0,66	0,64	0,61	0,60
100	0,71	0,69	0,65	0,63
150	0,81	0,78	0,73	0,70
200	0,92	0,87	0,80	0,77
240	1,00	0,94	0,86	0,82
270		1,00	0,91	0,86
330			1,00	0,94
375				1,00

SPACING S	Reduction factor Ψ_s Cracked & non-cracked concrete		
Anchor size	M20	M24	M30
90	0,59		
115	0,61	0,59	
140	0,64	0,61	0,58
180	0,68	0,64	0,61
200	0,70	0,66	0,62
250	0,75	0,70	0,65
350	0,84	0,78	0,71
450	0,94	0,86	0,77
510	1,00	0,90	0,80
630		1,00	0,88
750			0,95
840			1,00

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



$$\Psi_{c,N} = 0{,}25 + 0{,}5 \cdot \frac{c}{h_{ef}}$$

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

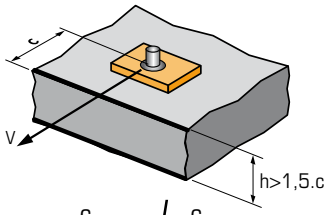
$c_{cr,N} = 1{,}5.h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group.

EDGE C	Reduction factor $\Psi_{c,N}$ Cracked & non-cracked concrete			
Anchor size	M8	M10	M12	M16
40	0,50			
45	0,53	0,50	0,45	
50	0,56	0,53	0,48	0,45
75	0,72	0,67	0,59	0,55
100	0,88	0,81	0,70	0,65
120	1,00	0,92	0,80	0,73
135		1,00	0,86	0,79
165			1,00	0,91
190				1,00

EDGE C	Reduction factor $\Psi_{c,N}$ Cracked & non-cracked concrete		
Anchor size	M20	M24	M30
55	0,41		
60	0,43	0,39	
80	0,49	0,44	0,39
150	0,69	0,61	0,52
200	0,84	0,73	0,61
255	1,00	0,86	0,71
315		1,00	0,81
420			1,00

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

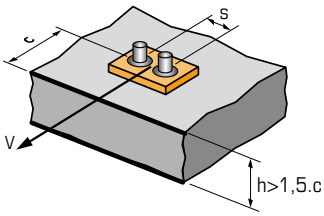


$$\Psi_{s-c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

For single anchor fastening

Reduction factor $\Psi_{s-c,V}$ Cracked & non-cracked concrete

$\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
$\Psi_{s-c,V}$	1,00	1,31	1,66	2,02	2,41	2,83	3,26	3,72	4,19	4,69	5,20	5,72

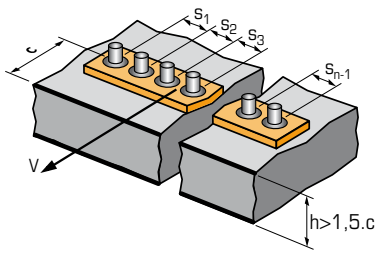


$$\Psi_{s-c,V} = \frac{3.c + s}{6.c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

For 2 anchors fastening

Reduction factor $\Psi_{s-c,V}$ Cracked & non-cracked concrete

$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
1,0	0,67	0,84	1,03	1,22	1,43	1,65	1,88	2,12	2,36	2,62	2,89	3,16
1,5	0,75	0,93	1,12	1,33	1,54	1,77	2,00	2,25	2,50	2,76	3,03	3,31
2,0	0,83	1,02	1,22	1,43	1,65	1,89	2,12	2,38	2,63	2,90	3,18	3,46
2,5	0,92	1,11	1,32	1,54	1,77	2,00	2,25	2,50	2,77	3,04	3,32	3,61
3,0	1,00	1,20	1,42	1,64	1,88	2,12	2,37	2,63	2,90	3,18	3,46	3,76
3,5		1,30	1,52	1,75	1,99	2,24	2,50	2,76	3,04	3,32	3,61	3,91
4,0			1,62	1,86	2,10	2,36	2,62	2,89	3,17	3,46	3,75	4,05
4,5				1,96	2,21	2,47	2,74	3,02	3,31	3,60	3,90	4,20
5,0					2,33	2,59	2,87	3,15	3,44	3,74	4,04	4,35
5,5						2,71	2,99	3,28	3,71	4,02	4,33	4,65
6,0						2,83	3,11	3,41	3,71	4,02	4,33	4,65

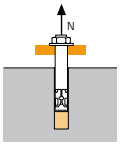


For 3 anchors fastening and more

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

SPIT CC Method (values issued from ETA - Seismic category C1)

TENSILE in kN

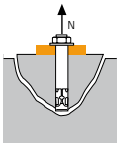


Pull-out resistance

$$N_{Rd,p,C1} = N^0_{Rd,p,C1} \cdot f_b$$

$N^0_{Rd,p,C1}$							Design pull-out resistance
Anchor size	M8	M10	M12	M16	M20	M24	M30
Category C1 - Single anchor							
h_{ef}	**80**	**90**	**110**	**125**	**170**	**210**	**280**
$N^0_{Rd,p,C1}$ (C20/25)	8,0	11,6	18,0	25,6	44,4	68,6	105,6
Category C1 - Group of anchors [1]							
h_{ef}	**80**	**90**	**110**	**125**	**170**	**210**	**280**
$N^0_{Rd,p,C1}$ (C20/25)	6,8	9,9	15,3	21,8	37,8	58,3	89,7

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

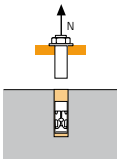


Concrete cone resistance

$$N_{Rd,c,C1} = N^0_{Rd,c,C1} \cdot f_b \cdot \Psi_s \cdot \Psi_{c,N}$$

$N^0_{Rd,c,C1}$							Design cone resistance
Anchor size	M8	M10	M12	M16	M20	M24	M30
Category C1 - Single anchor							
h_{ef}	**80**	**90**	**110**	**125**	**170**	**210**	**280**
$N^0_{Rd,c,C1}$ (C20/25)	14,6	17,4	23,5	28,5	45,2	62,1	95,6
Category C1 - Group of anchors [1]							
h_{ef}	**80**	**90**	**110**	**125**	**170**	**210**	**280**
$N^0_{Rd,c,C1}$ (C20/25)	12,9	15,4	20,8	25,2	39,9	54,8	84,3

[1] when more than one anchor of the group is submitted to tensile load
$\gamma_{Mc} = 1,5$

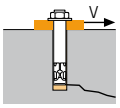


Steel resistance

$N_{Rd,s,C1}$							Steel design tensile resistance
Anchor size	M8	M10	M12	M16	M20	M24	M30
MAXIMA stud Zn.	12,9	20,5	29,8	55,6	69,0	99,4	159,1
MAXIMA stud A4	13,9	21,9	31,6	58,8	92,0	132,1	98,3
Std. stud grade 5.8	12,0	19,3	28,0	52,7	82,0	118,0	187,3
Std. stud grade 8.8	19,3	30,7	44,7	84,0	130,7	188,0	299,3
Std. stud grade 10.9				NA			

MAXIMA stud Zn. : $\gamma_{Ms} = 1,71$ for M8 to M16 and $\gamma_{Ms} = 1,49$ for M20 to M30
MAXIMA stud A4 : $\gamma_{Ms} = 1,87$
Standard stud grade 5.8 and 8.8 : $\gamma_{Ms} = 1,5$
* Special grade available on request.

SHEAR in kN

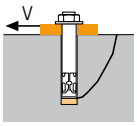


Concrete edge resistance

$$V_{Rd,c,C1} = V^0_{Rd,c,C1} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$$

$V^0_{Rd,c,C1}$							Design concrete edge resistance at minimum edge distance (C_{min})
Anchor size	M8	M10	M12	M16	M20	M24	M30
Category C1 - Single anchor							
h_{ef}	**80**	**90**	**110**	**125**	**170**	**210**	**280**
C_{min}	40	45	45	50	55	60	80
S_{min}	40	45	45	75	90	115	140
$V^0_{Rd,c,C1}$ (C20/25)	1,7	2,6	3,8	6,5	10,3	14,9	23,6
Category C1 - Group of anchors [1]							
h_{ef}	80	90	110	125	170	210	280
C_{min}	40	45	45	50	55	60	80
S_{min}	40	45	45	75	90	115	140
$V^0_{Rd,c,C1}$ (C20/25)	1,4	2,2	3,2	5,5	8,7	12,7	20,1

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$

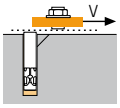


Pryout failure

$$V_{Rd,cp,C1} = V^0_{Rd,cp,C1} \cdot f_b \cdot \Psi_s \cdot \Psi_{c,N}$$

$V^0_{Rd,cp,C1}$							Design pryout resistance
Anchor size	M8	M10	M12	M16	M20	M24	M30
Category C1 - Single anchor							
h_{ef}	**80**	**90**	**110**	**125**	**170**	**210**	**280**
$V^0_{Rd,cp,C1}$ (C20/25)	29,2	34,8	47,1	57,0	90,4	124,2	191,2
Category C1 - Group of anchors [1]							
h_{ef}	80	90	110	125	170	210	280
$V^0_{Rd,cp,C1}$ (C20/25)	25,8	30,7	41,5	50,3	79,8	109,6	168,7

[1] when more than one anchor of the group is submitted to shear load
$\gamma_{Mc} = 1,5$



Steel resistance [2]

$V_{Rd,s,C1}$							Steel design shear resistance
Anchor size	M8	M10	M12	M16	M20	M24	M30
Category C1 - Single anchor							
MAXIMA stud Zn.	5,4	8,5	12,4	23,0	28,9	41,6	66,6
Std. stud grade 5.8	5,2	8,1	11,8	21,8	34,2	49,3	78,4
Std. stud grade 8.8	11,7	18,6	27,0	50,4	78,4	112,8	179,2
Category C1 - Group of anchors [1]							
MAXIMA stud Zn.	4,6	7,2	10,5	19,6	24,5	35,4	56,6
Std. stud grade 5.8	4,4	6,9	10,0	18,6	29,0	41,9	66,6
Std. stud grade 8.8	9,9	15,8	22,9	42,8	66,6	95,9	152,3

[1] when more than one anchor of the group is submitted to tensile load
MAXIMA stud Zn. : $\gamma_{Ms} = 1,43$
Standard stud grade 5.8 and 8.8 : $\gamma_{Ms} = 1,25$

$$N_{Rd,C1} = \min(N_{Rd,p,C1} ; N_{Rd,c,C1} ; N_{Rd,s,C1})$$
$$\beta_N = N_{Sd} / N_{Rd,C1} \leq 1$$

$$V_{Rd,C1} = \min(V_{Rd,c,C1} ; V_{Rd,cp,C1} ; V_{Rd,s,C1})$$
$$\beta_V = V_{Sd} / V_{Rd,C1} \leq 1$$

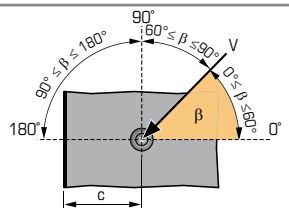
$$\beta_N + \beta_V \leq 1,2$$

f_b INFLUENCE OF CONCRETE

Concrete class	f_b Non-cracked concrete		f_b Cracked concrete
	M8-M16	M20-M30	M8-M30
C25/30	1,02	1,06	1,00
C30/40	1,05	1,15	1,00
C40/60	1,07	1,23	1,00
C50/60	1,09	1,30	1,00

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

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



Material properties for SPIT VIPER XTREM Adhesive

Test Method	Performance	Test report	Testing Conditions
Contact with water for domestic purposes.	Suitable	WRAS APPROVAL NUMBER: 1710516	BS6920-1:2000 and/or 2014
Emission of volatile organic compounds (VOC)	Classification A+	Test certificate N° CTEST165196	ISO 16000
Compressive strength	62 MPa	CEDRE Lab Test report n° 37091	ASTM D695 Cylinder specimens : Ø25 mm 50 mm ; cured 24 h at 20°C
Elasticity modulus in tensile Tensile strength	4.23 GPa 12.1 MPa	Rescoll Lab Test report n° 1702351	NF EN ISO 527-2 Specimens cured 24 h at 20°C/50%HR
Elasticity modulus in flexure Flexural strength	6.29 GPa 33 MPa		ISO 14125 Specimens cured 24 h at 20°C/50%HR
Linear coefficient of shrinkage	1µm/mm	Nelson Lab Test report 17-1328	ASTM D2566 Specimens cured 24 h at 20°C/50%HR
Volume resistivity	2.10^{11} Ω.cm	LCIE Lab Test report n°151350-711426 VIPER XTREM is in the insulating category	IEC62631-3-1:2016 Test conditions : 25°C/50%HR Test voltage: 500Vdc
Permittivity	12,5		IEC60250:1969 Test conditions : 25°C/50%HR Test voltage: 20 V rms
Dilectric dissipation factor	0,264		

VIPER XTREM TR

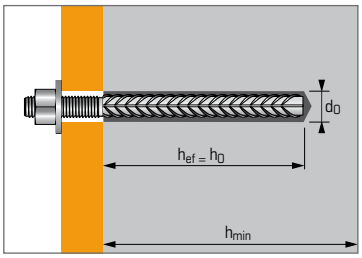
Starter bar fastenings

Vinylester resin for starter bar fastenings for use in cracked & non-cracked concrete and seismic performance C1 category

Product from spit

ETA European Technical Assessment

ETA Option 1- 17/0514



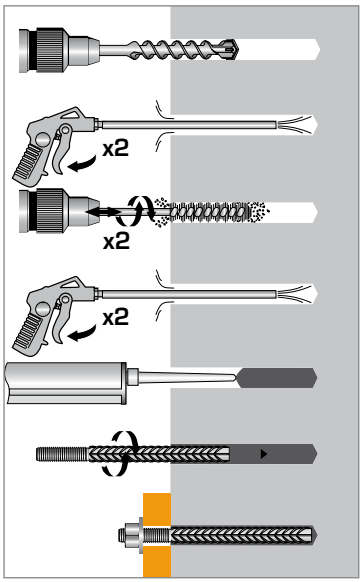
APPLICATION

- Starter bar fastenings in non-reinforced concrete

Technical data

Anchor size	Min. anchor depth (mm) h_{ef}	Max. anchor depth (mm) h_{ef}	Min. thick. of base material (mm) h_{min}	Drilling diameter (mm) d_0
Ø8	56	160	h_{ef} + 30 mm	10
Ø10	70	200		12
Ø12	84	240		15
Ø16	112	320	h_{ef} + 2xd_0	20
Ø20	140	400		25
VIPER Vinylester resin, dual component cartridge 410 ml			code :	060201

INSTALLATION*



***Premium cleaning :**

- 2 blowing with compressed air
- 2 brushing with brushed fitted on a drilling machine
- 2 blowing with compressed air

Mechanical characteristics

Nominal steel bar diameter		Ø8	Ø10	Ø12	Ø16	Ø20
Sections (cm^2)		0,503	0,785	1,13	2,01	3,14
Min. resistance to failure (kN)	Fe E400	21,13	32,97	47,46	84,42	131,88
	Fe E500	25,90	40,43	58,20	103,52	161,71
Ultimate limit load N_{Rd} (kN)	Fe E500	21,85	34,15	49,17	87,42	136,59

The mechanical characteristics of the high adhesion rebars are defined in the NFA 35-016 and NFA 35-017 standards.

Setting time

Ambient temperature	Max. time for installation	Curing time
5°C	60 min.	240 min.
6°C ▶ 10°C	40 min.	180 min.
11°C ▶ 20°C	15 min.	120 min.
21°C ▶ 30°C	8 min.	60 min.
31°C ▶ 40°C	4 min.	60 min.

VIPER XTREM TR

Starter bar fastenings

Ramset™

For detail design, please refer to CC method in following page.

Ultimate ($N_{Ru,m}$, $V_{Ru,m}$) and characteristic loads (N_{Rk}, V_{Rk}) in kN

Mean Ultimate loads are derived from test results in admissible service conditions, and characteristic loads are statistically determined

TENSILE

Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
Non-cracked concrete (C20/25)					
h_{ef}	**80**	**100**	**120**	**160**	**200**
$N_{Ru,m}$	30,7	47,9	68,9	122,4	191,2
N_{Rk}	26,1	40,8	58,8	102,0	142,5
Cracked concrete (C20/25)					
h_{ef}	**80**	**100**	**120**	**160**	**200**
$N_{Ru,m}$	20,3	32,7	48,4	89,6	144,5
N_{Rk}	10,1	15,8	24,9	44,3	75,5

SHEAR

Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
Cracked & non-cracked concrete (C20/25)					
V_{RK}	15,7	24,6	34,7	61,6	96,3

* Base on 500 N/mm² bar

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

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

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

TENSILE

Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
Non-cracked concrete (C20/25)					
h_{ef}	**80**	**100**	**120**	**160**	**200**
N_{Rd}	17,4	27,2	39,2	68,0	95,0
Cracked concrete (C20/25)					
h_{ef}	**80**	**100**	**120**	**160**	**200**
N_{Rd}	6,7	10,5	16,6	29,5	50,3

γ_{Mc} = 1,5

SHEAR

Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
Cracked & non-cracked concrete (C20/25)					
V_{Rd}	11,0	17,2	24,3	43,1	67,4

γ_{Ms} = 1,43

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

$$N_{rec} = \frac{N_{Rk}}{3}$$

$$V_{rec} = \frac{V_{Rk}}{3}$$

TENSILE

Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
Non-cracked concrete (C20/25)					
h_{ef}	**80**	**100**	**120**	**160**	**200**
N_{rec}	8,7	13,6	19,6	34,0	47,5
Cracked concrete (C20/25)					
h_{ef}	**80**	**100**	**120**	**160**	**200**
N_{rec}	3,4	5,3	8,3	14,8	25,2

γ = 3

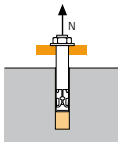
SHEAR

Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
Cracked & non-cracked concrete (C20/25)					
V_{rec}	5,2	8,2	11,6	20,5	32,1

γ = 3

SPIT CC Method (values issued from ETA)

TENSILE in kN

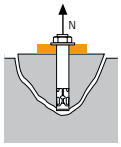


Pull-out resistance for dry and wet concrete (1)

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

$N^0_{Rd,p}$					Design pull-out resistance
Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
h_{ef}	80	100	120	160	200
Non-cracked concrete (C20/25)	17,4	27,2	39,2	69,7	108,9
Cracked concrete (C20/25)	6,7	10,5	16,6	29,5	50,3

$\gamma_{Mc} = 1,5$

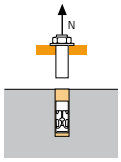


Concrete cone resistance for dry and wet concrete (1)

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

$N^0_{Rd,c}$					Design cone resistance
Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
h_{ef}	80	100	120	160	200
Non-cracked concrete (C20/25)	24,0	33,6	44,2	68,0	95,0
Cracked concrete (C20/25)	17,2	24,0	31,5	48,6	67,9

$\gamma_{Mc} = 1,5$



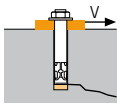
Steel resistance

$N_{Rd,s}$					Steel design tensile resistance
Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
Fe E500	20,0	30,7	44,3	79,3	123,6

γ_{Ms} Fe E500 = 1,4

(1) The concrete in the area of the anchorage is water statured. The anchor may be installed in flooded holes, but the figures above cannot be used, you must use the values given in the ETA for the category 2.

SHEAR in kN

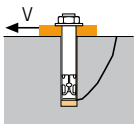


Concrete edge resistance

$V_{Rd,c} = V^0_{Rd,c} \cdot f_b \cdot f_{\beta,V} \cdot \Psi_{S\text{-}C,V}$

$V^0_{Rd,c}$					Design concrete edge resistance at minimum edge distance (C_{min})
Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
Cracked & non-cracked concrete (C20/25)					
h_{ef}	80	100	120	160	200
C_{min}	40	45	45	50	55
S_{min}	40	45	45	75	90
$V^0_{Rd,c}$	2,4	3,2	3,5	4,7	7,8

$\gamma_{Mc} = 1,5$

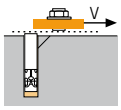


Pryout failure

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

$V^0_{Rd,cp}$					Design pryout resistance
Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
h_{ef}	80	100	120	160	200
Non-cracked concrete (C20/25)	34,9	54,5	78,4	136,0	190,1
Cracked concrete (C20/25)	13,4	20,9	33,2	59,0	100,5

$\gamma_{Mcp} = 1,5$



Steel resistance

$V_{Rd,s}$					Steel design shear resistance
Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
Fe E500	11,2	17,6	24,8	44,0	68,8

γ_{Ms} Fe E500 = 1,4

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

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

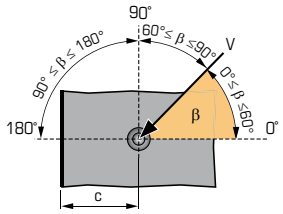
$$\beta_N + \beta_V \leq 1,2$$

f_b INFLUENCE OF CONCRETE

Concrete class	f_b Non-cracked concrete	f_b Cracked concrete
C25/30	1,02	1,00
C30/37	1,05	1,00
C40/50	1,07	1,00
C50/60	1,09	1,00

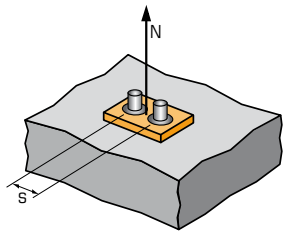
$f_{\beta,V}$ INFLUENCE OF SHEAR LOADING DIRECTION

Angle β [°]	$f_{\beta,V}$
0 to 55	1
60	1,1
70	1,2
80	1,5
90 to 180	2



SPIT CC Method (values issued from ETA)

Ψ_s INFLUENCE OF SPACING FOR CONCRETE CONE RESISTANCE IN TENSILE LOAD



$$\Psi_s = 0{,}5 + \frac{s}{6h_{ef}}$$

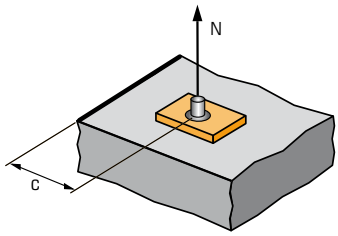
$s_{min} < s < s_{cr,N}$

$s_{cr,N} = 3.h_{ef}$

Ψ_s must be used for each spacing influenced the anchors group.

SPACING S					Reduction factor Ψ_s Cracked & non-cracked concrete
Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
40	0,58				
50	0,60	0,58			
60	0,63	0,60	0,58		
80	0,67	0,63	0,61	0,58	
100	0,71	0,67	0,64	0,60	0,58
150	0,81	0,75	0,71	0,66	0,63
200	0,92	0,83	0,78	0,71	0,67
240	1,00	0,90	0,83	0,75	0,70
300		1,00	0,92	0,81	0,75
360			1,00	0,88	0,80
480				1,00	0,90
600					1,00

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



$$\Psi_{c,N} = 0{,}25 + 0{,}5\,\frac{c}{h_{ef}}$$

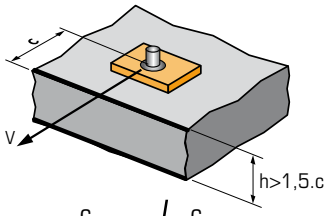
$c_{min} < c < c_{cr,N}$

$c_{cr,N} = 1.5h_{ef}$

$\Psi_{c,N}$ must be used for each distance influenced the anchors group.

EDGE C					Reduction factor $\Psi_{c,N}$ Cracked & non-cracked concrete
Anchor size	Ø8	Ø10	Ø12	Ø16	Ø20
40	0,50				
45	0,53	0,48	0,44		
50	0,56	0,50	0,46	0,41	
65	0,66	0,58	0,52	0,45	0,41
80	0,75	0,65	0,58	0,50	0,45
120	1,00	0,85	0,75	0,63	0,55
150		1,00	0,88	0,72	0,63
180			1,00	0,81	0,70
240				1,00	0,85
300					1,00

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

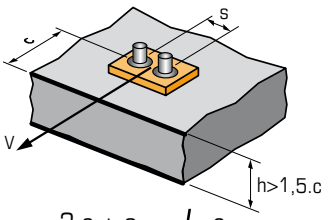


$$\Psi_{s\text{-}c,V} = \frac{c}{c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

For single anchor fastening

Reduction factor $\Psi_{s\text{-}c,V}$ Cracked & non-cracked concrete

$\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
$\Psi_{s\text{-}c,V}$	1,00	1,31	1,66	2,02	2,41	2,83	3,26	3,72	4,19	4,69	5,20	5,72

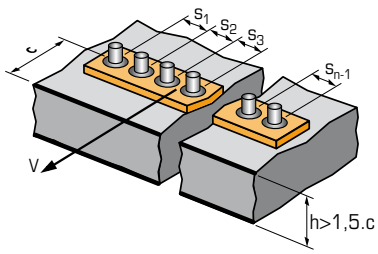


$$\Psi_{s\text{-}c,V} = \frac{3.c + s}{6.c_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$

For 2 anchors fastening

Reduction factor $\Psi_{s\text{-}c,V}$ Cracked & non-cracked concrete

$\frac{s}{c_{min}}$ \ $\frac{c}{c_{min}}$	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2
1,0	0,67	0,84	1,03	1,22	1,43	1,65	1,88	2,12	2,36	2,62	2,89	3,16
1,5	0,75	0,93	1,12	1,33	1,54	1,77	2,00	2,25	2,50	2,76	3,03	3,31
2,0	0,83	1,02	1,22	1,43	1,65	1,89	2,12	2,38	2,63	2,90	3,18	3,46
2,5	0,92	1,11	1,32	1,54	1,77	2,00	2,25	2,50	2,77	3,04	3,32	3,61
3,0	1,00	1,20	1,42	1,64	1,88	2,12	2,37	2,63	2,90	3,18	3,46	3,76
3,5		1,30	1,52	1,75	1,99	2,24	2,50	2,76	3,04	3,32	3,61	3,91
4,0			1,62	1,86	2,10	2,36	2,62	2,89	3,17	3,46	3,75	4,05
4,5				1,96	2,21	2,47	2,74	3,02	3,31	3,60	3,90	4,20
5,0					2,33	2,59	2,87	3,15	3,44	3,74	4,04	4,35
5,5						2,71	2,99	3,28	3,71	4,02	4,33	4,65
6,0						2,83	3,11	3,41	3,71	4,02	4,33	4,65



For 3 anchors fastening and more

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

VIPER XTREM TR

Post-installed rebar

Rebar anchoring system

Product from spit

ETA 17/0513
EAD 330087-00-0601

VIPER XTREM

- Vinylester resin
- Fast cure time
- Storage time 18 months
- Usable in wet environments
- Good fire performance
- Cartridge compatible with standard injection gun

Mechanical characteristics of rebars

Nominal steel rebar Ø		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Sections (cm²)		0,503	0,785	1,13	1,54	2,01	3,14	4,91	8,04
Min. resistances to failure (kN)	Fe E400	21,13	32,97	47,46	64,68	84,42	131,88	206,22	337,68
	Fe E500	25,90	40,43	58,20	79,31	103,52	161,71	252,87	414,06
Ultimate limit load N_{Rd} (kN)	Fe E500	21,85	34,15	49,17	66,93	87,42	136,59	213,43	349,56

The mechanical characteristics of the high adhesion rebars are defined in the CoP for Structural Use of Concrete.

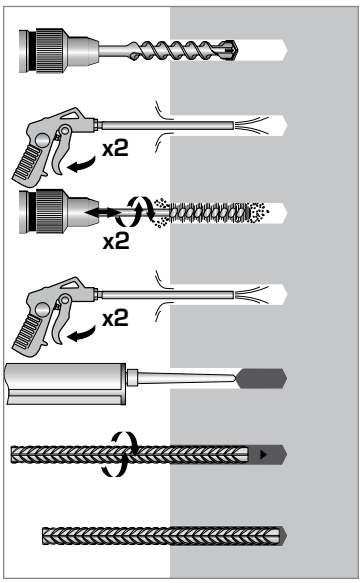
FIRE BEHAVIOUR

Fire performances included in the ETA

Setting time

Ambient temperature	Max. time for installation	Curing time
5°C	60 min.	240 min.
6°C ▶ 10°C	40 min.	180 min.
11°C ▶ 20°C	15 min.	120 min.
21°C ▶ 30°C	8 min.	60 min.
31°C ▶ 40°C	4 min.	60 min.

INSTALLATION*



***Premium cleaning :**
- 2 blowing with compressed air
- 2 brushing with brushed fitted on a drilling machine
- 2 blowing with compressed air

Sizing rules for steel reinforcement fixings for concrete according to eurocode 2 regulations and ETA 17/0513

The basic anchorage length $L_{b,rqd}$ (mm) for the ultimate limit load for rebar F_{Rd} (N) is given by following equation:

$$L_{b,rqd} = \frac{F_{Rd}}{\Pi \cdot Ø \cdot \eta_1 \cdot \eta_2 \cdot f_{bd}}$$

The design anchorage length L_{bd} (mm) is determined as follow:

$L_{bd} = L_{b,rqd} \cdot \alpha_2 \cdot \alpha_5$

F_{Rd} : Design ultimate load (N)
f_{bd} : Design value of the bond strength in N/mm²
Ø : Rebar diameter (mm)
η : depends on bond conditions - $\eta_1 = 1$ ("good bond" conditions). See § 8.4.2 (EN 1992-1-1)
η_2 : depends on rebar diameter - $\eta_2 = 1$ for Ørebar ≤ 32 mm

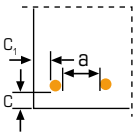
Concrete class	f_{ck} (Mpa)	f_{bd} (Mpa)
C20/25	20	2,3
C25/30	25	2,7
C30/37	30	3,0
C35/45	35	3,4
C40/50	40	3,7*
C45/55	45	4,0*
C50/60	50	4,3*

*for Ø25/28/32 in diamond drilling conditions refer to ETA (annex C3)

with α_2 : **Influence of concrete minimum cover**

$\alpha_2 = 1 - 0{,}15\,(Cd - Ø_{rebar}) / Ø_{rebar} \geq 0{,}7$

$Cd = \min\left(C\,;\,C_1\,;\,\frac{a}{2}\right)$



with α_5 : **Influence of the confinement by transverse pressure**

The factor α_5 take into account of the effect of the pressure transverse to the plane of splitting along the design length.

$\alpha_5 = 1 - 0{,}04 \cdot p \geq 0{,}7$
where p is the transverse pressure at the ultimate limit state along L_{bd} in MPa.

p (Mpa)	α_5
3	0,88
5	0,8
7	0,72

Minimum achorage length for C20/25 according to ETA

Diameter d_s (mm)	Drilling diameter d_o (mm)	$F_{y,k}$ (N/mm²)	Ultimate limit load (kN)	$L_{b,min}$ (mm)	$L_{o,min}$ (mm)	$L_{bd,y}$ (α_2=1) (mm)	$L_{bd,y}$ (α_2=0.7) (mm)	*$L_{bd,y}$ (α_2<0.7) (mm)	L_{max} (mm)
8	**10**	500	21.85	113	200	378	265	110	900
10	**12**	500	34.15	142	200	473	331	137	900
12	**15**	500	49.17	170	200	567	397	164	900
14	**18**	500	66.93	198	210	662	463	192	900
16	**20**	500	87.42	227	240	756	529	219	900
20	**25**	500	136.59	284	300	945	662	274	900
25	**30**	500	213.43	354	375	1182	827	343	900
28	**35**	500	268.04	397	420	1325	927	384	900
32	**40**	500	349.56	454	480	1512	1058	438	900

$L_{b,min} = \alpha_{1b} \cdot \max(0.3 \cdot L_{b,rgd}\ ;\ 10 \cdot \text{Ørebar}\ ;\ 100\text{mm})$ [EC2 8.6]
$L_{o,min} > \max(0.3\ \alpha_6\ L_{b,rgd}\ ;\ 15 \cdot \text{Ørebar}\ ;\ 200\text{mm})$ [EC2 8.11]
$F_{yk} = 500$ N/mm², $\alpha_6 = 1{,}0$ and $\alpha_{1b} = 1$ for C20/25
* For $L_{bd,y}$ ($\alpha_2 > 0.7$), please consult Ramset technical support

Bond strength in N/mm² according to ETA for good bond conditions

Bar diameter	Concrete strength class								
	C 12/15	C 16/20	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
ø8 - ø32	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3

Ramset™

HIT M & HIT M-A2

zinc coated & stainless steel version

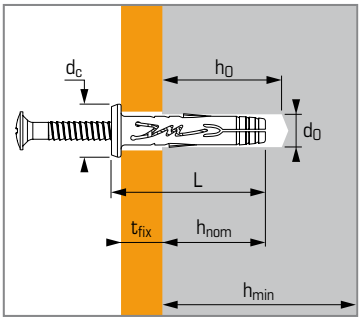
Hammer-set anchor for light duty fixings for concrete and all materials types

Product from spit

ETA European Technical Assessment

ETAG 014 - 06/0032

INOX STAINLESS STEEL



APPLICATION

- Insulation cladding
- Profiles for thin coat external
- Insulation systems
- Drywall track
- Wood
- Flashing
- Electrical accessories
- Collar

Use the ETA figures to design ETICS application.

MATERIAL

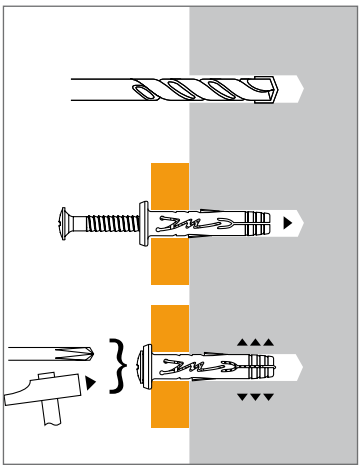
- **Body:** polyamid 6
- **Expansion nail:**
  Zinc coated steel: FR 15 (5 µm)
  Stainless steel: A2
- **Screw head type:** PZ2/PZ3

Technical data

Anchor size	Embedment depth (mm) h_{nom}	Max. thickness of part to be fixed (mm) t_{fix}	Drilling depth through part to be fixed (mm) L+8	Drilling depth in base material (mm) h_0	Drilling diameter (mm) d_0	Min. thickness of base material (mm) h_{min}	Cylinder head diameter (mm) d_c	Total anchor length (mm) L	Type of nail	Code: Zinc coated steel nail	Code: Stainless steel A2 nail
5X25/5 P	20	5	35	30	5	100	9	27	PZ2	050116	-
5X35/15 P		15	45					37		050117	-
6X30/5 P	25	5	40	35	6	100	11	32	PZ2	050118	060104
6X40/12 P		12	47					39		050119	-
6X50/25 P		25	60					52		050121	060105
6X65/40 P		40	75					67		050122	060106
6X40/12 V	25	12	47	35	6	100	10	39	PZ2	050129	-
6X50/25 V		25	60					52		050131	-
6X65/40 V		40	75					67		050132	-
8X40/10 P	30	10	50	40	8	100	13	42	PZ2	060090	060107
8X40/10 P20		10	50					42		055378	-
8X60/30 P		30	70					62		060091	060108
8X90/60 P		60	100					92		060092	060109
8X110/80 P		80	120					112		060093	-
8X130/100 P		100	140					132		060094	-
8X60/30 V	30	30	70	40	8	100	11,5	62	PZ2	060095	-
8X90/60 V		60	100					92		060096	-
8X110/80 V		80	120					112		060097	-
8X130/100 V		100	140					132		060098	-
8X160/125 P	30	125	166	40	8	100	15	158	PZ3	057601	-
8X180/145 P		145	186					178		057602	-
8X200/165 P		165	206					198		057603	-

(1) In masonry, the thickness of the part to be fixed may fluctuate, to ± 5 mm for Ø5 and Ø6 mm and to ± 10 mm for Ø8 mm, to allow a good contact between collar and the part to be fixed.

INSTALLATION



Kind reminder :
For anchor sizes
8X160/125P, 8X180/145P &
8X200/165P,
setting only by screwing

Characteristics loads (N_{Rk}, V_{Rk}) in kN

TENSILE

Base material \ Anchor size	Ø5	Ø6	Ø8
Concrete (C20/25)			
N_{Rk}	0,60	0,90	1,2
Solid concrete blocks B120 (fc = 13,5 N/mm²)			
N_{Rk}	0,30	0,40	0,50
Clay bricks (fc = 55 N/mm²)			
N_{Rk}	0,20	0,80	1,2
Hollow concrete blocks B40 not rendered (fc = 6,5 N/mm²)			
N_{Rk}	0,20	0,30	1,2
Hollow concrete blocks B40 rendered (fc = 6,5 N/mm²)			
N_{Rk}	0,95	1,70	2,25
Hollow clay bricks Eco-30 not rendered (fc = 4,5 N/mm²)			
N_{Rk}	0,30	0,40	0,50
Hollow clay bricks Eco-30 rendered (fc = 4,5 N/mm²)			
N_{Rk}	0,95	1,30	1,70
Engineering clay bricks not rendered (fc = 14,5 N/mm²)			
N_{Rk}	0,55	0,75	0,95
Engineering clay bricks rendered (fc = 14,5 N/mm²)			
N_{Rk}	0,95	1,30	1,70
Aerated concrete (Mvn = 500 kg/m³)			
N_{Rk}	0,15	0,2	0,3
Plasterboard BA13			
N_{Rk}	0,15	0,15	0,18
Plasterboard BA10 + polystyren			
N_{Rk}	0,18	0,18	0,2

SHEAR

	5X25/5 5X35/15	6X30/5 6X40/12 6X50/25	6X65/40	8X40/10 to 8X90/60	8X110/80 to 8X200/165
V_{Rk}	1,9	2,8	2,25	4,3	3,55
V_{Rk}	1,9	2,8	2,25	4,3	3,55
V_{Rk}	1,9	2,8	2,25	4,3	3,55
V_{Rk}	1,9	2,25	2,25	2,8	2,8
V_{Rk}	1,9	2,25	2,25	2,8	2,8
V_{Rk}	0,55	0,75	0,75	0,9	0,9
V_{Rk}	0,9	1,1	1,3	1,7	1,7
V_{Rk}	1,9	2,25	2,25	2,8	2,8
V_{Rk}	1,9	2,8	2,25	4,3	3,55
V_{Rk}	0,15	0,2	0,2	0,3	0,3
V_{Rk}	0,15	0,15	0,15	0,18	0,18
V_{Rk}	0,18	0,18	0,18	0,2	0,2

Ramset™

Design loads (N_{Rd}, V_{Rd}) and recommended loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

$$N_{Rd} = \frac{N_{Rk}\,^{(1)}}{\gamma_M} \qquad N_{rec} = \frac{N_{Rk}\,^{(1)}}{\gamma_M \cdot \gamma_F} \qquad V_{Rd} = \frac{V_{Rk}\,^{(2)}}{2{,}68} \qquad V_{rec} = \frac{V_{Rk}\,^{(2)}}{3{,}75}$$

(1) Issue from ETA

(2) Derived from tests results

TENSILE

Anchor size / Base material	Ø5	Ø6	Ø8
Concrete (C20/25)			
N_{Rd}	0,3	0,45	0,6
N_{rec}	0,21	0,32	0,42
Solid concrete blocks B120 (fc = 13,5 N/mm²)			
N_{Rd}	0,15	0,2	0,25
N_{rec}	0,11	0,14	0,18
Clay bricks (fc = 55 N/mm²)			
N_{Rd}	0,1	0,4	0,6
N_{rec}	0,07	0,28	0,43
Hollow concrete blocks B40 not rendered (fc = 6,5 N/mm²)			
N_{Rd}	0,1	0,15	0,6
N_{rec}	0,7	0,11	0,43
Hollow concrete blocks B40 rendered (fc = 6,5 N/mm²)*			
N_{Rd}	0,35	0,63	0,84
N_{rec}	0,25	0,45	0,6
Hollow clay bricks Eco-30 not rendered (fc = 4,5 N/mm²)			
N_{Rd}	0,21	0,28	0,35
N_{rec}	0,15	0,2	0,25
Hollow clay bricks Eco-30 rendered (fc = 4,5 N/mm²)*			
N_{Rd}	0,35	0,49	0,63
N_{rec}	0,25	0,35	0,45
Engineering clay bricks not rendered (fc = 14,5 N/mm²)*			
N_{Rd}	0,21	0,28	0,35
N_{rec}	0,15	0,2	0,25
Engineering clay bricks rendered (fc = 14,5 N/mm²)*			
N_{Rd}	0,35	0,49	0,63
N_{rec}	0,25	0,35	0,45
Aerated concrete (Mvn = 500 kg/m³)*			
N_{Rd}	0,06	0,08	0,12
N_{rec}	0,04	0,06	0,08
Plasterboard BA13*			
N_{Rd}	0,06	0,06	0,07
N_{rec}	0,04	0,04	0,05
Plasterboard BA10 + polystyren*			
N_{Rd}	0,07	0,07	0,08
N_{rec}	0,05	0,05	0,06

$\gamma_M = 2$; $\gamma_F = 1{,}4$

* Base materials not submitted to ETA

SHEAR

	5X25/5 5X35/15	6X30/5 6X40/12 6X50/25	6X65/40	8X40/10 to 8X90/60	8X110/80 to 8X200/165
Concrete (C20/25)					
V_{Rd}	0,7	1,05	0,84	1,61	1,33
V_{rec}	0,5	0,75	0,6	1,15	0,95
Solid concrete blocks B120 (fc = 13,5 N/mm²)					
V_{Rd}	0,7	1,05	0,84	1,61	1,33
V_{rec}	0,5	0,75	0,6	1,15	0,95
Clay bricks (fc = 55 N/mm²)					
V_{Rd}	0,7	1,05	0,84	1,05	1,33
V_{rec}	0,5	0,75	0,6	0,75	0,95
Hollow concrete blocks B40 not rendered (fc = 6,5 N/mm²)					
V_{Rd}	0,7	0,84	0,84	0,63	1,05
V_{rec}	0,5	0,6	0,6	0,45	0,75
Hollow concrete blocks B40 rendered (fc = 6,5 N/mm²)*					
V_{Rd}	0,7	0,84	0,84	1,33	1,05
V_{rec}	0,5	0,6	0,6	0,95	0,75
Hollow clay bricks Eco-30 not rendered (fc = 4,5 N/mm²)					
V_{Rd}	0,21	0,28	0,28	0,07	0,35
V_{rec}	0,15	0,2	0,2	0,05	0,25
Hollow clay bricks Eco-30 rendered (fc = 4,5 N/mm²)*					
V_{Rd}	0,35	0,42	0,49	0,63	0,63
V_{rec}	0,25	0,3	0,35	0,45	0,45
Engineering clay bricks not rendered (fc = 14,5 N/mm²)*					
V_{Rd}	0,7	0,84	0,84	0,32	1,05
V_{rec}	0,5	0,6	0,6	0,23	0,75
Engineering clay bricks rendered (fc = 14,5 N/mm²)*					
V_{Rd}	0,7	1,05	0,84	0,32	1,33
V_{rec}	0,5	0,75	0,6	0,23	0,95
Aerated concrete (Mvn = 500 kg/m³)*					
V_{Rd}	0,06	0,08	0,08	0,21	0,12
V_{rec}	0,04	0,06	0,06	0,15	0,08
Plasterboard BA13*					
V_{Rd}	0,06	0,06	0,06	0,13	0,07
V_{rec}	0,04	0,04	0,04	0,09	0,05
Plasterboard BA10 + polystyren*					
V_{Rd}	0,07	0,07	0,07	0,27	0,08
V_{rec}	0,05	0,05	0,05	0,19	0,06

Spacing data

IN CONCRETE

Anchor size	$C_{cr,N\ mini}$	$C_{cr,V\ mini}$
	Minimum distance between anchors and from edges (mm)	
Ø5	100	100
Ø6	100	100
Ø8	100	100

Ramset™

B-LONG

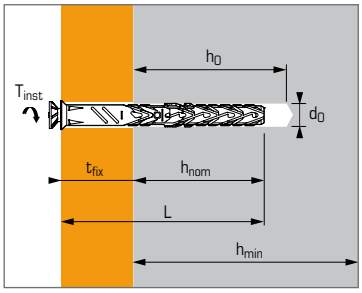
zinc coated & stainless steel version

Frame anchor for fixings in concrete, solid masonry, hollow block and aerated concrete

Product from spit

European Technical Assessment
ETAG 020 - 13/1068

B-LONG is included in ITW Seismic Research Program
http://seismic.spit.it



APPLICATION

- Roofing clamps
- Sanitary equipement
- Fixing wall plates
- Timbers
- Insulation
- Facade bracketing

MATERIAL

- **Body:** polyamid 6
- **Screw:**

Zinc coated steel: grade 6.8 (5 µm)
Stainless steel: A4-80

- **Head type:**

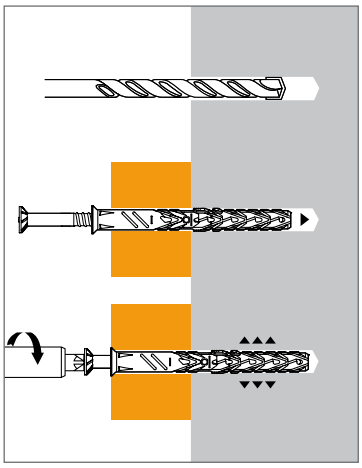
F : countersunk head

TORX 30 (Ø8)
TORX 40 (Ø10)

HS : hexagonal head

+ integrated washer

INSTALLATION



Technical data

Anchor size	Concrete		Structural clay block		Hollow clay brick/ Aerated concrete		Setting data and Anchor size					Code			
	Embed. depth (mm) h_{nom}	Max. thickness to fix (mm) t_{fix}	Embed. depth (mm) h_{nom}	Max. thickness to fix (mm) t_{fix}	Embed. depth (mm) h_{nom}	Max. thickness to fix (mm) t_{fix}	Base material thickness (mm) h_{min}	Drilling depth (mm) h_0	Drilling diameter (mm) d_0	Total anchor length (mm) L	Tighten torque T_{inst}	Head version F	Head version HS	Head version F - A4	Head version HS - A4
8X60/10	50	10	50	10	50	10	100	60	8	60	12	567950	-	-	-
8X80/30		30		30		30				80		567951	-	567942	-
8X100/50		50		50		50				100		567952	-	567943	-
8X120/70		70		70		70				120		567953	-	-	-
8X150/100		100		100		100				150		567954	-	-	-
10X60/10	40	20	50	10	70	-	h_{nom} X2	h_{nom} +10 mm	10	60	16*	-	567969	-	567986
10X80/30		40		30		10				80		567957	567970	567981	567987
10X100/50		60		50		30				100		567958	567971	567982	567988
10X120/70		80		70		50				120		567959	567972	567983	567989
10X140/90		100		90		70				140		567960	567973	567984	-
10X160/110		120		110		90				160		567961	567974	-	-
10X180/130		140		130		110				180		567962	567975	-	-
10X200/150		160		150		130				200		567963	567976	-	-
10X230/180		190		180		160				230		567964	567977	-	-
10X260/210		220		210		190				260		567965	567978	-	-
10X280/230		240		230		210				280		567966	567979	-	-
10X300/250		260		250		230				300		567967	567980	-	-

* In aereted concrete apply torque at 50% of nominal value

Products on special orders

B-LONG

zinc coated & stainless steel version

Ramset™

Characteristic loads (N_{Rk}, V_{Rk}) in kN

TENSILE (Temperature : -40°C < T < +50°C[2])

Anchor size / Base material[1] / h_{nom}	Ø8 / 50	Ø10 / 40	Ø10 / 50	Ø10 / 70
Concrete (C20/25)				
N_{Rk}	3,0	3,5	5,5	-
Solid clay brick Wienerberger MZ 28-1,8 (fck = 20 Mpa)[1]				
N_{Rk}	3,0	-	3,0	-
Hollow clay brick Wienerberger Porotherm BIOPLAN (fbk = 12 Mpa) [1]				
N_{Rk}	2,0	-	2,0	-
Hollow concrete block B40 (fbk = 4 Mpa) [1]				
N_{Rk}	1,5	-	1,2	-
Autoclaved aerated concrete type low strength YTONG «Clima» Block (fbk = 2,4 Mpa)				
N_{Rk}	-	-	0,6	0,6
Autoclaved aerated concrete type high strength YTONG «Sismico» Block (fbk = 5 Mpa)				
N_{Rk}	-	-	1,5	2,0

SHEAR

Anchor size / Base material[1] / h_{nom}	Ø8 / 50	Ø10 / 40	Ø10 / 50	Ø10 / 70
Concrete (C20/25)				
V_{Rk}	6,9	9,1	9,1	9,1
Solid clay brick Wienerberger MZ 28-1,8 (fck = 20 Mpa) [1]				
V_{Rk}	3,0	-	3,0	-
Hollow clay brick Wienerberger Porotherm BIOPLAN (fbk = 12 Mpa) [1]				
V_{Rk}	2,0	-	2,0	-
Hollow concrete block B40 (fbk = 4 Mpa) [1]				
V_{Rk}	1,5	-	1,2	-
Autoclaved aerated concrete type low strength YTONG «Clima» Block (fbk = 2,4 Mpa)				
V_{Rk}	-	-	0,6	0,6
Autoclaved aerated concrete type high strength YTONG «Sismico» Block (fbk = 5 Mpa)				
V_{Rk}	-	-	1,5	2,0

Design loads (N_{Rd}, V_{Rd}) and recommended loads (N_{rec}, V_{rec}) in kN

TENSILE (Temperature : -40°C < T < +50°C[2])

Anchor size / Base material[1] / h_{nom}	Ø8 / 50	Ø10 / 40	Ø10 / 50	Ø10 / 70
Concrete (C20/25)				
N_{Rd}	1,7	1,9	3,1	-
N_{rec}	1,2	1,4	2,2	-
Solid clay brick Wienerberger MZ 28-1,8 (fck = 20 Mpa) [1]				
N_{Rd}	1,2	-	1,2	-
N_{rec}	0,9	-	0,9	-
Hollow clay brick Wienerberger Porotherm BIOPLAN (fbk = 12 Mpa) [1]				
N_{Rd}	0,8	-	0,8	-
N_{rec}	0,6	-	0,6	-
Hollow concrete block B40 (fbk = 4 Mpa) [1]				
N_{Rd}	0,6	-	0,5	-
N_{rec}	0,4	-	0,3	-
Autoclaved aerated concrete type low strength YTONG «Clima» Block (fbk = 2,4 Mpa)				
N_{Rd}	-	-	0,30	0,30
N_{rec}	-	-	0,21	0,21
Autoclaved aerated concrete type high strength YTONG «Sismico» Block (fbk = 5 Mpa)				
N_{Rd}	-	-	0,75	1,00
N_{rec}	-	-	0,54	0,71

SHEAR

Anchor size / Base material[1] / h_{nom}	Ø8 / 50	Ø10 / 40	Ø10 / 50	Ø10 / 70
Concrete(C20/25)				
V_{Rd}	4,6	6,0	6,0	6,0
V_{rec}	3,3	4,3	4,3	4,3
Solid clay brick Wienerberger MZ 28-1,8 (fck = 20 Mpa) [1]				
V_{Rd}	1,1	-	1,2	-
V_{rec}	0,8	-	0,9	-
Hollow clay brick Wienerberger Porotherm BIOPLAN (fbk = 12 Mpa) [1]				
V_{Rd}	0,8	-	0,8	-
V_{rec}	0,6	-	0,6	-
Hollow concrete block B40 (fbk = 4 Mpa) [1]				
V_{Rd}	0,6	-	0,5	-
V_{rec}	0,4	-	0,3	-
Autoclaved aerated concrete type low strength YTONG «Clima» Block (fbk = 2,4 Mpa)				
V_{Rd}	-	-	0,30	0,30
V_{rec}	-	-	0,21	0,21
Autoclaved aerated concrete type high strength YTONG «Sismico» Block (fbk = 5 Mpa)				
V_{Rd}	-	-	0,75	1,00
V_{rec}	-	-	0,54	0,71

[1] Other material references are specified in the ETA
[2] Suitable for «range b» temperatures (-40°C <T <+80°C) : figures above must be reduced, refer to ETA for data.

Spacing data

IN CONCRETE

	Minimum distance between anchors and from edges (mm)				
	h_{nom}	$S_{cr,N}$	$C_{cr,N}$	S_{min}	C_{min}
Ø8	50	60	50	50	50
Ø10	40	65	80	60	50
Ø10	50	90	100	70	60

IN HOLLOW MASONRIES

The anchor must be installed at the minimum distance of:
- 100 mm from one edge.
- 200 mm from another anchor with spacing parallel to the edge.
- 400 mm from another anchor with spacing perpendicular to the edge.

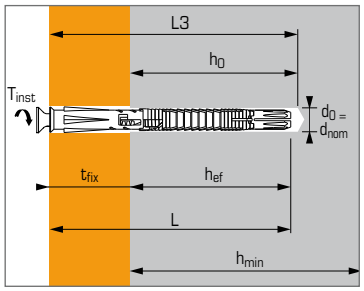
Ramset™

PROLONG

Universal frame fixing for concrete, in hollow and solid masonries

Product from spit

ETA European Technical Assessment
ETAG 020 - 11/0035
PROLONG Ø10



APPLICATION

- Roofing clamps
- Sanitary equipment
- Fixing wall plates
- Timbers

MATERIAL

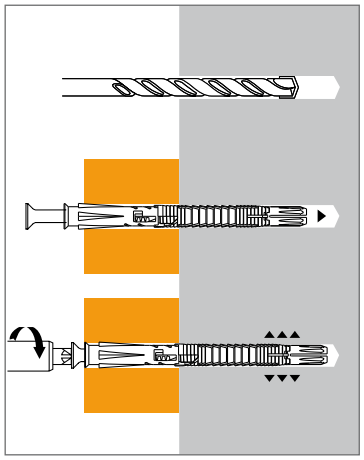
- **Body :** polyamid 6 (halogene free)
- **Screw :** zinc coated steel 5.8 (5 µm)
- **Head type:**
  F : countersunk head for Ø10

TORX 40

H: hexagonal head + large washer for Ø12 and Ø16

Ø10 : Sw = 13 mm
Ø12: Sw = 17 mm
Ø16: Sw = 19 mm

INSTALLATION



Spacing data

IN CONCRETE AND SOLID MASONRIES

Mini. distance between anchors and from edge (mm)

	$S_{cr,N}$	$C_{cr,N}$	$C_{cr,V}$	S_{min}	C_{min}
Ø10	140	70	70	50	60
Ø12	140	70	90	50	60
Ø16	140	70	105	50	60

IN HOLLOW MASONRIES

The anchor must be installed at the minimum distance of:
- 200 mm from another anchor,
- 105 mm from one edge.

Technical data

Anchor size	Anchor depth (mm) h_{ef}	Max. thickness of part to be fixed (mm) t_{fix}	Anchor external diameter (mm) d_{nom}	Base material thickness (mm) h_{min}	Drilling diameter (mm) d_0	Drilling depth (mm) h_0	Min. drilling depth through part to be fixed (mm) L3	Total sleeve length (mm) L	Tighten torque (Nm) T_{inst}	Code Head version F	Code Head version H
10X80/10	70	10	10	140	10	80	80	80	10	566653	-
10X100/30		30					110	100		566654	
10X115/45		45					125	115		566655	
10X145/75		75					155	145		566656	
10X160/90		90					170	160		566657	
10X185/115		115					195	185		566658	
10X210/140		140					220	210		566659	
12X120/50	70	50	12	200	12	85	135	120	10	-	566675
12X145/75		75					160	145			566676
12X165/95		95					180	165			566677
12X185/115		115					200	185			566678
12X210/140		140					225	210			566679
16X145/55	90	55	16	200	16	110	165	145	20	-	566680
16X165/75		75					185	165			566681
16X185/95		95					205	185			566682
16X200/110		110					220	200			566683
16X240/150		150					260	240			566428
16X270180		180					290	270			566484

Ultimate loads ($N_{Ru,m}$, $V_{Ru,m}$) in kN

TENSILE

Base material \ Anchor size	Ø10	Ø12	Ø16
Concrete (C20/25)			
$N_{Ru,m}$	5,0	7,8	11,0
Clay bricks			
$N_{Ru,m}$	5,75	7,4	10,4
Hollow concrete blocks not rendered			
$N_{Ru,m}$	1,4	2,2	4,2
Hollow clay bricks not rendered			
$N_{Ru,m}$	1,4	1,2	1,2
Aerated concrete			
$N_{Ru,m}$	1,25	1,9	2,6

SHEAR

Base material \ Anchor size	Ø10	Ø12	Ø16
Concrete (C20/25)			
$V_{Ru,m}$	5,0	12,5	27,0
Clay bricks			
$V_{Ru,m}$	5,75	11,2	24,3
Hollow concrete blocks not rendered			
$V_{Ru,m}$	1,4	3,4	4,8
Hollow clay bricks not rendered			
$V_{Ru,m}$	1,4	3,5	5,1
Aerated concrete			
$V_{Ru,m}$	-	-	-

Design loads (N_{Rd}, V_{Rd}) and recommended loads (N_{rec}, V_{rec}) for one anchor without edge or spacing influence in kN

TENSILE

Base material \ Anchor size	Ø10	Ø12	Ø16
Concrete (C20/25)			
N_{Rd}	1,4	2,23	3,14
N_{rec}	1,0	1,56	2,2
Clay bricks			
N_{Rd}	1,6	2,11	2,97
N_{rec}	1,15	1,48	2,08
Hollow concrete blocks not rendered			
N_{Rd}	0,4	0,63	1,2
N_{rec}	0,28	0,44	0,84
Hollow clay bricks not rendered			
N_{Rd}	0,4	0,3	0,3
N_{rec}	0,28	0,24	0,24
Aerated concrete			
N_{Rd}	0,35	0,54	0,74
N_{rec}	0,25	0,38	0,52

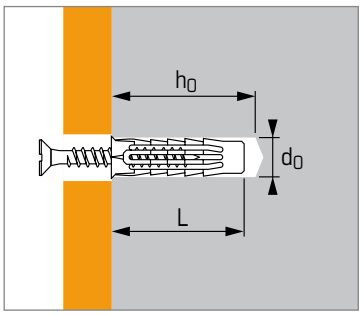
SHEAR

Base material \ Anchor size	Ø10	Ø12	Ø16
Concrete (C20/25)			
V_{Rd}	1,4	3,57	7,71
V_{rec}	1,0	2,5	5,4
Clay bricks			
V_{Rd}	1,6	3,2	6,94
V_{rec}	1,15	2,24	4,86
Hollow concrete blocks not rendered			
V_{Rd}	0,4	0,97	1,37
V_{rec}	0,28	0,7	0,96
Hollow clay bricks not rendered			
V_{Rd}	0,4	1	1,45
V_{rec}	0,28	0,7	1,02
Aerated concrete			
V_{Rd}	-	-	-
V_{rec}	-	-	-

Ramset™

Nylon anchor for hollow and solid material

Product from spit



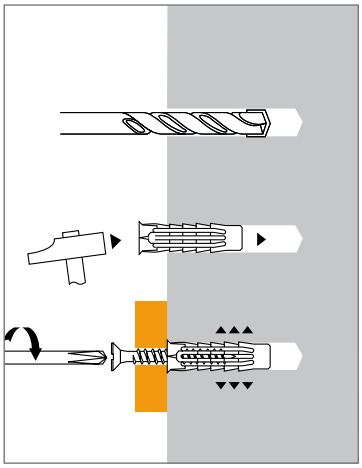
APPLICATION

- Lightweight fixing in all base material
- Small electrical accessories, small light fittings, fuse boxes, etc...

MATERIAL

- **Body:** polyamid 6
  Suitable temperature -20° + 40°C
- ***Screw :** Special screw supplied, head type PZ2

INSTALLATION



Technical data

Anchor size	Screw diameter (mm)	Drilling depth (mm) h_0	Drilling diameter (mm) d_0	Total anchor length (mm) L	Code	
					without screw	with VBA screw*
5X25	3 - 4	35	5	25	565642	565646
6X30	4 - 5	40	6	30	565643	565647
8X40	4,5 - 6	50	8	40	565644	565648
10X50	6 - 8	65	10	50	565645	565649
12X60	8- 10	75	12	60	565617	-
14X70	10 - 12	85	14	70	565618	-

Recommended loads (N_{rec}) and ultimate loads ($N_{Ru,m}$) in kN with wood screw

TENSILE

Base material \ Anchor size / Screw Ø	Ø5 / 4	Ø6 / 5	Ø8 / 6	Ø10 / 8
Concrete (≥C20/25)				
N_{rec}*	0,28	0,28	0,50	0,70
$N_{Ru,m}$*	1,40	1,40	2,50	3,50
Hollow concrete blocks B 40				
N_{rec}*	0,23	0,3	0,43	0,46
$N_{Ru,m}$*	1,15	1,5	2,15	2,30
Clay bricks BP 400				
N_{rec}*	0,20	0,26	0,35	0,60
$N_{Ru,m}$*	1,00	1,30	1,75	3,00
Hollow clay bricks Eco 40				
N_{rec}*	0,17	0,19	0,23	0,25
$N_{Ru,m}$*	0,85	0,95	1,15	1,25

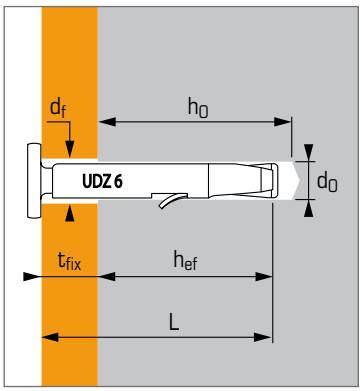
* Indicative values : depending on the type of screw used, the loads must be reduced by 50 %

UDZ 6

Ceiling anchor for multiple use of non-structural applications

Product from spit

ETA European Technical Assessment
ETAG 001-6 - 05/0038



Technical data

Anchor size	Anchor depth (mm) h_{ef}	Max. thickness of part to be fixed (mm) t_{fix}	Drilling depth (mm) h_0	Drilling diameter (mm) d_0	Total anchor length (mm) L	Clearance diameter (mm) d_f	Code
6X40/5	30	5	50	6	40	7	060084

APPLICATION

- Fixing on ceiling
- Fixing only for multiple use of non-structural applications

Characteristic resistance (N_{Rk}) in kN

TENSILE

Anchor size / Base material	6X40/5
Concrete (C20/25 to C50/60)	
N_{Rk}	1,5

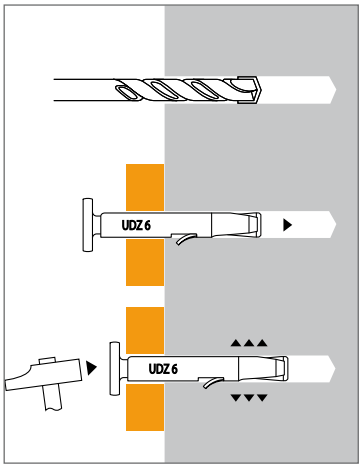
Design loads (N_{Rd}) and recommended loads (N_{rec}) for one anchor without edge or spacing influence in kN

$$N_{Rd} = \frac{N_{Rk}^{*}}{\gamma_M}$$

* Derived from tests results

$$N_{rec} = \frac{N_{Rk}^{*}}{\gamma_M \cdot \gamma_F}$$

INSTALLATION



TENSILE

Anchor size / Base material	6X40/5
Concrete (C20/25 to C50/60)	
N_{Rd}	1,00
N_{rec}	0,71

$\gamma_M = 1,5$; $\gamma_F = 1,4$

Spacing data

IN CONCRETE

	Characteristic distance between anchors and from edges and minimum thickness of concrete member (mm)		
	S_{min}	C_{min}	h_{min}
6X40/5	200	100	80

Fire behaviour

Design loads in kN

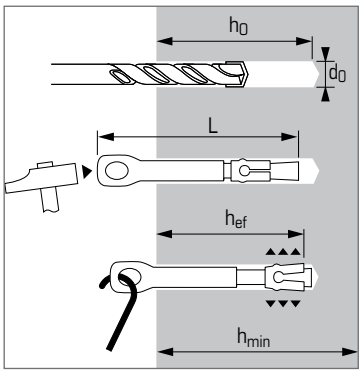
Fire duration	30 min.	1 h	1 h 30 min.	2 h
$F_{Rd,fi}$	0,45	0,36	0,26	0,26

$\gamma_M = 1,0$

FIX P6

Wirehanger

Product from spit



APPLICATION

- Suspended ceiling
- Light

Fire behaviour

Fire duration	60 min.	120 min.
6X65P	0,085*	0,045*

*Values calculated according to the technical report TR 020 published by EOTA "Evaluation of anchorages in concrete concerning resistance to fire".

Technical data

Anchor size	Anchor depth (mm) h_{ef}	Min. base material thickness (mm) h_{min}	Drilling depth (mm) h_0	Drilling diameter (mm) d_0	Total anchor length (mm) L	Code
6X65P	25	50	35	6	64	056100

Anchors mechanical properties

Anchor size		6X65P
f_{uk} (N/mm²)	Min. tensile strength	450
f_{yk} (N/mm²)	Yield strength	400

Recommended loads (N_{rec}, V_{rec}) and ultimate loads ($N_{Ru,m}$, $V_{Ru,m}$) in kN

TENSILE

Base material \ Anchor size	h_{ef}	6X65P 25
Concrete (C20/25)		
N_{rec}		1,5
$N_{Ru,m}$		6,0
Concrete (C30/37)		
N_{rec}		1,8
$N_{Ru,m}$		7,0
Concrete (≥C40/50)		
N_{rec}		2,2
$N_{Ru,m}$		8,6

Concrete rendered (max 5 mm): recommended load reduced to 50%

SHEAR

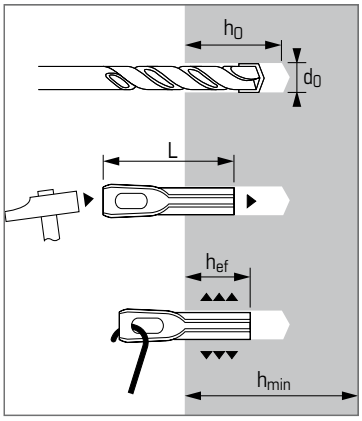
Base material \ Anchor size	h_{ef}	6X65P 25
Concrete (C20/25)		
V_{rec}		1,4
$V_{Ru,m}$		5,6
Concrete (C30/37)		
V_{rec}		1,7
$V_{Ru,m}$		6,8
Concrete (≥C40/50)		
V_{rec}		1,7
$V_{Ru,m}$		6,8

Concrete rendered (max 5 mm): recommended load reduced to 50%

G8

Ceiling anchor

Product from spit



APPLICATION

- Suspended ceiling

INSTALLATION

- Drilling ø 8, depth 25 mm.
- Push the anchor home into the hole and hit with the hammer to obtain the embendement of the anchor only reaching the wide part.

Technical data

Anchor size	Anchor depth (mm) h_{ef}	Min. base material thickness (mm) h_{min}	Drilling depth (mm) h_0	Drilling diameter (mm) d_0	Total anchor length (mm) L	Code
8X40	21	40	25	8	43	050015

Anchors mechanical properties

Anchor size		8X40
f_{uk} (N/mm²)	Min. tensile strength.	450
f_{yk} (N/mm²)	Yield strength	400

Recommended loads (N_{rec}) and ultimate loads ($N_{Ru,m}$) in kN

TENSILE

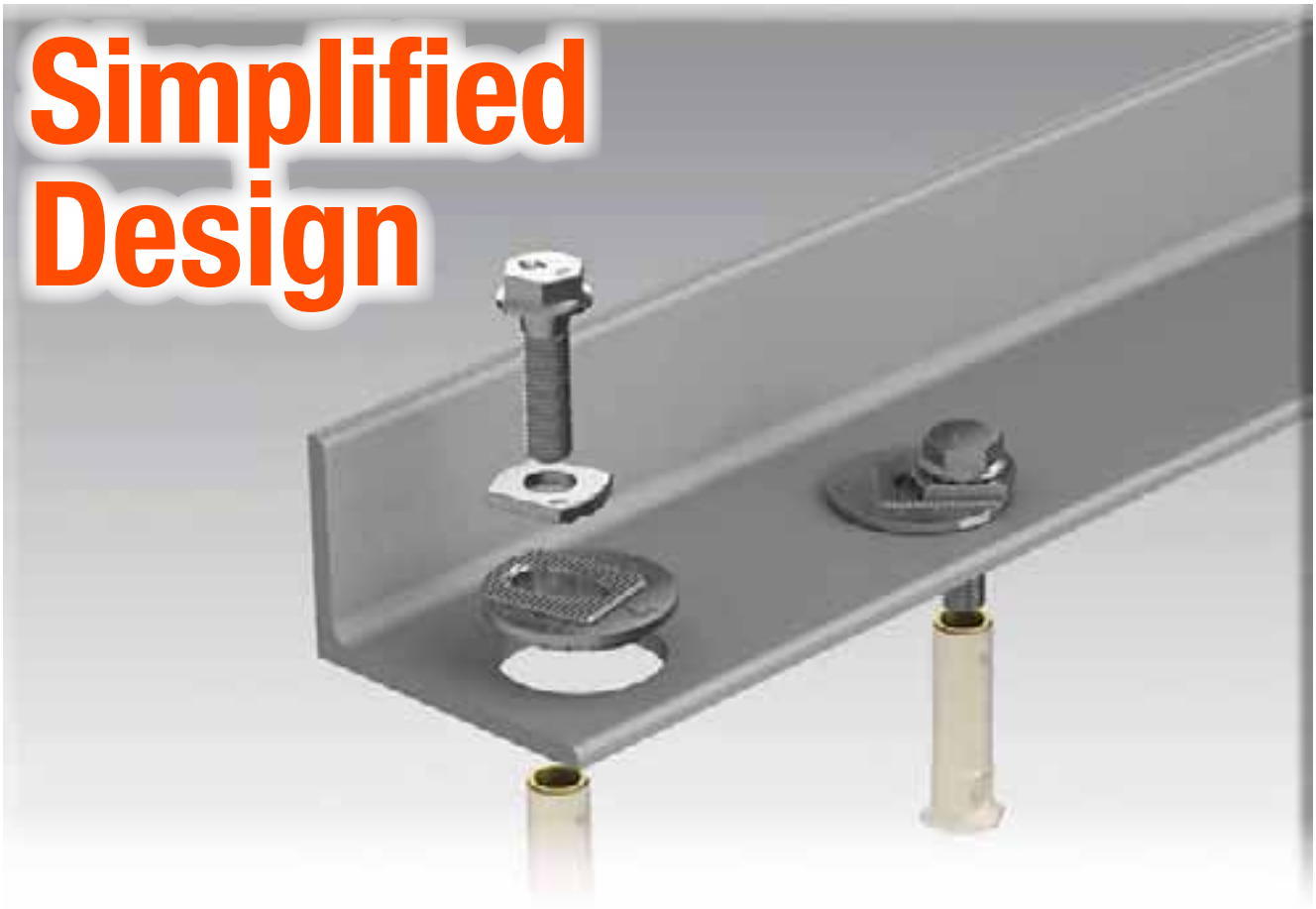
Base material \ Anchor size	h_{ef}	8X40 21
Concrete (C20/25 and C30/37)		
N_{rec}		0,6
$N_{Ru,m}$		3,2
Concrete (≥C40/50)		
N_{rec}		0,7
$N_{Ru,m}$		4,0

Concrete rendered (max 5 mm): recommended load reduced to 50%

Fire behaviour

Fire duration	60 min.	120 min.
8X40	0,035*	0,017*

*Characteristic resistance (kN). Values calculated according to the technical report TR020 published by EOTA "Evaluation of anchorages in concrete concerning resistance to fire".



This information is provided for the guidance of qualified structural engineers or other suitably skilled persons in the design of connections. It is the designer's responsibility to ensure compliance with the relevant standards, codes of practice, building regulations, workplace regulations and statutes as applicable.

This manual allows the designer to determine load carrying capacities based on actual application and installation conditions, then select an appropriate connection to meet the required load case through the use of the simplified design process to arrive at recommendations in line with strength limit state design principles.

ramsetreid™ has developed this Simplified Design Approach to achieve strength limit state design, and to allow for rapid selection of a suitable connection and through systematic analysis, establish that it will meet the required design criteria under strength limit state principles. The necessary diagrams, tables etc. for each specific product are included in this publication.

We have developed this design process to provide accurate anchor performance predictions and allow appropriate design solutions in an efficient and time saving manner.

Our experience over many years of anchor design has enabled us to develop this process which enables accurate and quick solutions without the need to work laboriously from first principles each time.

Preliminary Selection

Establish the design action effects, N* and V* (Tension and Shear) acting on each anchor being examined using the appropriate load combinations detailed in the AS1170 series of Australian Standards and NZS1170 series of New Zealand Standards.

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Refer to table 1a, 'Indicative combined loading – Interaction Diagram' for the anchor type selected, looking up N* and V* to select the anchor size most likely to meet the design requirements.

Note that the Interaction Diagram is for a specific concrete compressive strength and does not consider edge distance and anchor spacing effects, hence is a guide only and its use should not replace a complete design process.

ACTION **Note down the anchor size selected.**

Having selected an anchor size, check that the design values for edge distance and anchor spacing comply with the absolute minima detailed in table 1b. If your design values do not comply, adjust the design layout.

Calculate the anchor effective depth as detailed in step 1c.

This is an important structural dimension that will be referred to in subsequent tables.

Typically, greater effective depths will result in greater concrete tensile capacities.

ACTION **Note down the anchor effective depth, h.**
Note also the product part no. referenced.

Checkpoint 1

Anchor size selected ?
Absolute minima compliance achieved ?
Anchor effective depth calculated ?

If the above questions are answered satisfactorily, proceed to step 2.

STEP 2 Verify concrete tensile capacity - per anchor

Referring to table 2a, determine the reduced characteristic ultimate concrete tensile capacity ($ØN_{uc}$). This is the basic capacity, uninfluenced by edge distance or anchor spacings and is for the specific concrete compressive strength(s) noted.

ACTION **Note down the value for $ØN_{uc}$**

Calculate the concrete compressive strength effect, tension, X_{nc} by referring to table 2b. This multiplier considers the influence of the actual concrete compressive strength compared to that used in table 2a above.

ACTION **Note down the value for X_{nc}**

If the concrete edge distance is close enough to the anchor being evaluated, that anchors tensile performance may be reduced. Use table 2c, edge distance effect, tension, X_{ne} to determine if the design edge distance influences the anchors tensile capacity.

ACTION **Note down the value for X_{ne}**

For designs involving more than one anchor, consideration must be given to the influence of anchor spacing on tensile capacity. Use either of tables 2d or 2e to establish the anchor spacing effect, tension, X_{nae} or X_{nai}.

ACTION **Note down the value of X_{nae} or X_{nai}**

Checkpoint 2

Design reduced concrete tensile capacity, $ØN_{urc}$

$$ØN_{urc} = ØN_{uc} * X_{nc} * X_{ne} * (X_{nae} \text{ or } X_{nai}) \text{ (kN)}$$

This calculation takes into consideration the influences of concrete compressive strength, edge distance and anchor spacing to arrive at the design reduced concrete tensile capacity.

ACTION **Note down the value of $ØN_{urc}$**

STEP 3 Verify anchor tensile capacity - per anchor

Having calculated the concrete tensile capacity above ($ØN_{urc}$), consideration must now be given to other tensile failure mechanisms.

Calculate the reduced characteristic ultimate steel tensile capacity ($ØN_{us}$) from table(s) 3a.

ACTION **Note down the value of $ØN_{us}$**

For internally threaded anchoring products that utilise a separate bolt such as the Threaded Insert anchor, make use of step 3b to verify the reduced characteristic ultimate bolt steel tensile capacity ($ØN_{tf}$).

Checkpoint 3

Now that we have obtained capacity information for all tensile failure mechanisms, verify which one is controlling the design.

Design reduced ultimate tensile capacity, $ØN_{ur}$

$$ØN_{ur} = \text{minimum of } ØN_{urc}, ØN_{us}, ØN_{tf}$$

Check $N^* / ØN_{ur} \leq 1$,
if not satisfied return to step 1

This completes the tensile design process, we now look to verify that adequate shear capacity is available.

STEP 4 Verify concrete shear capacity - per anchor

Referring to table 4a, determine the reduced characteristic ultimate concrete edge shear capacity ($ØV_{uc}$). This is the basic capacity, uninfluenced by anchor spacings and is for the specific edge distance and concrete compressive strength(s) noted.

ACTION **Note down the value for $ØV_{uc}$**

Calculate the concrete compressive strength effect, shear, X_{vc} by referring to table 4b. This multiplier considers the influence of the actual concrete compressive strength compared to the nominal value used in table 4a above.

ACTION **Note down the value for X_{vc}**

The angle of incidence of the shear load acting towards an edge is considered through the factor X_{vd}, load direction effect, shear.

Use table 4c to establish its value.

ACTION **Note down the value for X_{vd}**

For a row of anchors located close to an edge, the influence of the anchor spacing on the concrete edge shear capacity is considered by the factor X_{va}, anchor spacing effect, concrete edge shear.

Note that this factor deals with a row of anchors parallel to the edge and assumes that all anchors are loaded equally.

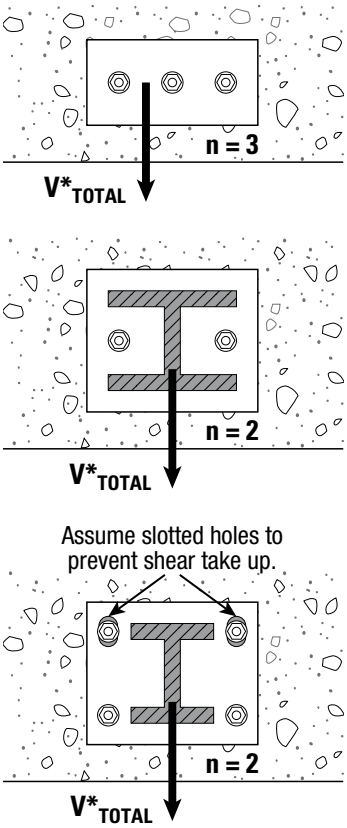
If designing for a single anchor, X_{va} = 1.0

ACTION **Note down the value for X_{va}**

In order to distribute the concrete edge shear evenly to all anchors within a row of anchors aligned parallel to an edge, calculate the multiple anchors effect, concrete edge shear, X_{vn}.

If designing for a single anchor, X_{vn} = 1.0

Examples



Note: Consider capacity of two anchors in row closest to edge only,
ie. anchor load = $V^*_{TOTAL}/2$ to each anchor.

ACTION **Note down the value for X_{vn}**

Checkpoint 4

Design reduced concrete shear capacity, $ØV_{urc}$

$$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn} * X_{vs} \text{ (kN)}$$

This calculation takes into consideration the influences of concrete compressive strength, edge distance and anchor spacing to arrive at the design reduced concrete shear capacity.

For a design involving two or more anchors in a row parallel to an edge, this value is the average capacity of each anchor assuming each is loaded equally.

ACTION **Note down the value of $ØV_{urc}$**

STEP 5 Verify anchor shear capacity - per anchor

Having calculated the concrete shear capacity above ($ØV_{urc}$), consideration must now be given to other shear failure mechanisms.

Calculate the reduced characteristic ultimate steel shear capacity ($ØV_{us}$) from table(s) 5a.

ACTION **Note down the value for $ØV_{us}$**

For internally threaded anchoring products that utilise a separate bolt such as the Threaded Insert anchor, make use of step 5b to verify the reduced characteristic ultimate bolt steel shear capacity ($ØV_{sf}$).

Checkpoint 5

Design reduced shear capacity, $ØV_{ur}$

Now that we have obtained capacity information for all shear failure mechanisms, verify which one is controlling the design.

$$ØV_{ur} = \text{minimum of } ØV_{urc}, ØV_{us}, ØV_{sf}$$

Check $V^* / ØV_{ur} \leq 1$,

if not satisfied return to step 1

This completes the shear design process, we now look to verify that adequate combined capacity is available for load cases having both shear and tensile components.

STEP 6 Combined loading and specification

For load cases having both tensile and shear components, verify that the relationship represented here is satisfied.

Checkpoint 6

For CC method
Check

$$N^*/ØN_{ur} + V^*/ØV_{ur} \leq 1.2,$$

if not satisfied return to step 1

For I-expert
Check

$$\beta_N^{1.5} + \beta_V^{1.5} \leq 1,$$

if not satisfied return to step 1

Specify the product to be used as detailed.

TCM CONCRETE INSERT

TCM GENERAL INFORMATION

Performance Related	Material Related	Installation Related
	Zn, GAL, A4 316	

Product

The TCM is a medium to heavy duty, cast-in ferrule. All steel threaded socket for casting into pre-cast concrete and institute concrete elements, giving a prefixed fastening point.

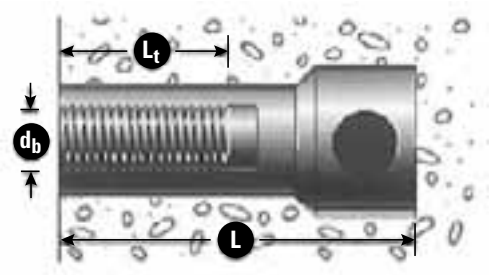
Benefits, Advantages and Features

~ Stress free anchoring close to edge and reduced anchor spacing.

~ Cast-in placement eliminates the need for drilling, this is particularly important where reinforcing is present in the fixing zone.

~ Ideal for shallow embedment as the anchor can be tied into the reinforcing to distribute the load over a wider area to become an integral part of the reinforcing structure.

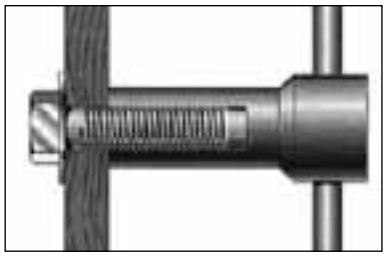
~ Cast-in anchors have high tensile load carrying capacities as well as applications in tension zones.



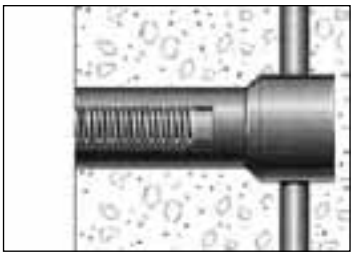
Materials	Surface Finish
Carbon Steel Stainless Steel 316	• Zinc electroplated with chromate conversion coating • Hot Dip Galvanized

Installation

Concrete inserts can be set in wet concrete, attached into reinforcing through the cross hole or fastened to the inside of formwork with a bolt through the formwork.



1. Drill hole in formwork. Pass the bolt through the hole into the concrete insert and tighten. Tie the insert to the reinforcing system.



2. Pour the concrete. Remove the bolt and formwork leaving the Concrete Insert firmly embedded.

Principal Applications

~ Structural connections.
~ Curtain wall and panel facade fixings. (concrete, GRC etc.)
~ Exposure to industrial environments.
~ Marine applications.

Installation and Working Load Limit Performance Details - Stainless Steel TCM

TCM size, d_b	Installation Details				Dimensions			Working Load Limit (kN) FOS = 3						
	Effective depth, h_{ef} (mm)	Fixutre Hole dia. d_f (mm)	Tightening Torque, T_r (Nm)	Cross hole to suit	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear, V_a (kN) @40 N/mm²	Tension, N_a (kN)					
									Unreinforced ferrule			Reinforced ferrule		
									30 N/mm²	40 N/mm²	50 N/mm²	30 N/mm²	40 N/mm²	50 N/mm²
M 8	28	9	10	R8 x 300	40	75	40	5.9	4.3	4.9	5.4	-	-	-
M10	29	12	17	R8 x 300	44	100	50	8.7	4.7	5.3	5.9	5.6	6.3	7.1
M12	37	14	30	R8 x 300	55	120	65	14.2	6.9	7.8	8.7	8.3	9.3	10.4
M16	52	18	75	Y12 x 300	75	160	85	28.0	12.7	14.4	16.0	15.2	17.2	19.3
M20	57	22	144	Y12 x 300	85	180	100	31.7	14.2	16.1	18.0	17.0	19.3	21.6
M24	100.5	27	250	Y12 x 300	150	300	160	42.7	31.4	35.5	39.7	38.1	43.1	48.2

Installation and Working Load Limit Performance Details - Zn Plated / Hot Dipped Galv. TCM

TCM size, d_b	Installation Details				Dimensions			Working Load Limit (kN) FOS = 3						
	Effective depth, h_{ef} (mm)	Fixutre Hole dia. d_f (mm)	Tightening Torque, T_r (Nm)	Cross hole to suit	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear, V_a (kN) @40 N/mm²	Tension, N_a (kN)					
									Unreinforced ferrule			Reinforced ferrule		
									30 N/mm²	40 N/mm²	50 N/mm²	30 N/mm²	40 N/mm²	50 N/mm²
M 8	28	9	10	R8 x 300	40	75	40	5.5	4.3	4.9	5.4	-	-	-
M10	29	12	17	R8 x 300	44	100	50	8.5	4.7	5.3	5.9	5.6	6.3	7.1
M12	37	14	30	R8 x 300	55	120	65	13.3	6.9	7.8	8.7	8.3	9.3	10.4
M16	52	18	75	Y12 x 300	75	160	85	26.9	12.7	14.4	16.0	15.2	17.2	19.3
M20	57	22	144	Y12 x 300	85	180	100	29.3	14.2	16.1	18.0	17.0	19.3	21.6
M24	100.5	27	250	Y12 x 300	150	300	160	36.7	31.4	35.5	39.7	38.1	43.1	48.2

Note:
1. This table does not consider edge distance and anchor spacing effects, hence is a guide only and its use should not replace a complete design process.
2. For Shear loads acting toward the concrete edge(s) or when the above edge distances and anchor spacings are not achievable, please consult Ramset Technical Consultant or refer to design table and use the simplified strength limit state design process to verify capacity.
3. Reinforced TCM is TCM connected to reinforcing bar.
4. Recommended test load for single anchor = Working Load (kN) x 1.5

Description and Part Numbers

TCM size, d_b	TCM length, L (mm)	Effective depth, h_{ef} (mm)	Thread length, L_t (mm)	Order No. s/s	Order No. Zn	Order No. Gal
M 8	35	28	16	TCM8RSS	TCM8R	TCM8GH
M10	44	29	20	TCM10RSS	TCM10R	TCM10GH
M12	54	37	25	TCM12RSS	TCM12R	TCM12GH
M16	75	52	32	TCM16RSS	TCM16R	TCM16GH
M20	80	57	38	TCM20RSS	TCM20R	TCM20GH
M24	125	101	50	TCM24RSS	TCM24R	TCM24GH

Minimum thread engagement = 1.2 x d_b

Engineering Properties

TCM size, d_b	Stress area at cross hole, A_s (mm²)	Stainless Steel		Carbon Steel	
		Yield Strength, f_y (MPa)	UTS, f_u (MPa)	Yield Strength, f_y (MPa)	UTS, f_u (MPa)
M 8	63.7	420	580	330	430
M10	70 3	420	580	330	430
M12	114.2	420	580	330	430
M16	157.8	420	580	330	430
M20	170.0	420	580	330	430
M24	275.6	420	580	330	430

Strength Limit State Design

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram

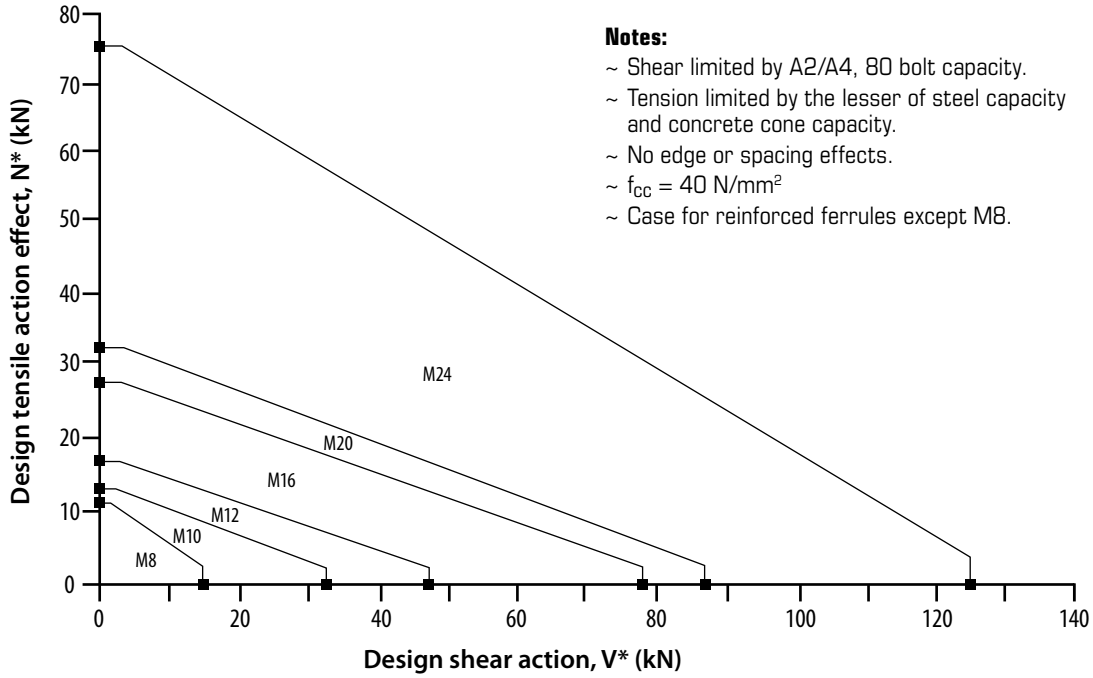


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size. d_b	M8	M10	M12	M16	M20	M24
a_m e_m	25	30	35	45	60	75

Step 1c Calculate anchor effective depth, h_{ef} (mm)

Effective depth, h_{ef} (mm)
Read value from "Description and Part Numbers" table on page 89.

Checkpoint 1 Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.

Strength Limit State Design

STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, $ØN_{uc}$ (kN), $Ø_c = 0.6$

TCM size. d_b			M8	M10	M12	M16	M20	M24
Effective depth. h_{ef} (mm)			28	29	37	52	57	100.5
Unreinforced TCM	Concrete compressive strength (N/mm²)	20	6.0	6.5	9.6	17.7	19.8	43.8
		25	6.9	7.5	11.1	20.4	22.9	50.6
		30	7.7	8.4	12.4	22.8	25.6	56.5
		40	8.8	9.5	14.0	25.8	28.9	63.9
		50	9.8	10.6	15.6	28.9	32.3	71.5
		60	10.9	11.9	17.5	32.3	36.2	79.9
Reinforced TCM	Concrete compressive strength (N/mm²)	20	-	7.8	11.5	21.2	23.8	53.1
		25	-	9.0	13.3	24.5	27.4	61.4
		30	-	10.0	14.9	27.4	30.7	68.6
		40	-	11.3	16.8	31.0	34.7	77.6
		50	-	12.7	18.8	34.7	38.8	86.8
		60	-	14.2	21.0	38.8	43.4	97.0

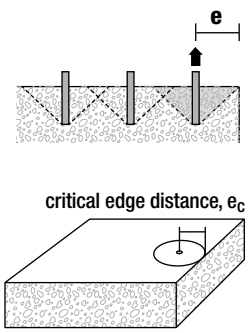
* Cross bar of 300mm in length shall be used for reinforced ferrules case.

For working load design per BD requirement, $N_{as} = ØN_{uc}/0.6/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 2b Concrete compressive strength effect, tension, X_{nc}

$X_{nc} = 1.0$ as concrete compressive strength effect included in table 2a.

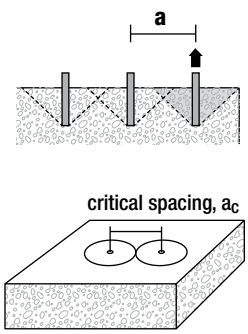
Table 2c Edge distance effect, tension, X_{ne}



TCM size, d_b	M8	M10	M12	M16	M20	M24
Critical Edge dist, e_c (mm)	40	44	55	73	85	150
Edge distance, e (mm)						
25	0.74					
30	0.83	0.78				
35	0.91	0.86	0.75			
40	1.00	0.94	0.81			
45		1.00	0.87	0.70		
55			1.00	0.79	0.75	
65				0.88	0.83	
75				1.00	0.91	0.65
85					1.00	0.69
100						0.76
125						0.88
150						1.00

$X_{ne} = 0.3 + 0.7 * e/e_c \leq 1$

Table 2d Anchor spacing effect, end of a row, tension, X_{nae}



TCM size. d_b	M8	M10	M12	M16	M20	M24
Critical spacing. a_c (mm)	75	87	110	160	170	300
Anchor spacing. a (mm)						
25	0.67					
30	0.71	0.67				
40	0.77	0.73	0.68			
50	0.85	0.79	0.73	0.66		
60	0.92	0.84	0.77	0.69	0.68	
80	1.00	0.96	0.86	0.75	0.74	0.63
100		1.00	0.95	0.82	0.79	0.67
120			1.00	0.88	0.85	0.70
140				0.94	0.91	0.73
160				1.00	0.97	0.77
180					1.00	0.80
200						0.83
250						0.91
300						1.00

$Xnae = 0.5\ (1 + a/a_c) \leq 1$

Strength Limit State Design

Checkpoint 2

Limit State Design:

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$
$ØN_{urc} = ØN_{uc} * X_{nc} * X_{ne} * X_{nae}$

Working Load Design Method (Alternative):

Working load concrete tensile capacity, N_{ar}
$N_{ar} = N_{ac} * X_{nc} * X_{ne} * X_{nae}$

STEP 3

Verify concrete tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n = 0.8$

TCM size, d_b	M8	M10	M12	M16	M20	M24
316 Stainless Steel	25.5	28.1	45.7	63.1	68.0	110.2
Carbon Steel	21.9	24.2	39.3	54.3	58.5	94.8

$ØN_{us} = 0.8 \times N_{us}$
For working load design per BD requirement, Nas = $ØN_{us}/0.8/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 3b Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN), $Ø_v = 0.8$

TCM size. d_b	M8	M10	MI 2	M16	M20	M24
Grade A2-70/A4-70 stainless steel	20.5	32.5	47.3	88.0	137.2	197.7
Grade 4.6 Carbon Steel	11.7	18.6	27.0	50.3	78.4	112.8
Grade 8.8 Carbon Steel	23.4	37.2	54.0	100.0	162.4	234.4

$ØN_{us} = 0.8 \times N_{atf}$
For working load design per BD requirement, Nas = $ØN_{atf}/0.8/3$ (BD requires safety factor of structural fixing = 3 minimum)

Checkpoint 3

Limit State Design:

Design reduced ultimate tensile capacity, $ØV_{ur}$
$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$, $ØV_{tf}$
Check $N^* / ØV_{ur} \leq 1$
If not satisfied return to step 1.

Working Load Design Method (Alternative):

Working load limited tensile capacity, N
N_a = minimum (N_{ar}, N_{as}, N_{atf})
Check $N / V_a \leq 1$
If not satisfied return to step 1.

Strength Limit State Design

STEP 4 Verify concrete shear capacity - per anchor

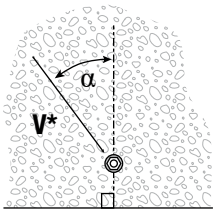
Table 4a Reduced characteristic ultimate concrete edge shear capacity, $ØV_{uc}$ (kN), $Ø_q = 0.6$, $f_{cc} = 25$ N/mm²

TCM size, d_b	M8	M10	M12	M16	M20	M24
Edge distance, e (mm)						
25	2.1					
30	2.3	2.6				
35	2.9	3.2	3.6			
40	3.6	4.0	4.3			
50	5.0	5.5	6.1	6.9		
60	6.6	7.3	8.0	9.1	9.7	
70	8.3	9.1	10.1	11.4	12.2	14.0
100	14.2	15.6	17.2	19.5	20.9	23.9
200	40.1	44.1	48.6	55.2	59.0	67.6
300		81.1	89.2	101.4	108.4	124.2
400				156.1	167.0	191.2
500				218.1	233.3	267.2
600					306.7	351.2

For working load design per BD requirement, $V_{ac} = ØV_{uc}/0.6/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 4b Concrete compressive strength effect, concrete edge shear, Xvc

f_{cc} (N/mm²)	20	25	30	40	50	60
X_{vc}	0.87	1.00	1.12	1.26	1.41	1.73



Load direction effect, conc. edge shear, Xvd

Table 4c Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90-180
X_{vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

Table 4d Anchor spacing effect, concrete edge shear, Xva

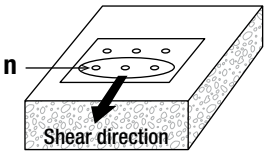
Note: For single anchor designs, $X_{va} = 1.0$

Xva = 0.5 (1+a/2.5e) ≤ 1

Edge distance, e (mm)	30	35	40	50	60	70	100	200	300	400	500	600
Anchor spacing, a (mm)												
30	0.70	0.67	0.65	0.62	0.60	0.59	0.56	0.53				
35	073	0.70	0.68	0.64	0.62	0.60	0.57	0.54	0.52			
40	0.77	0.73	0.70	0.66	0.63	0.61	0.58	0.54	0.53			
50	0.83	0.79	0.75	0.70	0.67	0.64	0.60	0 55	0.53	0.53		
60	0.90	0.84	0.80	0.74	0.70	0.67	0.62	0.56	0.54	0.53	0.52	
70	0.97	0.90	0.85	0.78	0.73	0.70	0.64	0.57	0.55	0.54	0.53	0.52
100	1.00	1.00	1.00	0.90	0.83	0.79	0.70	0.60	0.57	0.55	0.54	0.53
200				1.00	1.00	1.00	0.90	0.70	0.63	0.60	0.58	0.57
300							1.00	0.80	0.70	0.65	0.62	0.60
400								0.90	0.77	0.70	0.66	0.63
500								1.00	0.83	0.75	0.70	0.67
625									0.92	0.81	0.75	0.71
750									1.00	0.88	0.80	0.75
875										0.94	085	0.79
1000										1.00	0.90	0.83
1250											1.00	0.92
1500												1.00

This table should be read in conjunction with Table 4a, changing the edge distance "e" in this table also change the "e" in table 4a.

Strength Limit State Design



Number of anchor, n=3

Table 4e Multiple anchors effect, concrete edge shear, X_{vn}

Note: For single anchor designs, X_{vn} = 1.0

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

$$X_{vn\ (n=2)} = \frac{3.2e + (2n-2) * 0.64a}{3.2 * e * n} \qquad X_{vn} = \frac{X_{vn}\ (n=2)}{X_{vn}\ (n=x)}$$

Checkpoint 4

Limit State Design:

Design reduced ultimate concrete shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

Working Load Design Method (Alternative):

Working load concrete tensile capacity, V_{ar}

$V_{ar} = V_{ac} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

STEP 5

Verify concrete shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v$ = 0.6

(i) $ØV_{usc}$ Reduced characteristic ultimate combined concrete / steel shear capacity

TCM size, d_b	M8	M10	M12	M16	M20	M24
316 Stainless Steel	9.0	13.4	21.9	43.0	48.7	65.6
Carbon Steel	8.4	13.0	20.5	41.3	45.0	56.4

(ii) X_{vsc} Concrete compressive strength effect, combined concrete / steel shear

f_{cc} (N/mm²)	20	25	30	40	50	60
X_{vsc}	0.91	1.00	1.08	1.17	1.26	1.35

$ØV_{us} = ØV_{usc} * X_{vnc}$

For working load design per BD requirement, $V_{ac} = ØV_{uc}/0.6/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN), $Ø_v$ = 0.8

Anchor Size	M8	M10	M12	M16	M20	M24
Grade A2-70/A4-70 stainless steel	11.9	18.8	27.4	50.9	79.3	114.2
Grade 4.6 Carbon Steel	6.8	10.8	15.6	29.1	45.3	65.2
Grade 8.8 Carbon Steel	13.6	21.5	31.2	57.8	93.8	135.4

For working load design per BD requirement, $V_{ac} = ØV_{uc}/0.8/3$ (BD requires safety factor of structural fixing = 3 minimum)

Checkpoint 5

Limit State Design:

Design reduced ultimate shear capacity, $ØV_{ur}$

$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$, $ØV_{sf}$

Check $V^* / ØV_{ur} \leq 1$

If not satisfied return to step 1.

Working Load Design Method (Alternative):

Working load limited tensile capacity, V_a

V_a = minimum V_{ar}, V_{as}, V_{sf}

Check $V / V_a \leq 1$

If not satisfied return to step 1.

Strength Limit State Design

STEP 6 Combined loading and specification

Checkpoint 6

Limit State Design:

Check :
$N^* / ØN_{ur} + V^* / ØN_{ur} \leq 1.2$
If not satisfied return to step 1.

Working Load Design Method (Alternative):

Check :
$N_{(unfactored)} / N_a + V_{(unfactored)} / V_a \leq 1.2$
If not satisfied return to step 1.

Specify

Ramset™ TCM, (Ferrule Size) ((Part Number)) with a (Bolt Grade) bolt.

Example

Ramset™ TCM, M16 (TCM16RSS) with a Gr. 4.6 bolt.
To be installed in accordance with Ramset™ Technical Data Sheet.

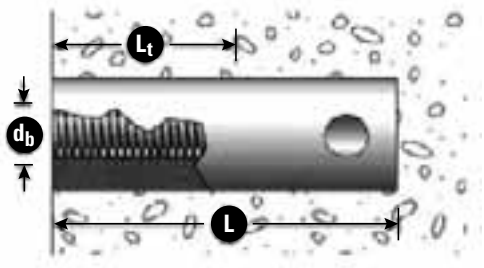
CIM CONCRETE INSERT

CIM GENERAL INFORMATION

Performance Related	Material Related	Installation Related
	Zn, GAL, A4 316	

Product

CIM is a medium to heavy duty, cast-in ferrule.



Benefits, Advantages and Features

Economical:

~ Simple cost effective design.

Superior corrosion resistance:

~ Both AISI 304 (A2) and AISI 316 (A4) stainless steel are available to suit different external environments.

Versatile:

~ Use in near face, far face or side face applications with our range of accessories.

Others:

~ Stress free anchoring close to edge and reduced anchor spacing.

~ Cast-in placement eliminates the need for drilling, particularly important where reinforcing is present in the fixing zone.

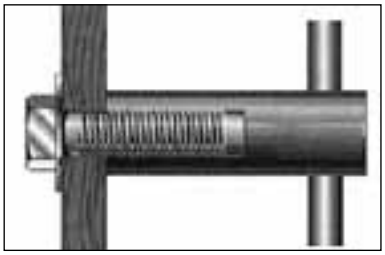
~ Ideal for shallow embedment as the anchor can be tied into the reinforcing to distribute the load over a wider area to become an integral part of the reinforcing structure

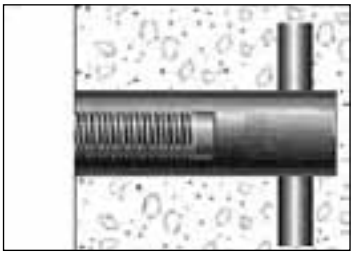
Principal Applications

~ Structural connections
~ Panel to panel connection
~ High shear load applications
~ Cooking bench
~ Temporary precast panel bracing points
~ Facade panel fixings (Concrete, GRC etc.)

Installation

Concrete inserts can be set in wet concrete, attached into reinforcing through the cross hole or fastened to the inside of formwork with a bolt through the formwork.





1. Drill hole in formwork.
2. Pass the bolt through the hole into the concrete insert CIM and tighten. Tie the pin of the insert to the reinforcing system.
3. Pour the concrete.
4. Remove the bolt and form-work leaving the concrete insert CIM firmly embedded.

Installation and Working Load Limit Performance Details - Stainless Steel CIM

Anchor Size	Thread Length	Anchor Length	Outside Diameter	Critical Edge Distance	Critical Anchor Spacing	Minimum Structural thickness	Fixture Hole Diameter	Tightening Torque	Tensile and Shear Working Load (Un-reinforced)@40N/mm²		Tensile and Shear Working Load Reinforced)@40N/mm²		Order No. for SS304 with cross pin	Order No. for SS304 w/o cross pin
CIM	L_t(mm)	L (mm)	D (mm)	e_c (mm)	a_c (mm)	b_m (mm)	d_f (mm)	T (Nm)	T (kN)	V (kN)	T (kN)	V (kN)		
M6	14	35	10	40	75	45	7	5	3.2	3.3	3.9	3.3	CIM6SS	CIM6SSN
M8	16	35	12	40	75	45	9	10	4.9	5.5	5.9	5.5	CIM8SS	CIM8SSN
M10	22	44	16	44	87	50	12	17	5.0	8.7	6.3	8.7	CIM10SS	CIM10SSN
M12	25	55	18	55	110	65	14	30	7.3	12.0	9.1	12.0	CIM12SS	CIM12SSN
M16	32	70	22	73	150	85	18	75	12.3	22.1	15.4	22.1	CIM16SS	CIM16SSN
M20	38	80	25	85	170	100	22	144	13.9	26.0	17.4	26.0	CIM20SS	CIM20SSN
M24	50	125	30	150	300	160	27	250	32.6	33.7	40.8	33.7	CIM24SS	CIM24SSN

Note:
1. This table does not consider edge distance and anchor spacing effects, hence is a guide only and its use should not replace a complete design process.
2. For Shear loads acting toward the concrete edge(s) or when the above edge distances and anchor spacings are not achievable, please consult Ramset Technical Consultant or refer to design table and use the simplified strength limit state design process to verify capacity.
3. Un-reinforced CIM is supplied with short pin through small cross hole. Reinforced CIM is supplied without pin but large cross hole to allow insertion of Y12 rebar.
4. Order No. for 316 stainless steel material shall have " 316 " indication behind ordinary order No.
5. Recommended test load for single anchor = Working Load (kN) x 1.5

Installation and Working Load Limit Performance Details - Zn Plated CIM

Anchor Size	Thread Length	Anchor Length	Outside Diameter	Critical Edge Distance	Critical Anchor Spacing	Minimum Structural thickness	Fixture Hole Diameter	Tightening Torque	Tensile and Shear Working Load (Un-reinforced)@40N/mm²		Tensile and Shear Working Load Reinforced)@40N/mm²		Order No. for Zn plated CIM with cross pin	Order No. for Zn plated CIM w/o cross pin
CIM	L_t(mm)	L (mm)	D (mm)	e_c (mm)	a_c (mm)	b_m (mm)	d_f (mm)	T (Nm)	T (kN)	V (kN)	T (kN)	V (kN)		
M6	14	35	10	40	75	45	7	5	3.2	3.0	3.9	3.0	CIM6	CIM6N
M8	16	35	12	40	75	45	9	10	4.9	5.2	5.9	5.2	CIM8	CIM8N
M10	22	44	16	44	87	50	12	17	5.0	8.5	6.3	8.5	CIM10	CIM10N
M12	25	55	18	55	110	65	14	30	7.3	11.6	9.1	11.6	CIM12	CIM12N
M16	32	70	22	73	150	85	18	75	12.3	20.9	15.3	20.9	CIM16	CIM16N
M20	38	80	25	85	170	100	22	144	13.9	23.3	17.4	23.3	CIM20	CIM20N
M24	50	125	30	150	300	160	27	250	32.5	29.0	40.7	29.0	CIM24	CIM24N

Note:
1. This table does not consider edge distance and anchor spacing effects, hence is a guide only and its use should not replace a complete design process.
2. For Shear loads acting toward the concrete edge(s) or when the above edge distances and anchor spacings are not achievable, please consult Ramset Technical Consultant or refer to design table and use the simplified strength limit state design process to verify capacity.
3. Un-reinforced CIM is supplied with short pin through small cross hole. Reinforced CIM is supplied without pin but large cross hole to allow insertion of Y12 rebar.
4. Recommended test load for single anchor = Working Load (kN) x 1.5

Engineering Properties

CIM size, d_b	Stress area at cross hole, A_s (mm²)	Carbon Steel		Stainless Steel	
		Yield Strength, f_y (MPa)	UTS, f_u (MPa)	Yield Strength, f_y (MPa)	UTS, f_u (MPa)
M6	24.6	330	430	420	580
M8	44.1	330	430	420	580
MI0	70.3	330	430	420	580
M12	102.9	330	430	420	580
M16	132.9	330	430	420	580
M20	149.0	330	430	420	580
M24	275.6	330	430	420	580

Strength Limit State Design

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram

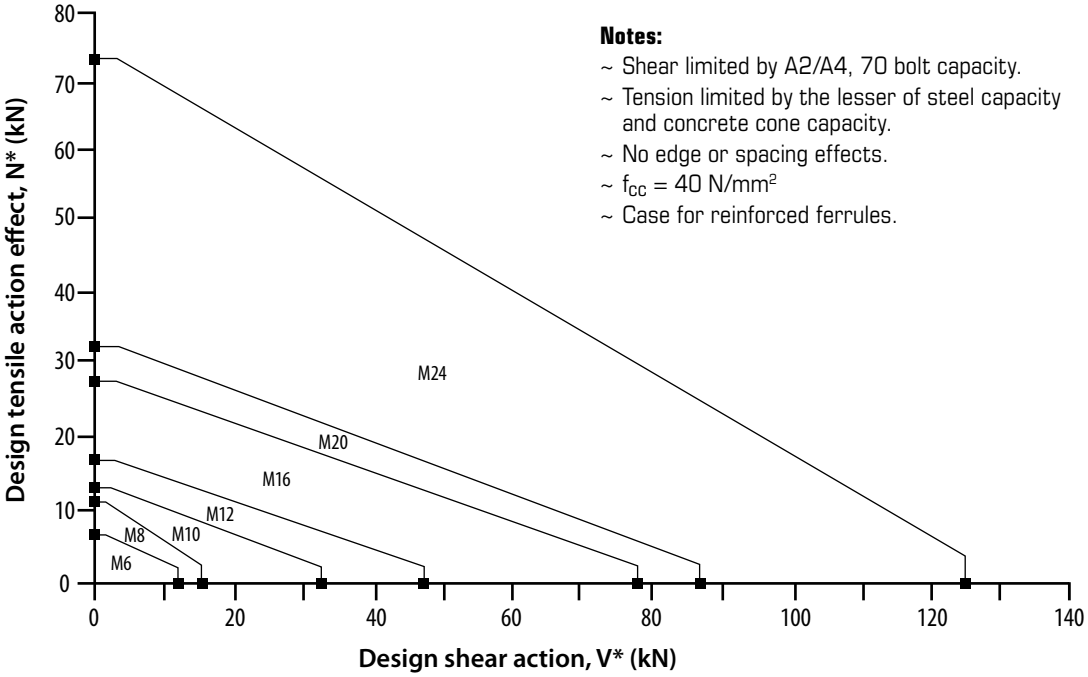


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

CIM size, d_b	M8	M10	M12	M16	M20	M24
a_m e_m	25	30	35	45	60	75

Checkpoint 1 Anchor size determined, absolute minima compliance achieved.

Strength Limit State Design

STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, $ØN_{uc}$ (kN), $Ø_c = 0.6\ f_{cc} = 25\ N/mm^2$

Anchor size, db	M6	M8	M10	M12	M16	M20	M24
Anchor Length, L (mm)	35	35	44	55	70	80	125
Effective Depth, hef (mm)	26	26	35	46	57	67	112
Unreinforced Terrules (w/ cross pin)	4.6	7.0	7.2	10.4	17.5	19.8	46.3
Reinforced Terrules (w/o cross pin)*	5.6	8.4	9.0	12.9	21.9	24.8	57.9

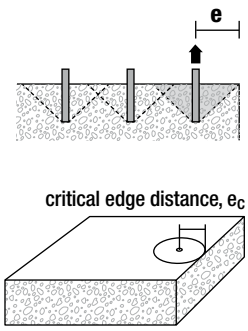
* Cross bar of 300mm in length shall be used for reinforced ferrules case.

For working load design per BD requirement, $N_{as} = ØN_{uc}/0.6/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 2b Concrete compressive strength effect, tension, X_{nc}

f_{cc} (N/mm²)	20	25	30	40	50	60
X_{nc}	0.86	1.00	1.11	1.27	1.42	1.58

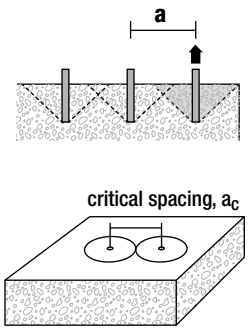
Table 2c Edge distance effect, tension, X_{ne}



TCM size, d_b	M6	M8	M10	M12	M16	M20	M24
Critical Edge dist, e_c (mm)	40	40	44	55	73	85	150
Edge distance, e (mm)							
25	0.74	0.74					
30	0.83	0.83	0.78				
35	0.91	0.91	0.86	0.75			
40	1.00	1.00	0.94	0.81			
45			1.00	0.87	0.73		
55				1.00	0.83	0.75	
65					0.92	0.83	
75					1.00	0.91	0.65
85						1.00	0.69
100							0.76
125							0.88
150							1.00

$X_{ne} = 0.3 + 0.7 * e/e_c \leq 1$

Table 2d Anchor spacing effect, end of a row, tension, X_{nae}



TCM size. d_b	M6	M8	M10	M12	M16	M20	M24
Critical spacing. a_c (mm)	75	75	87	110	150	170	300
Anchor spacing. a (mm)							
25	0.67	0.67					
30	0.71	0.71	0.67				
40	0.77	0.77	0.73	0.68			
50	0.85	0.85	0.79	0.73	0.67		
60	0.92	0.92	0.84	0.77	0.70	0.68	
80	1.00	1.00	0.96	0.86	0.77	0.74	0.63
100			1.00	0.95	0.83	0.79	0.67
120				1.00	0.90	0.85	0.70
140					0.97	0.91	0.73
160					1.00	0.97	0.77
180						1.00	0.80
200							0.83
250							0.91
300							1.00

$Xnae = 0.5\ (1 + a/a_c) \leq 1$

Strength Limit State Design

Checkpoint 2

Limit State Design:

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$
$ØN_{urc} = ØN_{uc} * X_{nc} * X_{ne} * X_{nae}$

Working Load Design Method (Alternative):

Working load concrete tensile capacity, N_{ar}
$N_{ar} = N_{ac} * X_{nc} * X_{ne} * X_{nae}$

STEP 3

Verify concrete tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n = 0.8$

CIM size, d_b	M6	M8	M10	M12	M16	M20	M24
Stainless Steel SS304/SS316	11.4	20.4	32.6	47.7	61.7	71.5	121.3
Carbon Steel	8.5	15.2	24.2	35.4	45.7	54.2	94.8

$ØN_{us} = 0.8 \times N_{us}$
For working load design per BD requirement, Nas = $ØN_{us}/0.8/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 3b Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN), $Ø_n = 0.8$

CIM size. d_b	M6	M8	M10	M12	M16	M20	M24
Grade A2-70/A4-70 stainless steel	11.3	20.5	32.5	47.3	88.0	137.2	197.7
Grade 4.6 Carbon Steel	6.4	11.7	18.6	27.0	50.3	78.4	112.8
Grade 8.8 Carbon Steel	12.9	23.4	37.2	54.0	100.0	162.4	234.4

$ØN_{us} = 0.8 \times N_{atf}$
For working load design per BD requirement, Nas = $ØN_{atf}/0.8/3$ (BD requires safety factor of structural fixing = 3 minimum)

Checkpoint 3

Limit State Design:

Design reduced ultimate tensile capacity, $ØV_{ur}$
$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$, $ØV_{tf}$
Check $N^* / ØV_{ur} \leq 1$
If not satisfied return to step 1.

Working Load Design Method (Alternative):

Working load limited tensile capacity, N
N_a = minimum (N_{ar}, N_{as}, N_{atf})
Check $N / V_a \leq 1$
If not satisfied return to step 1.

Strength Limit State Design

STEP 4

Verify concrete shear capacity - per anchor

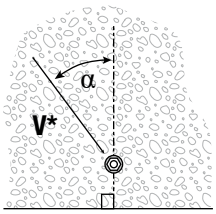
Table 4a Reduced characteristic ultimate concrete edge shear capacity, $ØV_{uc}$ (kN), $Ø_q = 0.6$, $f_{cc} = 25$ N/mm²

CIM size, d_b	M6	M8	M10	M12	M16	M20	M24
Edge distance, e (mm)							
25	1.6	2.1					
30	2.2	2.3	2.6				
35	2.7	2.9	3.2	3.6			
40	3.3	3.6	4.0	4.3			
50	4.6	5.0	5.5	6.1	6.9		
60	6.1	6.6	7.3	8.0	9.1	9.7	
70	7.7	8.3	9.1	10.1	11.4	12.2	14.0
100	13.1	14.2	15.6	17.2	19.5	20.9	23.9
200	37.0	40.1	44.1	48.6	55.2	59.0	67.6
300			81.1	89.2	101.4	108.4	124.2
400					156.1	167.0	191.2
500					218.1	233.3	267.2
600						306.7	351.2

For working load design per BD requirement, $V_{ac} = ØV_{uc}/0.6/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 4b Concrete compressive strength effect, concrete edge shear, X_{vc}

f_{cc} (N/mm²)	20	25	30	40	50	60
X_{vc}	0.87	1.00	1.12	1.26	1.41	1.58



Load direction effect, conc. edge shear, Xvd

Table 4c Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90-180
X_{vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

Table 4d Anchor spacing effect, concrete edge shear, X_{va}

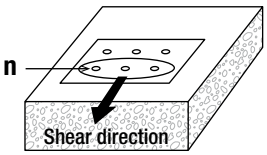
Note: For single anchor designs, $X_{va} = 1.0$

$Xva = 0.5\ (1+a/2.5e) \leq 1$

Edge distance, e (mm)	25	30	35	40	50	60	70	100	200	300	400	500	600
Anchor spacing, a (mm)													
25	0.70	0.67	0.64	0.63	0.60	0.58	0.57	0.55					
30	0.74	0.70	0.67	0.65	0.62	0.60	0.59	0.56	0.53				
35	0.78	0.73	0.70	0.68	0.64	0.62	0.60	0.57	0.54	0.52			
40	0.82	0.77	0.73	0.70	0.66	0.63	0.61	0.58	0.54	0.53			
50	0.90	0.83	0.79	0.75	0.70	0.67	0.64	0.60	0.55	0.53	0.53		
60	0.98	0.90	0.84	0.80	0.74	0.70	0.67	0.62	0.56	0.54	0.53	0.52	
70	1.00	0.97	0.90	0.85	0.78	0.73	0.70	0.64	0.57	0.55	0.54	0.53	0.52
100		1.00	1.00	1.00	0.90	0.83	0.79	0.70	0.60	0.57	0.55	0.54	0.53
200					1.00	1.00	1.00	0.90	0.70	0.63	0.60	0.58	0.57
300								1.00	0.80	0.70	0.65	0.62	0.60
400									0.90	0.77	0.70	0.66	0.63
500									1.00	0.83	0.75	0.70	0.67
625										0.92	0.81	0.75	0.71
750										1.00	0.88	0.80	0.75
875											0.94	0.85	0.79
1000											1.00	0.90	0.83
1250												1.00	0.92
1500													1.00

This table should be read in conjunction with Table 4a, changing the edge distance "e" in this table also change the "e" in table 4a.

Strength Limit State Design



Number of anchor, n=3

Table 4e Multiple anchors effect, concrete edge shear, X_{vn}

Note: For single anchor designs, X_{vn} = 1.0

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

$$X_{vn\ (n=2)} = \frac{3.2e + (2n-2) * 0.64a}{3.2 * e * n} \qquad X_{vn} = \frac{X_{vn}\ (n=2)}{X_{vn}\ (n=x)}$$

Checkpoint 4

Limit State Design:

Design reduced ultimate concrete shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

Working Load Design Method (Alternative):

Working load concrete tensile capacity, V_{ar}

$V_{ar} = V_{ac} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

STEP 5

Verify concrete shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v$ = 0.6

(i) $ØV_{usc}$ Reduced characteristic ultimate combined concrete / steel shear capacity

CIM size, d_b	M6	M8	M10	M12	M16	M20	M24
Stainless Steel SS304/SS316	5.1	8.2	13.4	18.5	34.0	40.0	51.8
Carbon Steel	4.6	7.8	13.0	17.9	32.1	35.8	44.6

(ii) X_{vsc} Concrete compressive strength effect, combined concrete / steel shear

f_{cc} (N/mm²)	20	25	30	40	50	60
X_{vsc}	0.91	1.00	1.08	1.17	1.26	1.35

$ØV_{us} = ØV_{usc} * X_{vnc}$

For working load design per BD requirement, $V_{ac} = ØV_{uc}/0.6/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN), $Ø_v$ = 0.8

Anchor Size	M6	M8	M10	M12	M16	M20	M24
Grade A2-70/A4-70 stainless steel	6.5	11.9	18.8	27.4	50.9	79.3	114.2
Grade 4.6 Carbon Steel	3.8	6.8	10.8	15.6	29.1	45.3	65.2
Grade 8.8 Carbon Steel	7.5	13.6	21.5	31.2	57.8	93.8	135.4

For working load design per BD requirement, $V_{ac} = ØV_{uc}/0.8/3$ (BD requires safety factor of structural fixing = 3 minimum)

Checkpoint 5

Limit State Design:

Design reduced ultimate shear capacity, $ØV_{ur}$

$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$, $ØV_{sf}$

Check $V^* / ØV_{ur} \leq 1$

If not satisfied return to step 1.

Working Load Design Method (Alternative):

Working load limited tensile capacity, V_a

V_a = minimum V_{ar}, V_{as}, V_{sf}

Check $V / V_a \leq 1$

If not satisfied return to step 1.

Strength Limit State Design

STEP 6 Combined loading and specification

Checkpoint 6

Limit State Design:

Check :
$N^* / ØN_{ur} + V^* / ØN_{ur} \leq 1.2$
If not satisfied return to step 1.

Working Load Design Method (Alternative):

Check :
$N_{(unfactored)} / N_a + V_{(unfactored)} / V_a \leq 1.2$
If not satisfied return to step 1.

Specify

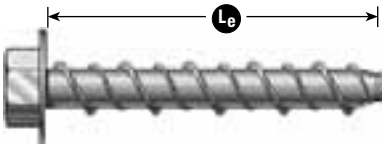
Ramset™ CIM,
(Ferrule Size)
((Part Number))

ANKASCREW GENERAL INFORMATION

Performance Related	Material	Installation Related

Product

The AnkaScrew™ Anchor is a medium duty, rotation setting thread forming anchor.



Benefits, Advantages and Features

Fast and easy to install:

~ Simply screws into hole.

Fast and easy to remove:

~ Screws out leaving an empty hole with no protruding metal parts to grind off

Close to edge and for close anchor spacing:

~ Does not expand and burst concrete.

Substrate

~ Concrete, masonry, hollow brick, hollow block.

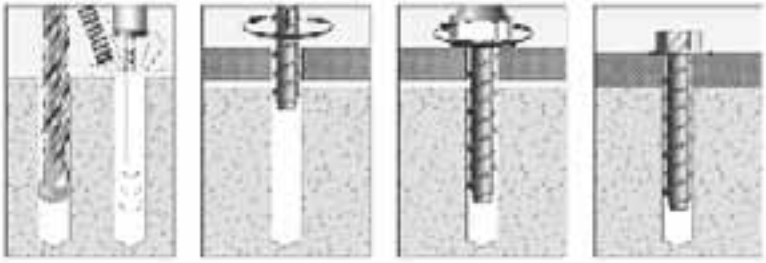
Coating

- Zinc plated and mechanical plated are available for selection. Mechanical plated version has 40um (min) in thickness.

Principal Applications

~ Pallet racking.
~ Temporary safety barriers.
~ Conveyors.
~ Pipe brackets.
~ Gate hinges into brickwork.
~ Temporary hand rails.
~ Bottom plates.

Installation



1. Drill hole to correct diameter and depth. Clean thoroughly with brush. Remove debris by way of vacuum or hand pump, compressed air etc.
2. Using a socket wrench, screw the AnkaScrew™ into the hole using slight pressure until the self tapping action starts.
3. Tighten the AnkaScrew™ . If resistance is experienced when tightening, unscrew anchor one turn and retighten. Ensure not to over tighten.
4. For optimum performance, a torque wrench should be used.

Installation and Working Load Limit performance details

Anchor Size, d_b	Installation Details				Dimensions *		Working Load Limit (FOS = 3)			
	Drilled Hole Diameter, d_h (mm)	Fixture Hole Diameter, d_f (mm)	Anchor Effective Depth, h_{ef} (mm)	Tightening Torque, T_r (Nm)	Edge Distance, e_c (mm)	Anchor Spacing, a_c (mm)	Shear, V_a (kN) f_{cc} >25N/mm²	Tension, Na (kN) Concrete Cube Strength, fcc		
								25 N/mm2	30 N/mm2	40 N/mm2
6	6	8	30	25	25	50	2.8Δ	2.0	2.2	2.4
			37				3.2Δ	2.6	2.8	3.0
			45				3.8Δ	3.3	3.5	3.8
8	8	10	40	40	35	70	5.3Δ	3.0	3.3	3.6
			50				5.9Δ	4.1	4.4	4.8
			60				7.0Δ	5.2	5.6	6.1
10	10	12	50	60	40	80	8.6Δ	4.4	4.8	5.2
			62				9.7Δ	5.9	6.4	7.0
			75				11.5Δ	7.7	8.3	9.1
12	12	15	60	80	50	100	10.4Δ	6.2	6.7	7.3
			75				11.8Δ	8.6	9.4	10.2
			90				13.9Δ	11.3	12.2	13.3

This table does not consider edge distance and anchor spacing effects, hence is a guide only and its use should not replace a complete design process.

* For shear loads acting towards an edge or where these dimensions are not achievable, please use the simplified strength limit state design process to verify capacity.

Note: For recommended test load for single anchor = Working Load (kN) x 1.5

Δ Limited by Steel Strength (Carbon Steel).

Description And Part Numbers

Anchor size, d_b	Effective length, L_e (mm)	Part No.	
		Hex Head (Zn Plated)	Hex Head (Mechanically Galv.)
5	30	AS05030H	-
6	50	AS06050H	AS06050HGH
	75	AS06075H	AS06075HGH
	100	AS06100H	AS06100HGH
8	60	AS08060H	AS08060HGH
	75	AS08075H	AS08075HGH
	100	AS08100H	AS08100HGH
10	60	AS10060H	AS10060HGH
	75	AS10075H	AS10075HGH
	100	AS10100H	AS10100HGH
	150	AS10150H	-
12	75	AS12075H	AS12075HGH
	100	AS12100H	AS12100HGH
	150	AS12150H	-

Engineering Properties

Anchor size, d_h (mm)	Stress area. A_s (mm2)	Yield strength, f_y (MPa)	UTS, f_u (MPa)
6	22.9	640	800
8	42.4	640	800
10	69.4	640	800
12	84.1	640	800

Effective depth, h_{ef} (mm)

hef = lesser L_e - T_{fix}

$5*d_h$

T_{fix} = total thickness of material (s) being fixed

Substrate thickness, b_m (mm)

b_m = great of: 1.5 x h_{ef}

$h_{ef} + (2*d_h)$

Strength Limit State Design

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram

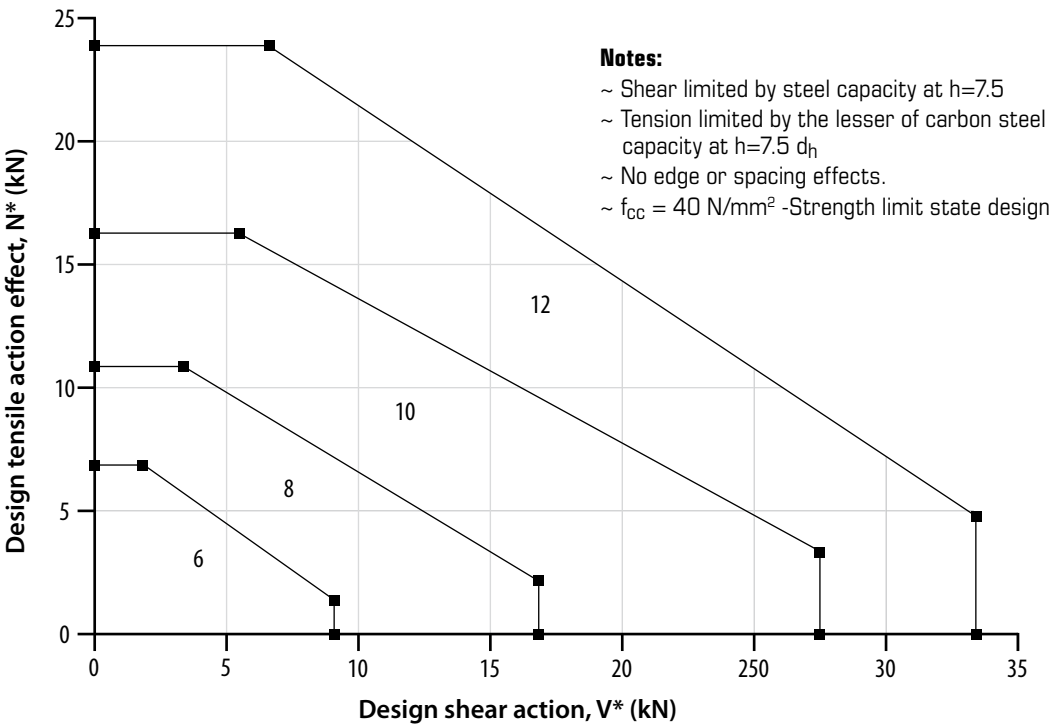


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size. d_b	6	8	10	12
a_m e_m	20	25	30	35

Step 1c Calculate anchor effective depth, h_{ef} (mm)

Effective depth, h_{ef} (mm)

h_{ef} = lesser of Le - T_{fix}
5 * d_h

T_{fix} = total thickness of material(s) being fixed

Checkpoint 1 Anchor size determined, absolute minima compliance achieved, effective depth (h_{ef}) calculated.

Strength Limit State Design

STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, $ØN_{uc}$ (kN), $Ø_c = 0.6\ f_{cc} = 25\ N/mm^2$

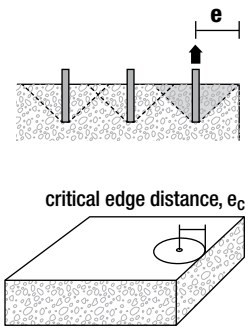
Anchor size, d_b	6	8	10	12
Effective Depth, h_{ef}(mm)				
30	3.7			
35	4.4			
40	5.1	5.5		
45	5.9	6.4		
50		7.4	8.0	
55		7.5	9.1	
60		9.3	10.2	11.3
75			13.9	15.6
90				20.4

Note: Effective depth, h_{ef} must be > 3.5 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.
For working load design per BD requirement, $N_{as} = ØN_{uc}/0.6/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 2b Concrete cube strength effect, tension, X_{nc}

f_{cc} (N/mm²)	25	30	40	50
X_{nc}	1.00	1.08	1.17	1.27

Table 2c Edge distance effect, tension, X_{ne}

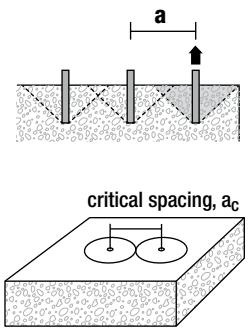


Anchor size, d_b	6	8	10	12
Edge distance, e (mm)				
20	0.88			
25	1	0.85		
30		096	0.83	
35		1	0.91	0.81
40			1	0.88
45				0.96
50				1

$X_{ne} = 0.3 + 0.7 * e/4d_b \leq 1$

Table 2d Anchor spacing effect, end of a row, tension, X_{nae}

Note: For single anchor designs, $X_{nae} = 1.0$



Anchor size, d_b	6	8	10	12
Anchor spacing, a (mm)				
20	0.78			
25	0.85	0.76		
30	092	0.81	0.75	
35	1	0.86	0.79	
40		0.92	0.83	
45		1	0.88	0.81
50			0.92	0.85
55			0.96	0.88
60			1	0.92
70				1

$X_{ne} = 0.5 + (1+a/6d_b) \leq 1$

Strength Limit State Design

Checkpoint 2

Limit State Design:

Design reduced ultimate concrete shear capacity, $ØN_{urc}$
$ØN_{urc} = ØN_{uc} * X_{nc} * X_{ne} * X_{nae}$

Working Load Design Method (Alternative):

Working load concrete tensile capacity, N_{ar}
$N_{ar} = N_{ac} * X_{nc} * X_{ne} * X_{nae}$

STEP 3

Verify anchor tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n = 0.8$

Anchor size, d_b	M6	MB	M10	M12	M16	M20
Carbon steel	9.1	15.7	21.8	27.8	45.5	72.5
316 Stainless steel	6.4	12.6	21.8	29.9	55.2	97.7

$ØN_{us} = 0.8 * N_{us}$
For working load design per BD requirement, $N_{as} = ØN_{uc}/0.8/3$ (BD requires safety factor of structural fixing = 3 minimum)

Step 3b Reduced characteristic ultimate bait steel tensile capacity, $ØN_{tf}$ (kN)
Not appropriate for this product

Checkpoint 3

Limit State Design:

Design reduced ultimate shear capacity, $ØN_{ur}$
$ØN_{ur}$ = minimum of $ØN_{urc}$, $ØN_{us}$
Check $N^* / ØN_{ur} \leq 1$
If not satisfied return to step 1.

Working Load Design Method (Alternative):

Working load limited tensile capacity, (N)
N_a = minimum (N_{ar}, N_{as})
Check $N / N_a \leq 1$
If not satisfied return to step 1.

Strength Limit State Design

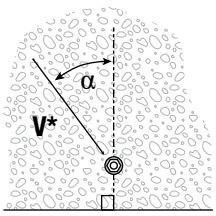
STEP 4 Verify concrete shear capacity - per anchor

Table 4a Reduced characteristic ultimate concrete edge shear capacity, $ØV_{uc}$ (kN), $Ø_q = 0.6$, $f_{cc} = 25$ N/mm²

$ØV_{uc} = 5.45 * d_h$ ^ 0.5 * e ^ 1.5 * 0.6

Anchor size, d_h (mm)	6	8	10	12
Edge distance, e (mm)				
20	0.7			
25	1.0	1.2		
30	1.3	1.5	1.7	
35	1.7	1.9	2.1	2.3
50	2.8	3.3	3.7	4.0
75	5.2	6.0	6.7	7.4
100	8.0	9.2	10.3	11.3
150	14.7	17.0	19.0	20.8
200	22.7	26.2	29.2	32.0
250		36.6	40.9	44.8
300			53.7	58.9
400				90.6

Note: Effective depth, h_{ef} must be > 4 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.
For working load design per BD requirement, $V_{as} = ØV_{uc}/0.6/3$ (BD requires safety factor of structural fixing = 3 minimum)



Load direction effect, conc. edge shear, Xvd

Table 4b Concrete compressive strength effect, concrete edge shear, X_{vc}

f_{cc} (N/mm²)	25	30	40	50
X_{vc}	1.00	1.11	1.27	1.42

Table 4c Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90-180
X_{vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

Table 4d Anchor spacing effect, concrete edge shear, X_{va}

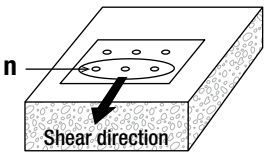
Note: For single anchor designs, $X_{va} = 1.0$

$X_{va} = 0.5\ (1+a/2.5e) \leq 1$

Edge distance, e (mm)	20	25	30	35	50	75	100	150	200	250	300	400
Anchor spacing, a (mm)												
20	0.70	0.66	0.63	0.61	0.58	0.55	0.54	0.53	0.52			
25	0.75	0.70	0.67	0.64	0.60	0.57	0.55	0.53	0.53	0.52		
30	0.80	0.74	0.70	0.67	0.62	0.58	0.56	0.54	0.53	0.52	0.52	
35	0.85	0.78	0.73	0.70	0.64	0.59	0.57	0.55	0.54	0.53	0.52	0.52
40	0.90	0.82	0.77	0.73	0.66	0.61	0.58	0.55	0.54	0.53	0.53	0.52
50	1.00	0.90	0.83	0.79	0.70	0.63	0.60	0.57	0.55	0.54	0.53	0.53
65		1.00	0.93	0.87	0.76	0.67	0.63	0.59	0.57	0.55	0.54	0.53
80			1.00	0.96	0.82	0.71	0.66	0.61	0.58	0.56	0.55	0.54
100				1.00	0.90	0.77	0.70	0.63	0.60	0.58	0.57	0.55
125					1.00	0.83	0.75	0.67	0.63	0.60	0.58	0.56
150						0.90	0.80	0.70	0.65	0.62	0.60	0.58
200						1.00	0.90	0.77	0.70	0.66	0.63	0.60
250							1.00	0.83	0.75	0.70	0.67	0.63
300								0.90	0.80	0.74	0.70	0.65
450								1.00	0.95	0.86	0.80	0.73
600									1.00	0.98	0.90	0.80
1000										1.00	1.00	1.00

This table should be read in conjunction with Table 4a, changing the edge distance "e" in this table also change the "e" in table 4a.

Strength Limit State Design



Number of anchor, n=3

Table 4e Multiple anchors effect, concrete edge shear, X_{vn}

Note: For single anchor designs, X_{vn} = 1.0

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	I.00	1.0D	1.00	1.00	1.00	1.00	100	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.83	0.91	0.93	0.95	0.96	0.98	1.00
4	G.57	0.84	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.30	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	Q.80	0.84	0.88	0.92	0.9G	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	D.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.93	0.95	1.00

$$X_{vn\ (n=2)} = \frac{3.2e + (2n-2) * 0.64a}{3.2 * e * n} \qquad X_{vn} = \frac{X_{vn}\ (n=2)}{X_{vn}\ (n=x)}$$

Checkpoint 4

Limit State Design:

Design reduced ultimate concrete shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

Working Load Design Method (Alternative):

Working load concrete tensile capacity, V_{ar}

$V_{ar} = V_{ac} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

STEP 5

Verify concrete shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v$ = 0.8

Anchor size, d_h (mm)	6	8	10	12
h > 5 x d_h	6.8	12.6	20.7	25.0
h > 6 x d_h	7.7	14.3	23 4	28.4
h > 7 x d_h	8.6	16 0	26.2	31.7
h > 7.5 x d_h	9.1	16 8	27.5	33.4

$ØV_{uc} = 0.8 * V_{us}$

For working load design per BD requirement, $V_{as} = ØV_{uc}/0.8/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)

Not appropriate for this product.

Checkpoint 5

Limit State Design:

Design reduced ultimate shear capacity, $ØV_{ur}$

$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$

Check $V^* / ØV_{ur} \leq 1$

If not satisfied return to step 1.

Working Load Design Method (Alternative):

Working load limited tensile capacity, V_a

V_a = minimum of V_{ar}, V_{as}

Check $V / V_a \leq 1$

If not satisfied return to step 1.

Strength Limit State Design

STEP 6

Checkpoint 6

Combined loading and specification

Limit State Design:

Check :
$N^* / ØN_{ur} + V^* / ØN_{ur} \leq 1.2$
If not satisfied return to step 1.

Working Load Design Method (Alternative):

Check :
$N_{(unfactored)} / N_a + V_{(unfactored)} / V_a \leq 1.2$
If not satisfied return to step 1.

Specify

Ramset™ AnkaScrew™ Anchor, (Anchor Size) ((Part Number)). Maximum fixed thickness to be (t)mm.

Example

Ramset™ AnkaScrew™ Anchor, 12 mm (AS12100H). Maximum fixed thickness to be 40 mm. To be installed in accordance with Ramset™ Technical Data Sheet.

DYNASET™ DROP-IN ANCHOR

DYNASET GENERAL INFORMATION

Performance Related	Material Related	Installation Related

Product

The DynaSet™ Anchor is a medium duty, displacement setting expansion anchor.

Benefits, Advantages and Features

Fast installation:

~ Shallow embedment and simple setting action.

Convenient:

~ Threaded rod can be cut to equal lengths.

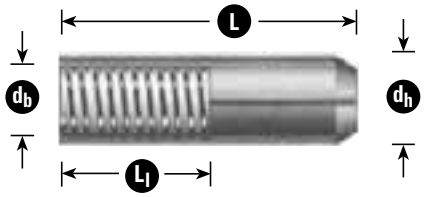
~ Flanged version sits flush with surface in overdrilled holes. Ideal as reusable anchorage point:

~ Internal threaded design.

~ No protruding metal parts when bolt or rod is removed.

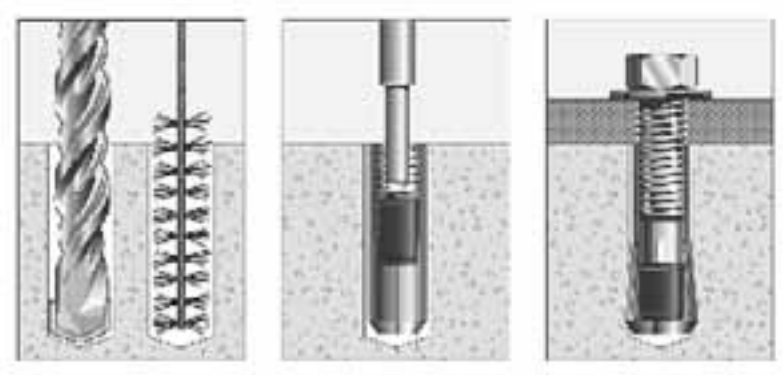
Superior corrosion resistance:

~ AISI 316(A4) Stainless Steel.



Principal Applications

~ Suspended services, such as cable tray, ventilation ducts or plumbing fixtures.
~ Stadium seating.
~ Holding down machinery.
~ Installing racking.
~ Suspended ceilings.



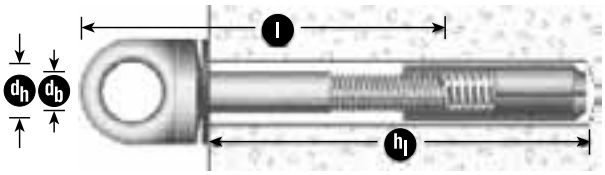
Installation

1. Drill hole at recommended diameter, to at least the anchor length in depth. Clean hole thoroughly with a brush. Remove debris by way of a vacuum pump, compressed air, hard pump etc.
2. Insert anchor and push to required depth. Using the special setting tool, drive the expander plug down until shoulder of the setting punch meets top of the anchor.
3. Position fixture then insert the bolt and tighten with torque wrench. The DynaSet™ anchor remains set in position if the bolt is removed.

DYNASET™ SAFETY RING ANCHOR

~ For use with Dynaset™ DSM12SS.
~ Secure fixing for high rise maintenance.

BS5845 (Static Tension - 10kN, Drop Test - 136kg/1m)
AS2626 (Static Tension - 15kN)
NZS5802 (Static Tension - 27kN, Static shear - 5kN, Drop Test - 110kg/1.2m)
BS EN795 (Static Tension - 10kN, Drop Test - 100kg/2.5m)



l Anchor Length (mm) X **d** Anchor Size (mm)		**d_b** Thread Size	**d_h** Anchor Hole Diameter (mm)	**h_l** Hole Depth (mm)	Finish	Pack Quantity	Order No.
16	138x16	M12	16	125	S/S	10	RSR12SS
	138x16	M12	16	125	Gal.	10	RSR12GM

Non-destructive pull-out test of 6kN and sustain for a minimum of 15 seconds is required for each Safety Ring Anchor after installation to ensure the compliance of BS EN 795 Standard.

DYNASET™ DROP-IN ANCHOR

Ramset™

Installation and Working Load Limit performance details

Anchor Size, d_b	Drill Hole Diameter, d_h (mm)	Fixture Hole Dia, d_f (mm)	Hole Depth, h_l (mm)	Anchor Effective Depth (mm)	Tightening Torque, T (Nm)	Concrete* Edge (mm)	Anchor* Spacing (mm)	Shear FOS = 3 (kN)	Tensile Working Load (kN) FOS = 3 Concrete compressive cube strength f_{cc} (N/mm²)		
									25 N/mm²	30 N/mm²	40 N/mm²
M6	8	7	28	23	6	80	69	1.9Δ	2.2	2.5	2.8
M8	10	9	33	28	10	100	84	2.4Δ	3.0	3.3	3.8
M10	12	12	43	38	20	135	114	2.9Δ	4.7	5.2	6.0
M12	16	14	53	48	40	170	144	5.5Δ	6.7	7.4	8.5
M16	20	18	68	63	95	220	189	8.7Δ	10.1	11.2	12.7
M20	25	22	83	78	180	275	234	10.9Δ	13.9	15.4	17.6

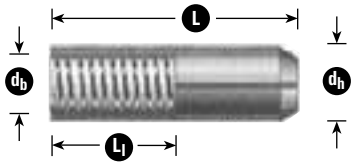
This table does not consider edge distance and anchor spacing effects, hence is a guide only and its use should not replace a complete design process.

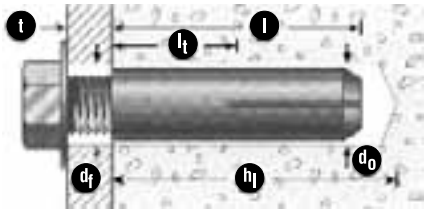
* For shear loads acting towards an edge or where these dimensions are not achievable, please use the simplified strength limit state design process to verify capacity.
Note: For recommended test load for single anchor = Working Load (kN) x 1.5

Δ Limited by Steel Strength (Carbon Steel). For Stainless Steel Trubolt, please refer to design tables for respective recommended load.

Description And Part Numbers

Anchor size, d_b	Hole Diameter dh (mm)	Anchor Length L (mm)	Effective Depth hef (mm)	Part No.		
				Zn	SS316	SS304
M6	8	25	23	DSM06	DSM06SS	DSM06SSA2
M8	10	30	28	DSM08	DSM08SS	DSM08SSA2
M10	12	40	38	DSM10	DSM10SS	DSM10SSA2
M12	16	50	48	DSM12	DSM12SS	DSM12SSA2
M16	20	65	63	DSM16	DSM16SS	DSM16SSA2
M20	25	80	78	DSM20	DSM20SS	DSM20SSA2





Substrate thickness, b_m (mm)
$b_m = 2 \times h_{ef}$

Engineering Properties

Anchor Size, d_b	Anchor Stress Area A_s (mm)	Carbon Steel		Stainless Steel		Section Modulus, Z (mm³)
		Yield Strength, f_{yk} (N/mm²)	UTS, f_{uk} (N/mm²)	Yield Strength, f_{yk} (N/mm²)	UTS, f_{uk} (N/mm²)	
M6	24.3	350	440	480	600	36.9
M8	32.0	350	440	480	600	63.7
M10	40.7	340	430	480	600	100.2
M12	96.3	260	320	480	600	292.9
M16	125.5	320	450	480	600	502.1
M20	159.8	320	450	480	600	789.6

Strength Limit State Design

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram

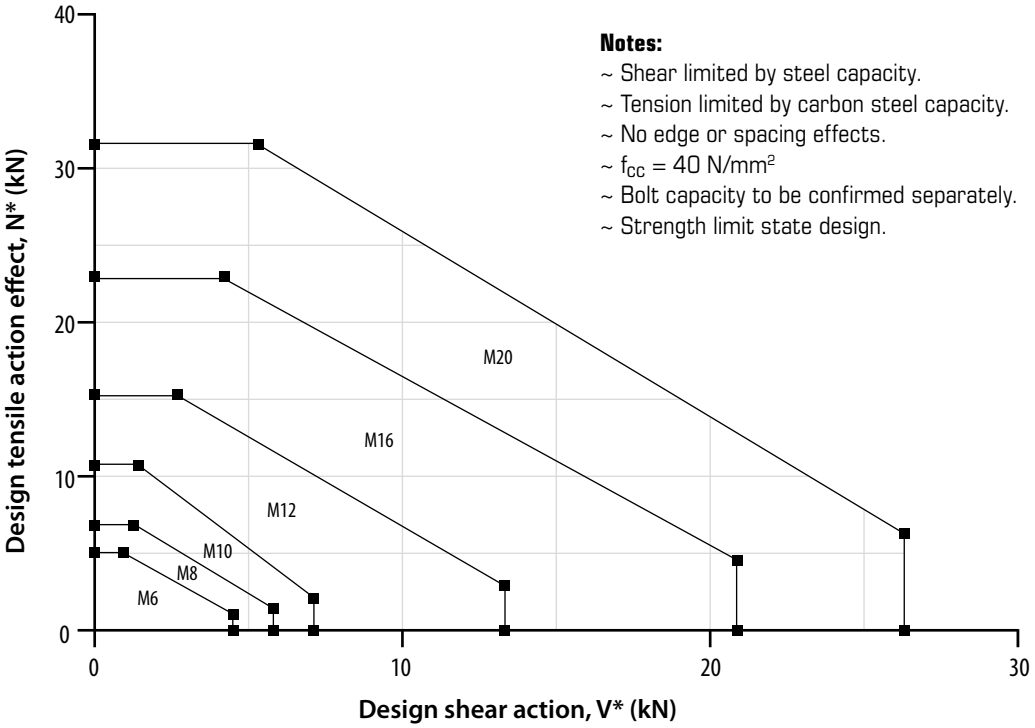


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size. d_b	M6	M8	M10	M12	M16	M20
Edge distance, e_m	80	100	135	170	220	275
Anchor spacing, a_m	60	70	95	120	160	195

Step 1c Calculate anchor effective depth, h_{ef} (mm)

Effective depth, h_{ef} (mm)

Read value from "Description and Part Numbers" table on page 113.

Checkpoint 1 Anchor size determined, absolute minima compliance achieved, effective depth (h_{ef}) calculated.

Strength Limit State Design

STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, $ØN_{uc}$ (kN), $Ø_c = 0.6$

Anchor size, d_b	M6	M8	M10	M12	M16	M20
Effective Depth, h_{ef}(mm)	23	28	38	48	63	78
Concrete compressive strength, f_{cc} (N/mm²)						
25	4.0	5.4	8.5	12.0	18.1	25.0
30	4.5	6.0	9.5	13.5	20.3	27.9
40	5.1	6.8	10.7	15.2	22.9	31.6
50	5.7	7.6	12.0	17.0	25.6	35.3

For working load design per BD requirement, $N_{as} = ØN_{uc}/0.6/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 2b Concrete compressive strength effect, tension, X_{nc}

X_{nc} = 1.0 as concrete compressive strength effect included in table 2a

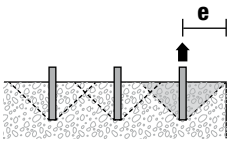
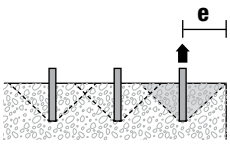


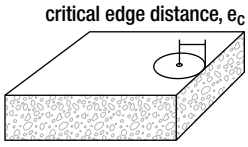
Table 2c Edge distance effect, tension, X_{ne}

X_{ne} = 1.0 for all valid edge distance values

Table 2d Anchor spacing effect, end of a row, tension, X_{nae}

Note: For single anchor designs, X_{nae} = 1.0





Anchor size, d_b	M6	M8	M10	M12	M16	M20
Anchor spacing, a (mm)						
60	0.93					
65	0.97					
70	1	0.92				
80		0.98				
90		1				
100			0.94			
110			0.98			
120			1	0.92		
130				0.95		
150				1	0.90	
170					0.95	
180					0.98	
190					1	
200						0.93
220						0.97
230						0.99
235						1

$X_{ne} = 0.3 + 0.7 * e/e_c \leq 1$

$e_c = 1.5 * h_{ef}$

Strength Limit State Design

Checkpoint 2

Limit State Design:

Design reduced ultimate concrete shear capacity, $ØN_{urc}$
$ØN_{urc} = ØN_{uc} * X_{nc} * X_{ne} * X_{nae}$

Working Load Design Method (Alternative):

Working load concrete tensile capacity, N_{ar}
$N_{ar} = N_{ac} * X_{nc} * X_{ne} * X_{nae}$

STEP 3

Verify anchor tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n = 0.8$

Anchor size, d_b	M6	MB	M10	M12	M16	M20
Carbon steel	8.5	11.2	13.8	24.7	40.2	51.1
304/316 Stainless steel	11.7	15,4	19,5	34.6	60.2	76,7

$ØN_{us} = 0.8 * N_{us}$
For working load design per BD requirement, $N_{as} = ØN_{uc}/0.8/3$ (BD requires safety factor of structural fixing = 3 minimum)

Step 3b Reduced characteristic ultimate bait steel tensile capacity, $ØN_{tf}$ (kN)

Establish the reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ from literature supplied by the. specified bolt manufacturer.

For nominal expected capacities of bolt manufactured to ISO standards, refer to section XXX, Page XXX.

Checkpoint 3

Limit State Design:

Design reduced ultimate shear capacity, $ØN_{ur}$
$ØN_{ur}$ = minimum of $ØN_{urc}$, $ØN_{us}$
Check $N^* / ØN_{ur} \leq 1$
If not satisfied return to step 1.

Working Load Design Method (Alternative):

Working load limited tensile capacity, (N)
N_a = minimum (N_{ar}, N_{as})
Check $N / N_a \leq 1$
If not satisfied return to step 1.

STEP 4 Verify concrete shear capacity - per anchor

Table 4a Reduced characteristic ultimate concrete edge shear capacity, $ØV_{uc}$ (kN), $Ø_q = 0.6$, $f_{cc} = 25$ N/mm²

$ØV_{uc} = 5.45 * d_h$ ^ 0.5 * e ^ 1.5 * 0.6

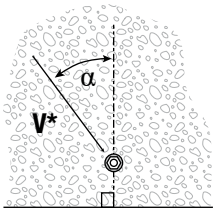
Anchor size, d_h (mm)	M6	M8	M10	M12	M16	M20
Drilled hole diameter (mm)	8	10	12	16	20	25
Edge distance, e (mm)						
80	6.6					
100	9.2	10.3				
125	12.9	14.5				
150	17.0	19.0	20.8			
175	21.4	23.9	26.2	30.3		
200	26.2	29.2	32.0	37.0		
250	36.6	40.9	44.8	51.7	57.8	
300		53.7	58.9	68.0	76.0	85.0
350			74.2	85.6	95.8	107.1
400			90.6	104.6	117.0	130.8
500					163.5	182.8
650						270.9

For working load design per BD requirement, $V_{as} = ØV_{uc}/0.6/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 4b Concrete compressive strength effect, concrete edge shear, X_{vc}

f_{cc} (N/mm²)	25	30	40	50
X_{vc}	1.00	1.11	1.27	1.42

Concrete compressive strength less than 25 N/mm² is not recommended.



Load direction effect, conc. edge shear, Xvd

Table 4c Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90-180
X_{vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

Table 4d Anchor spacing effect, concrete edge shear, X_{va}

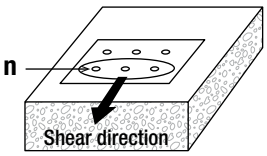
Note: For single anchor designs, $X_{va} = 1.0$

$X_{va} = 0.5\ (1+a/2.5e) \leq 1$

Edge distance, e (mm)	80	100	125	150	175	200	250	300	350	400	500	650
Anchor spacing, a (mm)												
60	0.65	0.62	0.60	0.58	0.57	0.56	0.55					
70	0.68	0.64	0.61	0.59	0.58	0.57	0.56	0.55				
80	0.70	0.66	0.63	0.61	0.59	0.58	0.56	0.55				
100	0.75	0.70	0.66	0.63	0.61	0.60	0.58	0.57	0.56	0.55		
120	0.80	0.74	0.69	0.66	0.64	0.62	0.60	0.58	0.57	0.56		
160	0.90	0.82	0.76	0.71	0.68	0.66	0.63	0.61	0.59	0.58	0.56	
200	1.00	0.90	0.82	0.77	0.73	0.70	0.66	0.63	0.61	0.60	0.58	0.56
250		1.00	0.90	0.83	0.79	0.75	0.70	0.67	0.64	0.63	0.60	0.58
300			0.98	0.90	0.84	0.80	0.74	0.70	0.67	0.65	0.62	0.59
400			1.00	1.00	0.96	0.90	0.82	0.77	0.73	0.70	0.66	0.62
500					1.00	1.00	0.90	0.83	0.79	0.75	0.70	0.65
625							1.00	0.92	0.86	0.81	0.75	0.69
750								1.00	0.93	0.88	0.80	0.73
875									1.00	0.94	0.85	0.77
1000										1.00	0.90	0.81
1250											1.00	0.88
1625												1.00

This table should be read in conjunction with Table 4a, changing the edge distance "e" in this table also change the "e" in table 4a.

Strength Limit State Design



Number of anchor, n=3

Table 4e Multiple anchors effect, concrete edge shear, X_{vn}

Note: For single anchor designs, X_{vn} = 1.0

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	I.00	1.0D	1.00	1.00	1.00	1.00	100	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.83	0.91	0.93	0.95	0.96	0.98	1.00
4	G.57	0.84	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.30	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	Q.80	0.84	0.88	0.92	0.9G	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	D.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.93	0.95	1.00

$$X_{vn\ (n=2)} = \frac{3.2e + (2n-2) * 0.64a}{3.2 * e * n} \qquad X_{vn} = \frac{X_{vn}\ (n=2)}{X_{vn}\ (n=x)}$$

Checkpoint 4

Limit State Design:

Design reduced ultimate concrete shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

Working Load Design Method (Alternative):

Working load concrete tensile capacity, V_{ar}

$V_{ar} = V_{ac} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

STEP 5

Verify concrete shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v$ = 0.8

Anchor size, d_h	M6	M8	M10	M12	M16	M20
Carbon steel	45	5.8	7.1	13 2	20.9	26.3
304/316 Stainless steel	6.1	7.9	10.0	17.8	31.3	39.4

$ØV_{uc} = 0.8 * V_{us}$

For working load design per BD requirement, $V_{as} = ØV_{us}/0.8/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)

Establish the reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ from literature supplied by the. specified bolt manufacturer.

For nominal expected capacities of bolt manufactured to ISO standards, refer to section XXX, Page XXX.

Checkpoint 5

Limit State Design:

Design reduced ultimate shear capacity, $ØV_{ur}$

$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$, $ØV_{sf}$

Check $V^* / ØV_{ur} \leq 1$

If not satisfied return to step 1.

Working Load Design Method (Alternative):

Working load limited tensile capacity, V_a

V_a = minimum of V_{ar}, V_{as}, V_{asf}

Check $V / V_a \leq 1$

If not satisfied return to step 1.

Strength Limit State Design

STEP 6

Checkpoint 6

Combined loading and specification

Limit State Design:

Check :
$N^* / ØN_{ur} + V^* / ØN_{ur} \leq 1.2$
If not satisfied return to step 1.

Working Load Design Method (Alternative):

Check :
$N_{(unfactored)} / N_a + V_{(unfactored)} / V_a \leq 1.2$
If not satisfied return to step 1.

Specify

Ramset™ Dynaset™ Anchor, (Anchor Size) ((Part Number)) with a (Bolt Grade) bolt.

Example

Ramset™ Dynaset™ Anchor. M16 (DSM16) with a Gr. 4.6 bolt.
To be installed in accordance with Ramset™ Technical Data Sheet.

RAMSET EPCON G5 GENERAL INFORMATION

Performance Related	Material Related	Installation Related
	Zn, GAL, A4 316	

EPCON G5 is a long working time, fast cure, heavy duty, aliphatic amine/epoxy injection system.

Features:

- Shorter bar development lengths from high bond strength - faster installation.
- Anchor and rebar in dry, damp, wet or flooded holes - no weather delays.
- Exceeds steel strength up to AIS1316 stainless steel at recommended embedments.
- High loads in shallow holes in thin slab.
- Long 15 minutes working time to allow full bar insertion - easier installation of larger diameter anchor and rebar.
- Fast 2 hours cure time.
- Anchor and rebar in carbide drilled and diamond cored holes.
- For tropical and temperate climates - easier to install anchor and rebar in hot weather.
- Odourless.
- Non-flammable.
- Eligible for overhead fixing.

ICC ES

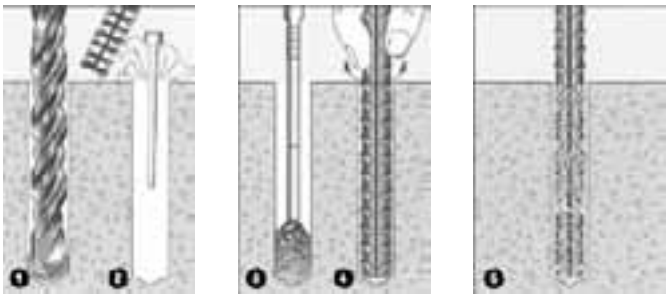
NSF Certified to ANSI/NSF 61

Approved for Cracked Concrete and All Seismic Zones

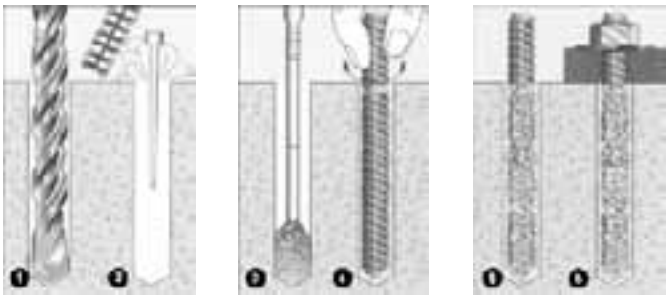
Principal Applications

~ Reinforcing bars,
~ Anchoring structural steel to concrete,
~ Starter bars,
~ Deformed bars,
~ Anchoring Stadium Seating

Installation (for Rebar Fixing)



Installation (for ChemSet Anchor Stud Fixing)



1. Drill recommended diameter and depth hole,
2. Clean hole with hole cleaning brush. Remove all debris using hole blower.
3. Insert mixing nozzle to bottom of hole. Fill hole to 1/2 of the hole depth slowly, ensuring no air pockets form,
4. Insert reinforcing bar (or chemset Anchor Stud) to bottom of hole while turning.
5. Allow EPCON G5 to cure as per setting times.
6. Attach fixture for ChemSet anchor stud case

Installation temperature

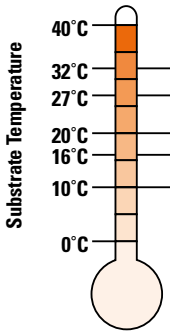
~ Substrate: 5°C to 40°C

- Load Should not be applied to anchor until the chemical has sufficiently cured as specified
- Warming of cartridge required if mortar temperature is below 20°C

Service temperature

-10°C to 80°C

Setting Times



EPCON G5	
Working Time (mins)	Cure Time (hrs)
8.5	2
12	2
15	2
18	3
21	6

Note: Cartidge temperature minimum 20°C

Recommended Loads (kN) Threaded Stud Fixing Application

Anchor size, d (mm)	Installation details				Dimensions			Working Load Limit (Concrete C30)	
	Drilled Hole diameter, d_h (mm)	Fixture Hole diameter, d_f (mm)	Hole depth, h_l (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Tension, N_a (kN)	Shear, Va (kN)
M8	10	10	80 100	10	30	50	100 130	6.0 7.6	5.6[Δ]
M10	12	12	90 110	20	40	60	120 140	12.4 15.2	8.9[Δ]
M12	14	15	110 150	30	50	70	140 185	18.1 24.7	13.0[Δ]
M16	18	19	110 125 145 190	60	65	100	140 160 190 235	25.4 28.9 34,7 43.9	24.0[Δ]
M20	24	24	150 170 250	120	80	120	190 220 315	36.0 40.9 60.1	39.1[Δ]
M24	28	28	160 210 280	200	95	145	200 270 345	41.2 54.1 72.1	56.4[Δ]
M30	35	35	210 280 380	400	120	180	265 360 470	61.1 80.4 1091	89.7[Δ]

This table does not consider edge distance and anchor spacing effects, hence is a guide only and its use should not replace a complete design process.
The factor of safety applied is 3.0.
For shear loads acting towards an edge or where these dimensions are not achievable, please use the simplified strength limit state design process to verify capacity.
Note: For recommended test load for single anchor = Working Load (kN) x 1.5

[Δ] Limited by Steel Strength (Carbon Steel Grade 8.8). The shear load will change with different steel grade adopted.
For anchor studs out of the range mentioned above, please consult your local Ramset technical representatives for more information.

Description and Part Numbers

Description	Cartridge Size	Part No.
Ramset Epcon G5	650 ml	Epcon G5

Effective depth, h_{ef} (mm)
Preferred $h_{ef} = h_l$ otherwise,
$h_{ef} = L_e - T_{fix}$
$h_{ef} \geq 6 * d_h$
T_{fix} = total thickness of material(s) being fastened

Substrate thickness, b_m (mm)
b_m = greater of: $1.25 \times h_{ef}$, $h_{ef} + (2 \times d_h)$

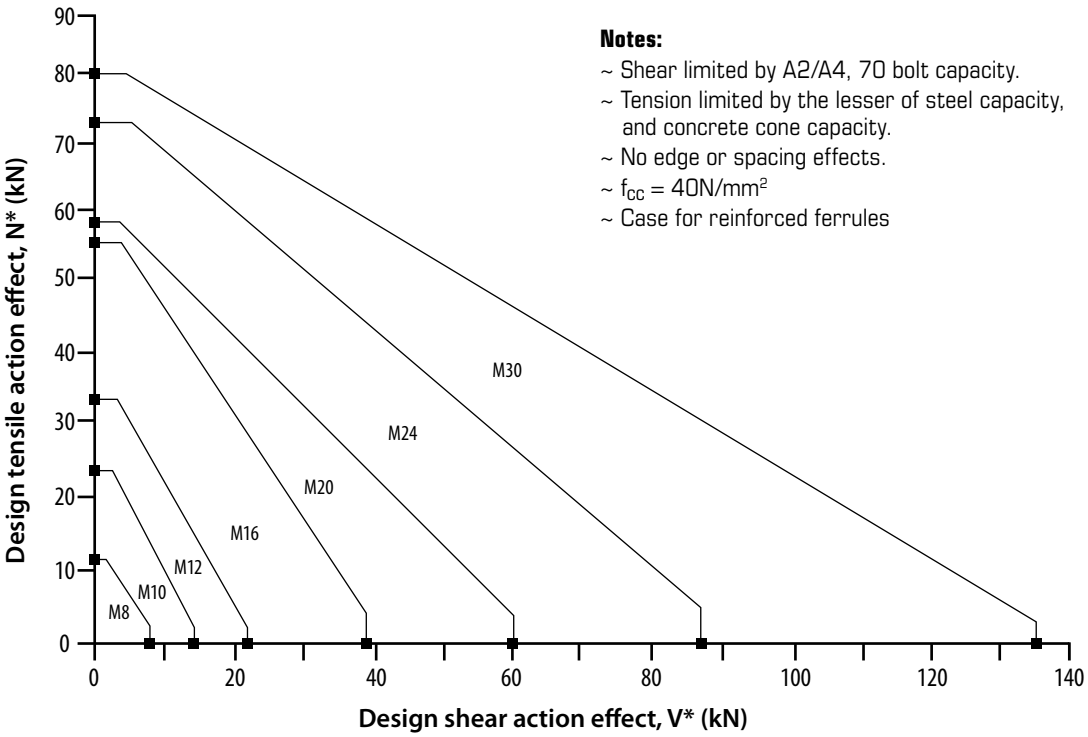
Estimating Table Numbers of Anchoring per 650 ml Cartridge (Threaded Stud Bolt Fixing Application)

Anchor Size(mm)	Hole Dia. (mm)	Hole Depth (mm)													
		60	75	90	100	120	150	180	200	225	250	275	300	350	400
M8	10	244.4	195.5	162.3	146.6	122.2	97.7	81.5	73.3	65.2	58.6	53.3	48.9	41.9	36.7
MI0	12	187.6	150.0	125.0	112.5	93.8	75.0	62.5	56.3	50.0	45.0	40.9	37.5	32.2	28.1
M12	14	-	119.6	99.7	89.7	74.8	59.8	49.9	44.9	39.9	35.9	32.6	29.9	25.6	22.4
M16	18	-	-	-	63.0	52.5	42.0	35.0	31.5	28.0	25.2	22.9	21.0	18.0	15.7
M20	24	-	-	-	-	25.0	20.0	16.7	15.0	13.3	12.0	10.9	10.0	8.6	7.5
M24	28	-	-	-	-	-	15.7	13.1	11.8	10.5	9.4	8.6	7.9	6.7	5.9
M30	35	-	-	-	-	-	-	8.4	7.6	6.7	6.1	5.5	5.1	4.3	3.8

Strength Limit State Design

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram



Note: loading for size above M30 is available upon request.

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	M8	M10	M12	M16	M20	M24	M30
a_m, e_m	25	30	35	45	60	75	90

Step 1c Calculate anchor effective depth, h_{ef} (mm)

Refer to "Description and Part Numbers" table for standard ChemSet™ Anchor Studs on Page XXX. Other lengths are available upon request.

Effective depth, h_{ef} (mm)
Preferred $h_{ef} = h_l$ otherwise,
$h_{ef} = L_e - T_{fix}$
$h_{ef} \geq 6 * d_h$
T_{fix} = total thickness of material(s) being fastened

Checkpoint 1 Anchor size determined, absolute minima compliance achieved, effective depth (h_{ef}) calculated.

Strength Limit State Design

STEP 2 Verify Concrete Tensile Capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, $ØN_{uc}$ (KN), $Ø_c = 0.6$, $f_{cc} = 25$ N/mm^2

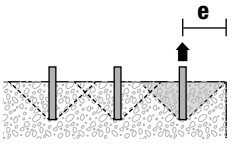
Anchor Size, d_h	M8	M10	MI2	M16	M20	M24	M30	M33	M36	M39
Drilled hole diameter, d_h(mm)	10	12	14	18	24	28	35	38	40	42
Effective Depth, h_{ef}										
50	6.5									
60	7.8	14.3								
70	9.1	16.7	19.8							
80	10.4	19.0	22.7							
90	11.6	21.4	25.5	35.9						
100	13.0	23.8	28.3	39.9						
110		24.4	31.1	43.8						
120			34.0	47.8	49.7					
125			35.4	49.8	51.8					
140			39.7	55.8	58.0	62.2				
150			42.5	59.8	62.2	66.6				
160				63.7	66.2	71.1				
170				67.7	70.4	75.5	84.2			
180				71.7	74.5	79.9	89.2			
190				75.7	78.7	84.4	94.1			
200					82.8	88.8	99.1	100.8		
210					87.0	93.3	104.1	105.8		
220					91.1	97.7	109.0	110.9		
230					95.3	102.1	114.0	115.9	117.8	
240					99.5	106.6	118.9	121.0	122.9	
250					103.6	111.0	123.9	126.0	128.0	
260						115.5	128.8	131.0	133.1	134.9
280						124.3	138.7	141.1	143.4	145.2
300							148.6	151.2	153.6	155.6
320							158.6	161.3	163.8	166.0
340							168.5	171.4	174.1	176.4
360							178.4	181.4	184.3	186.7
380							188.3	191.5	194.6	197.1
400								201.6	204.8	207.5
420								211.7	215.0	217.9
440									225.3	228.2
460									235.5	238.6
480										249.0
500										259.4

Note: Effective depth, h must be >= 6 x drilled hole diameter d_h for anchor to achieve tabled shear capacities.
For working load design per BD requirement, $N_{ac} = ØN_{uc} / 0.6 / 3$ (BD requires safety factor of structural fixing = 3)
For anchor studs out of the range mentioned above (M42 - M56), please consult your local Ramset technical representatives for more information.

Table 2b Concrete compressive strength effect, tension X_{nc}

Concrete fcc (N/mm2)	20	25	30	40	50	60
X_{nc}	0.95	1.00	1.04	1.10	1.15	1.20

Strength Limit State Design



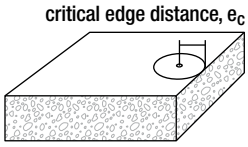
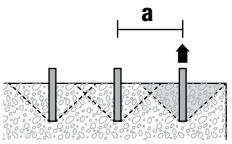


Table 2c Edge distance effect, tension, X_{ne}

Anchor Size, d_b	M8	M10	M12	M16	M20	M24	M30	M33	M36	M39
Edge distance, e (mm)										
25	0.85									
30	0.96	0.83								
35	1.00	0.92	0.82							
40		1.00	0.89							
50			1.00	0.85						
60				0.96	0.83					
65				1.00	0.87					
75					0.96	0.85				
80					1.00	0.89				
90						0.96	0.83			
100						1.00	0.89	0.84		
120							1.00	0.94	0.89	
130								1.00	0.94	0.89
140									1.00	0.93
155										1.00

$X_{ne} = 0.3 + 0.7 * (e/4*d_b)$:
d_b = anchor size



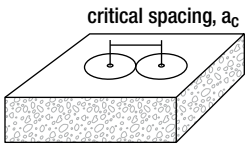


Table 2d Anchor spacing effect, end of a row, tension, X_{nae}

Anchor Size, d_b	M8	M10	M12	M16	M20	M24	M30	M33	M36	M39
Anchor spacing, a (mm)										
25	0.77									
30	0.82	0.75								
35	0.87	0.80	0.75							
40	0.92	0.84	0.78							
50	1.00	0.92	0.85	0.77						
60		1.00	0.92	0.82	0.75					
75			1.00	0.90	0.82	0.77				
90				0.97	0.88	0.82	0.75			
100				1.00	0.92	0.85	0.78	0.76	0.74	
120					1.00	0.92	0.84	0.81	0.78	0.76
150						1.00	0.92	0.88	0.85	0.83
180							1.00	0.96	0.92	0.89
200								1.00	0.97	0.93
220									1.00	0.98
230										1.00

$X_{nae} = 0.5 * \{1+[a/(6d_b)]\}$:
d_b = anchor size

Checkpoint 2

Limit State Design:

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$
$ØN_{urc} = ØN_{uc} * X_{nc} * X_{ne} * X_{nae}$

Working Load Design Method (Alternative):

Working load concrete tensile capacity, N_{ar}
$N_{ar} = N_{ac} * X_{nc} * X_{ne} * X_{nae}$

Strength Limit State Design

STEP 3 Verify Anchor Tensile Capacity — per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (KN), $Ø_n = 0.8$

Anchor Size, d_b,	M8	M10	M12	M16	M20	M24	M30	M33	M36	M39
Chemset Anchor Stud Grade 5.8 Carbon Steel	14.2	22.7	33.8	64.1	96.5	139.8	220.0	-	-	-
ISO 898 Anchor Stud Grade 8.8 Carbon Steel	23.4	37.1	54.0	100.0	162.4	234.4	372.8	460.8	542.4	648.0
Chemset Anchor Stud A4/316 Stainless Steel	16.5	26.1	37.9	70.7	110.3	158.9	252.5	-	-	-

$ØN_{us} = 0.8 * N_{us}$

For working load design per BD requirement. $N_{as} = ØN_{us}/0.8/3$ (BD requires safety factor of structural fixing = 3 minimum)

Table 3b Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (KN)

Not appropriate for this product

Checkpoint 3

Limit State Design:

Design reduced ultimate tensile capacity, $ØN_{ur}$

$ØN_{ur}$ = minimum of $ØN_{urc}$, $ØN_{us}$

Check $N^* / ØN_{ur} \leq 1$

If not satisfied, return to step 1

Working Load Design Method (Alternative):

Working load limit tensile capacity (N_a)

N_a = minimum of N_{ar}, N_{as}

Check $N / N_a \leq 1$

If not satisfied, return to step 1

Strength Limit State Design

STEP 4 Verify Concrete Shear Capacity - per anchor

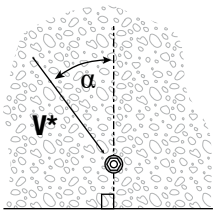
Table 4a Reduced characteristic ultimate concrete shear capacity, $ØV_{uc}$ (KN), $Ø_q$ = 0.6, f_{cc} = 25 N/mm²
$ØV_{uc}$ = 5.45 * d_h^0.5 * e^1.5 * 0.6

Anchor Size, d_b	M8	M10	M12	M16	M20	M24	M30	M33	M36	M39
Drilled hole diameter, d_b(mm)	10	12	14	18	24	28	35	38	40	42
Edge distance, e (mm)										
25	1.3									
30	1.7	1.9								
35	2.1	2.3	2.5	2.9						
50	3.7	4.0	4.3	4.9	5.7					
60	4.8	5.3	5.7	6.4	7.4	8.0				
75	6.7	7.4	7.9	9.0	10.4	11.2				
125	14.5	15.8	17.1	19.4	22.4	24.2	27.0			
200		32.0	34.6	39.2	45.3	48.9	54.7	57.0	58.5	60.0
300			63.6	72.1	83.3	89.9	100.5	104.8	107.5	110.1
400				111.0	128.2	138.5	154.8	161.3	165.5	169.6
500					179.1	193.5	216.3	225.4	231.3	237.0
600						254.4	284.4	296.3	304.0	311.5
700							358.4	373.4	383.1	392.6
800								456.2	468.1	479.6

Note: Effective depth. h_{ef} must be >= 6 x drilled hole diameter d_h for anchor to achieve tabled shear capacities.
For working load design per BD requirement, V_{ac} = $ØV_{uc}$ / 0.6 / 3 (BD requires safety factor of structural fixing = 3 minimum)

Table 4b Concrete compressive strength effect, concrete edge shear X_{vc}

Concrete f_{cc} (N/mm²)	25	30	40	50	60
X_{vc}	1.00	1.11	1.26	1.42	1.58



Load direction effect, conc. edge shear, Xvd

Table 4c Load direction effect, concrete edge shear, X_{vd}

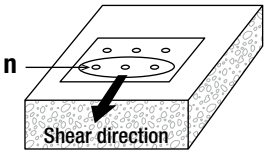
Angle, α°	0	10	20	30	40	50	60	70	80	90-180
X_{vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

Table 4d Anchor spacing effect, concrete edge shear, X_{va}
Note: For single anchor designs, X_{va} = 1.0
X_{va}=0.5 * (1+a/2.5e) ≤ 1

Edge distance, e (mm)	25	30	35	50	60	75	125	200	300	400	500	600	700
Anchor Spacina, a (mm)													
25	0.70	0.67	0.64	0.60	0.58	0.57	0.54						
30	0.74	0.70	0.67	0 62	0.60	0.58	0.55	0.53					
35	0.78	0.73	0.70	0.64	0.62	0.59	0.56	0.54	0.52				
50	0.90	0.83	0.79	0.70	0.67	0.63	0.58	0.55	0.53	0.53			
60	0.98	0.90	0.84	0.74	0.70	0.66	0.60	0.56	0.54	0.53	0.52		
75	1.00	1.00	0.93	0.80	0.75	0.70	0.62	0.58	0.55	0.54	0.53	0.53	
150			1.00	1.00	1.00	0.90	0.74	0.65	0.60	0.58	0.56	0.55	0.54
200						1.00	0.82	0.70	0.63	0.60	0.58	0.57	0.56
300							0.98	0.80	0.70	0.65	0.62	0.60	0.59
400							1.00	0.90	0.77	0.70	0.66	0.63	0.61
500								1.00	0.83	0.75	0,70	0.67	0.64
625									0.92	0.81	0.75	0.7!	0.68
750									1.00	0.88	0.8	0.75	0.71
900										0.95	0.86	0.80	0.76
1100										1.00	0.94	0.87	0.81
1300											1.00	0.93	0.87
1500												1.00	0.93
1750													1.00

This table should be read in conjunction with Table 4a, changing the edge distance "e" in this table also change the "e" in table 4a.

Strength Limit State Design



Number of anchor, n=3

Table 4e Multiple anchors effect, concrete edge shear, Xvn

Note: For single anchor designs. X_{vn} = 1.0

a/e	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.25	2.5
Numba of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	LOO	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	086	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0 93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0/96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

$$X_{vn\,(n=2)} = \frac{3.2e + (2n-2) * 0.64a}{3.2 * e * n} \qquad X_{vn} = \frac{X_{vn}\,(n=2)}{X_{vn}\,(n=x)}$$

Checkpoint 4

Limit State Design:

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

Working Load Design Method (Alternative):

Working load limit concrete tensile capacity, V_{ar}

$V_{ar} = V_{ac} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

STEP 5 Verify Concrete Shear Capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (KN), $Ø_v$ = 0.8

Anchor Size, d_b	M8	M10	M12	M16	M20	M24	M30	M33	M36	M39
Chemset Anchor Stud Grade 5.8 Carbon Steel	8.9	14.1	21.0	39.7	59.9	86.8	136.4	-	-	-
Chemset Anchor Stud Grade 8.8 Carbon Steel	13.6	21.5	31.2	57.8	93.8	135.4	215.3	266.1	313.2	374.2
Chemset Anchor Stud A4/316 Stainless Steel	11.8	18.7	27.2	50.6	79.0	113.8	180.8	-	-	-

$ØV_{us} = 0.8 * V_{us}$

For working load design per BD requirement, $V_{as} = ØV_{us}/0.8/3$ (BD requires safety factor of structural fixing = 3)

Table 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (KN)

Not appropriate for this product.

Checkpoint 5

Limit State Design:

Design reduced ultimate shear capacity, $ØV_{ur}$

$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$

Check $V^* / ØV_{ur} \leq 1$

If not satisfied return to step 1.

Working Load Design Method (Alternative):

Working load limited shear capacity, V_a

V_a = minimum (V_{ar}, V_{as})

Check $V / V_a \leq 1$

If not satisfied return to step 1.

STEP 6 Combined loading and specification

Checkpoint 6

Limit State Design:

Check :

$N^* / ØN_{ur} + V^* / ØN_{ur} \leq 1.2$

If not satisfied return to step 1.

Working Load Design Method (Alternative):

Check :

$N_{(unfactored)} / N_a + V_{(unfactored)} / V_a \leq 1.2$

If not satisfied return to step 1.

Strength Limit State Design (Rebar Fixing)

Ramset Chemset Injection System - Epcon G5
Method Statement for Installation of Rebars

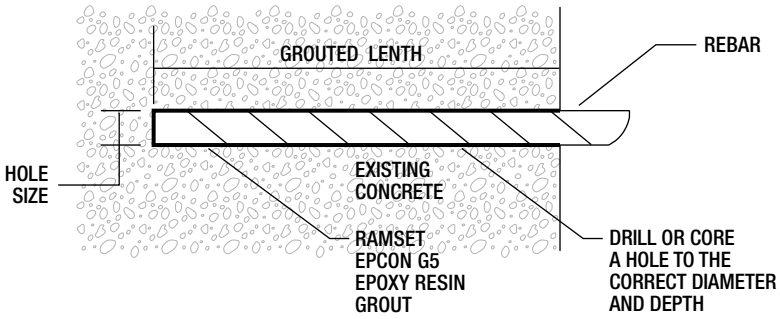
BAR DIA	HOLE SIZE	GROUTED LENGTH	CHAR. ULT. TENSILE LOAD as per BS5080 Part 1	YIELD STRENGTH OF 460N/mm² HIGH YIELD DOWEL BAR	YIELD STRENGTH OF 500N/mm² HIGH YIELD DOWEL BAR
Y10	12 mm	100 mm	46.8 kN	36.1 kN	39.3 kN
Y12	16 mm	120 mm	57.8 kN	52.0 kN	56.6 kN
Y16	20 mm	160 mm	103.7 kN	92.5 kN	100.5 kN
Y20	25 mm	200 mm	167.9 kN	144.5 kN	157.1 kN
Y25	30 mm	250 mm	255.4 kN	225.8 kN	245.4 kN
Y32	40 mm	320 mm	431.5 kN	369.9 kN	402.1 kN
Y40	48 mm	400 mm	630.5 kN	578.0 kN	628.3 kN
Y50	62 mm	500 mm	982.0 kN	903.2 kN	981.8 kN

* It is based on non-cracked concrete with strength 30MPa.
* Yield strength of rebar f_y : 460N/mm² / 500N/mm² .
* Please apply appropriate factor of safety to get your design working load.
* Pull Out Test Per BS5080: Part 1 had been performed on full range of dowel bars.
* No load reduction for installation conditions including dry, water-saturated, water-filled, and underwater applications.
* **For design condition under 1-4 how's FRP, please refer to page XXX,**

Features - excellent pull-out loads
- give more time to install anchors / rebars

Installation Procedure

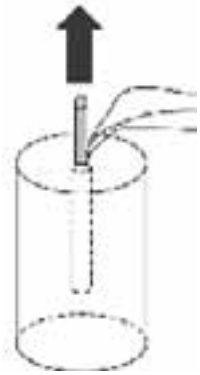
1) Drill a hole to the correct diameter and depth for particular rebar size being installed.
2) Wire brush the hole using wire brush, blow out all dust with forced air and leave no slurry.
3) Insert nozzle and fill the hole to at least one third its depth. When starting new cartridges or new nozzle, dispense and discard enough adhesive until uniform light grey colored is achieved.
4) Before the G5 gels, insert rebar into the bottom of hole with a slow twisting motion. Wipe off the excess resin if necessary.
5) After the G5 has fully cured, attach the fixture.



Warrington Fire Test Report

UP TO 4 HOURS FIRE RESISTANCE TEST PERFORMED ON REBAR GROUTED USING RAMSET EPCON G5 AT SPLICE OR ANCHORAGE CONNECTION TO BS 476 PART 20-1987

WFRA is NATA accredited. Two sets of fire tests under different concrete joint connection have been carried out to assess bond stress model that quantifies the relationship between bond stress and temperature for deformed bars anchored with RAMSET EPCON G5 when exposed to fire. The bond stress model is based on withdrawal tests of various bar diameters from heated concrete cylinders in addition to a fire test of a representative section of a loaded wall to slab as well as slab to slab connections exposed to heating regime of BS 476 Part 20. Briefly, the overall testing procedures conducted by Warrington Fire Research Centre can be illustrated as follows:



(1) Cylinder test: Pull out tests of full range of bar diameters (from Ø12 to Ø40) from heated concrete cylinders at different temperature were performed.

(2) Bond stress model: By comparing various heated temperatures and pull out force, temperature dependence bond stress model was obtained. Note that temperature based on was the temperature of coldest end of bar to gives conservative bond stress model.

(3) FEM: At the same time, with the help of finite element analysis of model TASEF, temperature at various covers and a range of slab/element thickness for periods of exposure between 30 minutes and four hours to the BS476:Part 20-1987 heating regime, were obtained.

(4) Full scale 4 hours Fire-resistance test in accordance with BS476:Part 20: Taking Splice Connection Test as an example, 2 reinforced slabs were connected by 2 nos of Y16 rebars, one end bonded to concrete with EPCON G5 and the one end cast-in. Based on concrete cover and slab thickness, temperature was obtained from finite-element modelling (FEM) as in (3). Consequently, bond stress was calculated using the bond stress model and applied loading was determined with reference to bond length, temperature dependence bond stress and bar diameter used in the full scale test.

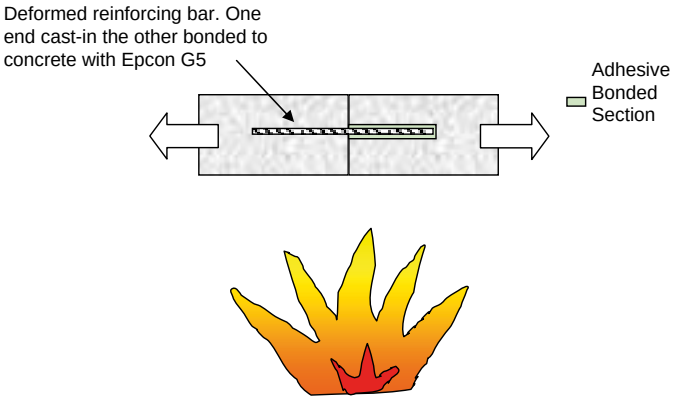
Please contact Ramset Technical Department to obtain full fire test reports for design purposes.

Warrington Fire Test Report

(5) FEM validation: Temperature probe were installed at various location to validate the temperature indicate by FEM. Therefore, temperature obtained from FEM can be confidently used to tabulate bond stress at different combinations of concrete cover and slab/element depth.

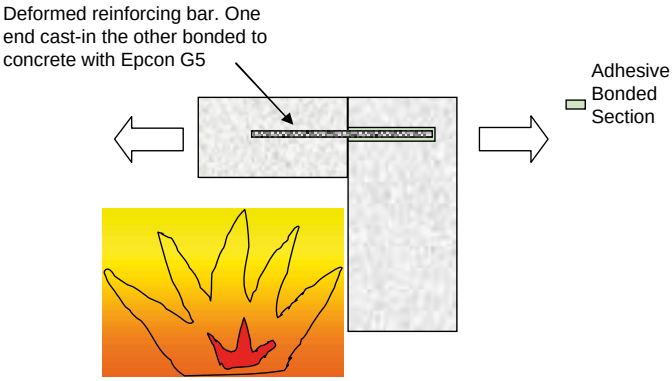
(6) Bond stress model validation: Since Slab splice joint did not failed after 4 hours fire test with the loading derived from bond stress model and loading has been increased up to 6 times higher to reach failure mode, the bond stress model is again proved to be very conservative.

For details, please refer to WRFA Report No.45832.3 for test under splice joint condition & WRFA Report No.45838.4 for test under anchorage joint condition.



Loaded Slab Heated to BS 476 Part 20

WFRA Report No.45832.3



Loaded Anchorage Connection Heated to BS 476 Part 20

WFRA Report No.45832.4

Internet

I-Expert is an application accessible from one internet browser ie Internet Explorer, Firefox, Safari, Chrome to find your fixing solution from any computer connected to internet, in total confidentiality and security.

FIND US ON

http://i-expert.spit.com

Ramset Fasteners (HK) Limited

Unit D, 22/F, Capital Trade Centre,
No. 62 Tsun Yip Street,
Kwun Tong, Kowloon,
Hong Kong.

Tel: (852) 2380 5201
Fax: (852) 2397 0375

E-mail : info@ramset.com.hk
Website : www.ramset.com.hk