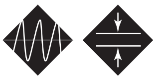
# TruBolt™

## STUD ANCHORS - NON-CRACKED CONCRETE



## GENERAL INFORMATION

| Performance Related | Material Specification | Installation Related |
|---|---|---|




### Product

**The Trubolt Anchor is a Heavy duty, torque setting expansion anchor.**

### Benefits, Advantages and Features

**Maximum shear capacity for hole size:**
- Stud diameter equals hole diameter.

**Fast installation:**
- Through fixing eliminates marking out and repositioning of fixtures.

**High clamp load:**
- Stud design ensures pull-down on fixture.

**Outstanding exterior durability:**
- 42 micron hot dip galvanised coating.

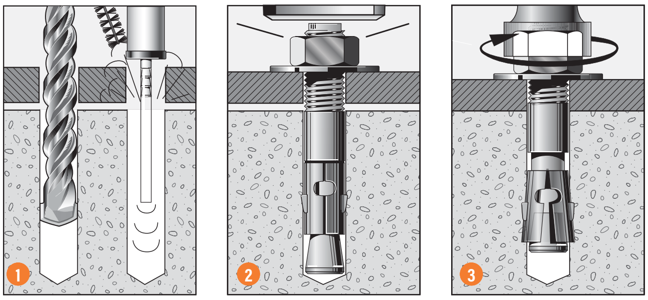
**Superior strength:**
- Cold forged steel construction.

**Ramset Design Method:**
- Uses technical data validated from testing in ANZ concrete substrates

### Principal Applications

- Structural beams and columns
- Bottom plate and batten fixing
- Formwork support
- Installing signs, handrails, balustrades and gates
- Safety barriers

### Installation




1. Drill hole to correct diameter and depth. Important: Use **Ramset™** Dustless Drilling System to ensure holes are clean. Alternatively,clean clean thoroughly with brush and remove debris by way of vacuum or hand pump, compressed air etc.
2. Insert the **Trubolt™** through the fixture and drive with a hammer until washer contacts the fixture.
3. Tighten the **Trubolt™** nut with a torque wrench to specified assembly torque.

# TruBolt™

## STUD ANCHORS - NON-CRACKED CONCRETE



### Installation and performance details

| Anchor Size, $d_b$ (mm) | Installation details | | | | Optimum dimensions* | | Reduced Characteristic Capacity | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Drilled Hole diam., $d_h$ (mm) | Fixture hole diameter, $d_f$ (mm) | Anchor effective depth, h (mm) | Tightening torque, $T_r$ (Nm) | Edge distance, $e_c$ (mm) | Anchor spacing, $a_c$ (mm) | Steel | Concrete | | |
| | | | | | | | Shear, $\phi V_{us}$ (kN) | Tension, $\phi N_{uc}$ (kN)** Concrete compressive strength, $f'_c$ | | |
| | | | | | | | | 20MPa | 25MPa | 32MPa |
| M10 | 10 | 12 | 40 | 35 | 60 | 120 | 13.5 | 6.7 | 7.5 | 8.5 |
| M12 | 12 | 14 | 48 | 50 | 75 | 150 | 17.1 | 8.8 | 9.9 | 11.2 |
| M16 | 16 | 18 | 64 | 155 | 100 | 200 | 28.8 | 13.6 | 15.2 | 17.2 |
| M20 | 20 | 24 | 80 | 355 | 120 | 240 | 54.7 | 19.0 | 21.3 | 24.0 |

* Note: For shear loads acting towards an edge or where these optimum dimensions are not achievable, please use the simplified strength limit state design process to verify capacity.
**Note: Reduced characteristic ultimate concrete tensile capacity = $\phi N_{uc}$, where $\phi$ = 0.60 and $N_{uc}$ = Characteristic ultimate concrete tensile capacity.
**For conversion to Working Load Limit MULTIPLY $\phi N_{uc}$ x 0.55**

## DESCRIPTION AND PART NUMBERS

| Anchor size, $d_b$ (mm) | Drilled hole diameter, $d_h$ (mm) | Effective length, $L_e$ (mm) | Part No. |
|---|---|---|---|
| M10 | 10 | 67 | T10090GH |
| M12 | 12 | 58 | T12080GH |
| | | 71 | T12100GH |
| | | 111 | T12140GH |
| | | 151 | T12180GH |
| M16 | 16 | 70 | T16110GH |
| | | 85 | T16125GH |
| | | 110 | T16150GH |
| | | 135 | T16175GH |
| M20 | 20 | 95 | T20140GH |
| | | 115 | T20160GH |
| | | 170 | T20215GH |

**Effective depth, h (mm)**

$h = L_e - t$

t = total thickness of material(s) being fixed

**Substrate thickness, $b_m$ (mm)**

$b_m = 2 \times h$

**Drilled hole depth, $h_1$ (mm)**

$h_1 = h + (2 \times d_h)$

h = Effective depth

## ENGINEERING PROPERTIES

| Anchor size $d_b$ | Stress area thread section $A_s$ (mm²) | Minimum diameter reduced section $d_m$ (mm) | Threaded Section | | Reduced Section | | Section Modulus Z (mm³) |
|---|---|---|---|---|---|---|---|
| | | | Yield Strength, $f_y$ (Mpa) | UTS, $f_u$ (Mpa) | Yield Strength, $f_y$ (Mpa) | UTS, $f_u$ (Mpa) | |
| M10 | 58.0 | 7.6 | 380 | 470 | 480 | 600 | 62.3 |
| M12 | 84.3 | 8.9 | 330 | 410 | 450 | 560 | 109.2 |
| M16 | 157.0 | 12.1 | 290 | 370 | 400 | 500 | 277.5 |
| M20 | 245.0 | 16.1 | 360 | 450 | 360 | 450 | 540.9 |

# TruBolt™

## STUD ANCHORS - NON-CRACKED CONCRETE



## STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram

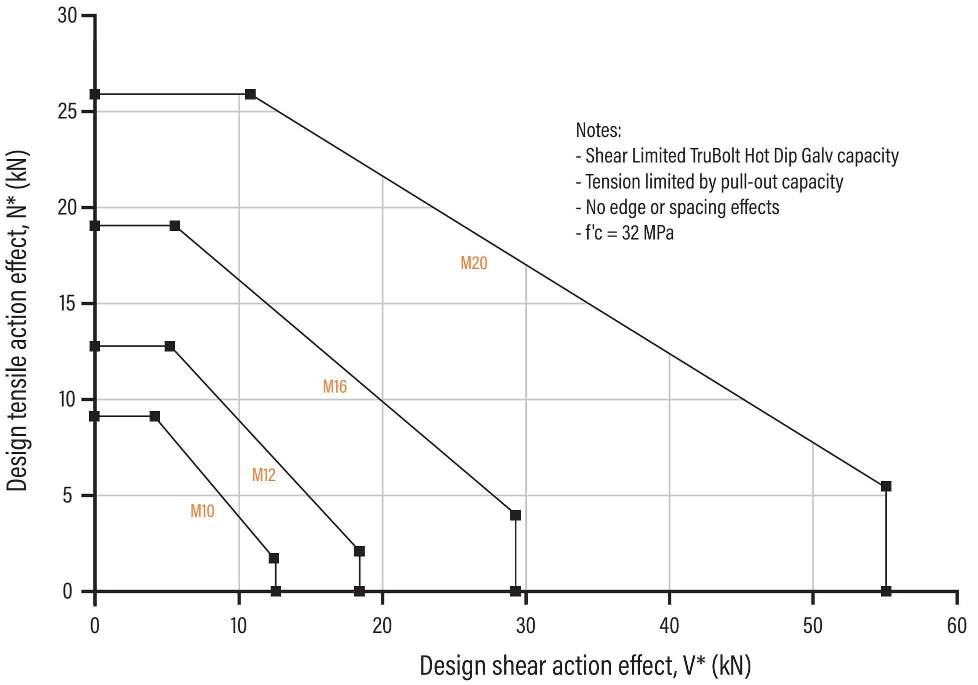



Table 1b Uncracked Concrete absolute minimum edge distance and anchor spacing values, $e_m$ and $a_m$ (mm) for Trubolt Hot Dip Gal

| Anchor size, $d_b$ | M10 | M12 | M16 | M20 |
|---|---|---|---|---|
| Min. Anchor Spacing - $a_m$ | 40 | 45 | 50 | 60 |
| Min. Anchor Spacing - $e_m$ | 60 | 65 | 75 | 95 |

### Step 1c Calculate anchor effective depth, h (mm)

Refer to "Description and Part Numbers" table on the previous page.

**Effective depth, h (mm)**
h = $L_e$ - t
t = total thickness of material(s) being fixed

**Checkpoint 1** Anchor size determined, absolute minimal compliance achieved, effective depth (h) calculated.

# TruBolt™

## STUD ANCHORS - NON-CRACKED CONCRETE

## STEP 2 Verify concrete tensile capacity - per anchor

### Table 2a Reduced characteristic ultmate concrete tensile capacity, $\phi N_{uc}$ (kN), $\phi_c$ = 0.6, f'c = 32 MPa

| Anchor Size, $d_b$ | M10 | M12 | M16 | M20 |
|---|---|---|---|---|
| Drilled Hole Dia, $d_h$ (mm) | 10 | 12 | 16 | 20 |
| Effective Depth, h (mm) | | | | |
| 40 | 8.5 | | | |
| 50 | 11.9 | 11.9 | | |
| 65 | 17.6 | 17.6 | 17.6 | |
| 80 | 24.0 | 24.0 | 24.0 | 24.0 |
| 95 | 31.0 | 31.0 | 31.0 | 31.0 |
| 110 | 38.7 | 38.7 | 38.7 | 38.7 |
| 125 | | 46.8 | 46.8 | 46.8 |
| 145 | | 58.5 | 58.5 | 58.5 |
| 160 | | | 67.8 | 67.8 |
| 180 | | | | 81.0 |

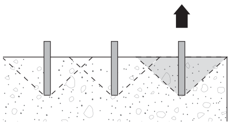
**All data relevant for Non-cracked concrete**

Note: Effective depth, h must be ≥ 4 x drilled hole diameter, $d_h$ for anchor to achieve tabled shear capacities.

### Table 2b Concrete compressive strength effect, tension, $X_{nc}$

| f'c (Mpa) | 20 | 25 | 32 | 40 | 50 |
|---|---|---|---|---|---|
| Xnc | 0.79 | 0.88 | 1.00 | 1.00 | 1.00 |

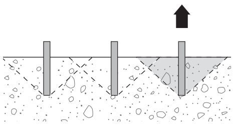
### Table 2c Edge distance effect, tension, $X_{ne}$



| Edge distance, e(mm) | 60 | 70 | 80 | 100 | 125 | 150 | 175 | 200 | 230 |
|---|---|---|---|---|---|---|---|---|---|
| Effective depth, h (mm) | | | | | | | | | |
| 40 | 1.00 | 1.00 | | | | | | | |
| 50 | 0.86 | 0.95 | 1.00 | | | | | | |
| 65 | 0.73 | 0.80 | 0.87 | 1.00 | | | | | |
| 80 | 0.65 | 0.71 | 0.77 | 0.88 | 1.00 | | | | |
| 95 | 0.59 | 0.64 | 0.69 | 0.79 | 0.91 | 1.00 | | | |
| 110 | 0.55 | 0.60 | 0.64 | 0.72 | 0.83 | 0.94 | 1.00 | | |
| 125 | 0.52 | 0.56 | 0.60 | 0.67 | 0.77 | 0.86 | 0.95 | 1.00 | |
| 145 | 0.49 | 0.53 | 0.56 | 0.62 | 0.70 | 0.78 | 0.86 | 0.94 | 1.00 |
| 160 | 0.48 | 0.50 | 0.53 | 0.59 | 0.66 | 0.74 | 0.81 | 0.88 | 0.97 |

### Table 2d Anchor spacing effect, end of a row, tension, $X_{nae}$

Note: For single anchor designs, $X_{nae}$ = 1.0

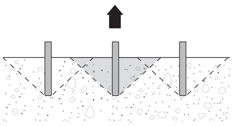


| Edge distance, a(mm) | 40 | 50 | 60 | 80 | 100 | 125 | 150 | 175 | 200 | 250 | 300 | 350 | 400 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective depth, h (mm) | | | | | | | | | | | | | |
| 40 | 0.67 | 0.71 | 0.75 | 0.83 | 0.92 | 1.00 | | | | | | | |
| 50 | 0.63 | 0.67 | 0.70 | 0.77 | 0.83 | 0.92 | 1.00 | 1.00 | | | | | |
| 65 | 0.60 | 0.63 | 0.65 | 0.71 | 0.76 | 0.82 | 0.88 | 0.95 | 1.00 | | | | |
| 80 | 0.58 | 0.60 | 0.63 | 0.67 | 0.71 | 0.76 | 0.81 | 0.86 | 0.92 | 1.00 | | | |
| 95 | 0.57 | 0.59 | 0.61 | 0.64 | 0.68 | 0.72 | 0.76 | 0.81 | 0.85 | 0.94 | 1.00 | | |
| 110 | 0.56 | 0.58 | 0.59 | 0.62 | 0.65 | 0.69 | 0.73 | 0.77 | 0.80 | 0.88 | 0.95 | 1.00 | |
| 125 | 0.55 | 0.57 | 0.58 | 0.61 | 0.63 | 0.67 | 0.70 | 0.73 | 0.77 | 0.83 | 0.90 | 0.97 | 1.00 |
| 145 | 0.55 | 0.56 | 0.57 | 0.59 | 0.61 | 0.64 | 0.67 | 0.70 | 0.73 | 0.79 | 0.84 | 0.90 | 0.96 |
| 160 | 0.54 | 0.55 | 0.56 | 0.58 | 0.60 | 0.63 | 0.66 | 0.68 | 0.71 | 0.76 | 0.81 | 0.86 | 0.92 |

# TruBolt™

## STUD ANCHORS - NON-CRACKED CONCRETE





### Table 2e Anchor spacing effect, internal to a row, tension, $X_{nai}$

Note: For single anchor designs, $X_{nai}$ = 1.0

| Edge distance, a (mm) | 40 | 50 | 60 | 80 | 100 | 125 | 150 | 175 | 200 | 250 | 300 | 350 | 400 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective depth, h (mm) | | | | | | | | | | | | | |
| **40** | 0.33 | 0.42 | 0.50 | 0.67 | 0.83 | 1.00 | | | | | | | |
| **50** | 0.27 | 0.33 | 0.40 | 0.53 | 0.67 | 0.83 | 1.00 | 1.00 | | | | | |
| **65** | 0.21 | 0.26 | 0.31 | 0.41 | 0.51 | 0.64 | 0.77 | 0.90 | 1.00 | | | | |
| **80** | 0.17 | 0.21 | 0.25 | 0.33 | 0.42 | 0.52 | 0.63 | 0.73 | 0.83 | 1.00 | | | |
| **95** | 0.14 | 0.18 | 0.21 | 0.28 | 0.35 | 0.44 | 0.53 | 0.61 | 0.70 | 0.88 | 1.00 | | |
| **110** | 0.12 | 0.15 | 0.18 | 0.24 | 0.30 | 0.38 | 0.45 | 0.53 | 0.61 | 0.76 | 0.91 | 1.00 | |
| **125** | 0.11 | 0.13 | 0.16 | 0.21 | 0.27 | 0.33 | 0.40 | 0.47 | 0.53 | 0.67 | 0.80 | 0.93 | 1.00 |
| **145** | 0.09 | 0.11 | 0.14 | 0.18 | 0.23 | 0.29 | 0.34 | 0.40 | 0.46 | 0.57 | 0.69 | 0.80 | 0.92 |
| **160** | | 0.10 | 0.13 | 0.17 | 0.21 | 0.26 | 0.31 | 0.36 | 0.42 | 0.52 | 0.63 | 0.73 | 0.83 |

**Checkpoint 2**

**Design reduced ultimate concrete tensile capacity, $\phi N_{urc}$**

$$\phi N_{urc} = \phi N_{uc} \ast X_{nc} \ast X_{ne} \ast (X_{nae} \text{ or } X_{nai})$$

**STEP 3**

### Verify Concrete Tensile Resistance - per anchor

**Table 3a Reduced characteristic ultimate steel tensile capacity, $\phi N_{us}$ (kN), $\phi_n$ = 0.8**

| Anchor size, $d_b$ | M10 | M12 | M16 | M20 |
|---|---|---|---|---|
| Trubolt - Hot Dip Galvanized | 21.8 | 27.8 | 45.5 | 72.5 |

**Table 3b Reduced characteristic ultimate pull-out capacity*, $\phi N_{up}$ (kN), $\phi_p$ = 0.65, f'c = 32 MPa**

| Anchor size, $d_b$ | M10 | M12 | M16 | M20 |
|---|---|---|---|---|
| Hole Diameter, $d_h$ (mm) | 10 | 12 | 16 | 20 |
| Effective depth, h (mm) | | | | |
| 40 | 9.2 | | | |
| 50 | | 12.9 | | |
| 65 | | | 19.0 | |
| 80 | | | | 26.0 |

*Note: Reduced characteristic ultimate Pull-through capacity is not influenced by reduced anchor spacing or edge distance

**Checkpoint 3a**

**Design reduced ultimate pull-out capacity, $\phi N_{urp}$**

$$\phi N_{urp} = \phi N_{up} \ast X_{nc}$$

**Checkpoint 3b**

**Design reduced ultimate tensile capacity, $\phi N_{ur}$**

**$\phi N_{ur}$ = minimum of $\phi N_{urc}$, $\phi N_{urp}$, $\phi N_{us}$**

**Check $N^*/\phi N_{ur} \leq 1$,**

**if not satisfied return to step 1**

# TruBolt™

## STUD ANCHORS - NON-CRACKED CONCRETE



### Tensile performance conversion table

| Performance Required | ConcreteTensile Performance | | Pull - Through Performance | | Steel Tensile Performance | |
|---|---|---|---|---|---|---|
| | Notation | Concrete Tension Capacity | Notation | Pull - Through Tension Capacity | Notation | Carbon Steel Tension Capacity |
| Strength Limit State | $\phi N_{urc}$ | MULTIPLY $\phi N_{urc}$ x 1.00 | $\phi N_{up}$ | MULTIPLY $\phi N_{up}$ x 1.00 | $\phi N_{us}$ | MULTIPLY $\phi N_{us}$ x 1.00 |
| Working Load Limit | $N_{ac}$ | MULTIPLY $\phi N_{urc}$ x 0.55 | $N_{ap}$ | MULTIPLY $\phi N_{up}$ x 0.51 | $N_{as}$ | MULTIPLY $\phi N_{us}$ x 0.56 |
| Cyclic Laoding | $N_{yc}$ | MULTIPLY $\phi N_{urc}$ x 0.19 | $N_{yp}$ | MULTIPLY $\phi N_{up}$ x 0.18 | $N_{ys}$ | MULTIPLY $\phi N_{us}$ x 0.19 |
| Fire Resistance | $N_{Rk,c,f,t}$ | Refer to Fire Resistance Section | $N_{Rk,p,f,t}$ | Refer to Fire Resistance Section | $N_{Rk,s,f,t}$ | Refer to Fire Resistance Section |
| Seismic | $N^0_{Rd,c,sis}$ | Refer to Seismic Section | $N^0_{Rd,p,sis}$ | Refer to Seismic Section | $N^0_{Rd,s,sis}$ | Refer to Seismic Section |

NOTE: Design Tensile Capacity is the minimum of Concrete Tension and Steel Tension Capacities

## STEP 4 Verify concrete shear capacity - per anchor

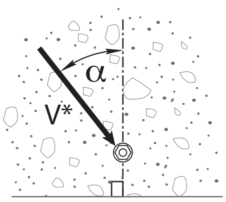
**Table 4a Reduced characteristic ultimate concrete edge shear capacity, $\phi V_{uc}$ (kN), $\phi$ = 0.6, $f'_c$ = 32 MPa**

| Anchor size, $d_b$ | M10 | M12 | M16 | M20 |
|---|---|---|---|---|
| Hole Diameter, $d_h$ (mm) | 10 | 12 | 16 | 20 |
| Edge distance, e (mm) | | | | |
| 60 | 6.1 | | | |
| 75 | 8.5 | 9.3 | 10.8 | |
| 100 | 13.1 | 14.3 | 16.6 | 18.5 |
| 150 | 24.1 | 26.4 | 30.4 | 34.0 |
| 200 | 37.0 | 40.6 | 46.9 | 52.4 |
| 250 | 51.8 | 56.7 | 65.5 | 73.2 |
| 300 | 68.0 | 74.5 | 86.1 | 96.2 |
| 350 | 85.7 | 93.9 | 108.5 | 121.3 |
| 450 | | 136.9 | 158.1 | 176.8 |
| 600 | | | | 272.2 |

Note: Effective depth, h must be ≥ 4 x drilled hole diameter, $d_h$ for anchor to achieve tabled shear capacities.

**Table 4b Concrete compressive strength effect, concrete edge shear, $X_{vc}$**

| $f'_c$ (MPa) | 20 | 25 | 32 | 40 | 50 |
|---|---|---|---|---|---|
| $X_{vc}$ | 0.79 | 0.88 | 1.00 | 1.12 | 1.25 |



Load direction effect, conc. edge shear, $X_{vd}$

**Table 4c - Concrete load direction effect, concrete edge shear, $X_{vd}$**

| Angle, α° | 0-55 | 60 | 70 | 80 | 90-180 |
|---|---|---|---|---|---|
| $X_{vd}$ | 1.0 | 1.1 | 1.2 | 1.5 | 2.0 |

# TruBolt™

## STUD ANCHORS - NON-CRACKED CONCRETE



**Table 4d Anchor spacing effect, concrete edge shear, $X_{va}$**

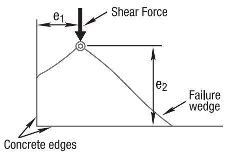
Note: For single anchor designs, $X_{va}$ = 1.0

| Edge distance, e (mm) | 60 | 75 | 100 | 150 | 200 | 250 | 300 | 350 | 450 | 600 | 850 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Anchor spacing, a (mm)** | | | | | | | | | | | |
| **40** | 0.63 | 0.61 | 0.58 | 0.55 | 0.54 | 0.53 | 0.53 | 0.52 | 0.52 | 0.51 | 0.51 |
| **60** | 0.70 | 0.66 | 0.62 | 0.58 | 0.56 | 0.55 | 0.54 | 0.53 | 0.53 | 0.52 | 0.51 |
| **80** | 0.77 | 0.71 | 0.66 | 0.61 | 0.58 | 0.56 | 0.55 | 0.55 | 0.54 | 0.53 | 0.52 |
| **100** | 0.83 | 0.77 | 0.70 | 0.63 | 0.60 | 0.58 | 0.57 | 0.56 | 0.54 | 0.53 | 0.52 |
| **125** | 0.92 | 0.83 | 0.75 | 0.67 | 0.63 | 0.60 | 0.58 | 0.57 | 0.56 | 0.54 | 0.53 |
| **150** | 1.00 | 0.90 | 0.80 | 0.70 | 0.65 | 0.62 | 0.60 | 0.59 | 0.57 | 0.55 | 0.54 |
| **200** | | 1.00 | 0.90 | 0.77 | 0.70 | 0.66 | 0.63 | 0.61 | 0.59 | 0.57 | 0.55 |
| **250** | | | 1.00 | 0.83 | 0.75 | 0.70 | 0.67 | 0.64 | 0.61 | 0.58 | 0.56 |
| **300** | | | | 0.90 | 0.80 | 0.74 | 0.70 | 0.67 | 0.63 | 0.60 | 0.57 |
| **400** | | | | 1.00 | 0.90 | 0.82 | 0.77 | 0.73 | 0.68 | 0.63 | 0.59 |
| **500** | | | | | 1.00 | 0.90 | 0.83 | 0.79 | 0.72 | 0.67 | 0.62 |
| **600** | | | | | | 0.98 | 0.90 | 0.84 | 0.77 | 0.70 | 0.64 |
| **800** | | | | | | 1.00 | 1.00 | 0.96 | 0.86 | 0.77 | 0.69 |
| **1000** | | | | | | | | 1.00 | 0.94 | 0.83 | 0.74 |
| **1500** | | | | | | | | | 1.00 | 1.00 | 0.85 |
| **2000** | | | | | | | | | | | 0.97 |

**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 |




ANCHOR AT A CORNER

**Table 4f Anchor at a corner effect, concrete edge shear, $X_{VS}$**

Note: For $e_1/e_2$ > 1.25, $X_{VS}$ = 1.0

| Edge distance, $e_2$ (mm) | 25 | 30 | 35 | 50 | 60 | 75 | 125 | 200 | 300 | 400 | 600 | 900 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Edge distance, $e_1$ (mm)** | | | | | | | | | | | | |
| **25** | 0.86 | 0.77 | 0.70 | 0.58 | 0.53 | 0.49 | 0.41 | 0.37 | 0.35 | 0.34 | 0.32 | 0.32 |
| **30** | 0.97 | 0.86 | 0.78 | 0.64 | 0.58 | 0.52 | 0.43 | 0.38 | 0.36 | 0.34 | 0.33 | 0.32 |
| **35** | 1.00 | 0.95 | 0.86 | 0.69 | 0.63 | 0.56 | 0.46 | 0.40 | 0.37 | 0.35 | 0.33 | 0.32 |
| **50** | 1.00 | 1.00 | 1.00 | 0.86 | 0.77 | 0.67 | 0.52 | 0.44 | 0.39 | 0.37 | 0.35 | 0.33 |
| **60** | 1.00 | 1.00 | 1.00 | 0.97 | 0.86 | 0.75 | 0.57 | 0.47 | 0.41 | 0.38 | 0.36 | 0.34 |
| **75** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.86 | 0.64 | 0.51 | 0.44 | 0.41 | 0.37 | 0.35 |
| **125** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.86 | 0.65 | 0.53 | 0.48 | 0.42 | 0.38 |
| **200** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.86 | 0.67 | 0.58 | 0.49 | 0.42 |
| **300** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.86 | 0.72 | 0.58 | 0.49 |
| **400** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.86 | 0.67 | 0.55 |
| **500** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.77 | 0.61 |
| **600** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.86 | 0.67 |
| **900** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.86 |

**Checkpoint 4**

**Design reduced ultimate concrete pryout capacity, $\phi V_{urcp}$**

$\phi V_{urc} = \phi V_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn} * X_{vs}$

# TruBolt™

## STUD ANCHORS - NON-CRACKED CONCRETE



## STEP 5 Verify anchor shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $\phi V_{us}$, (kN), $\phi_v$ = 0.8

| Anchor size, $d_b$ | M10 | M12 | M16 | M20 |
|---|---|---|---|---|
| Trubolt - Hot Dip Galvanized | 13.5 | 17.1 | 28.8 | 54.7 |

### Checkpoint 5

**Design reduced ultimate shear capacity, $\phi V_{ur}$**
**$\phi V_{ur}$ = minimum of $\phi V_{urc}$, $\phi V_{us}$**
**Check $V^*/\phi V_{ur} \leq 1$, if not satisfied return to step 1**

### Shear performance conversion table

| Performance Required | Concrete Shear Performance | | Steel Shear Performance | |
|---|---|---|---|---|
| | Notation | Concrete Shear Capacity | Notation | Carbon Steel Shear Capacity |
| Strength Limit State | $\phi V_{uc}$ | MULTIPLY $\phi V_{uc}$ x 1.00 | $\phi v_{us}$ | MULTIPLY $\phi V_{us}$ x 1.00 |
| Working Load Limit | $V_{ac}$ | MULTIPLY $\phi V_{uc}$ x 0.55 | $V_{as}$ | MULTIPLY $\phi V_{us}$ x 0.50 |
| Cyclic Laoding | $V_{yc}$ | MULTIPLY $\phi V_{uc}$ x 0.55 | $V_{ys}$ | MULTIPLY $\phi V_{us}$ x 0.50 |
| Fire Resistance | $V_{Rk,c,f,t}$ | Refer to Fire Resistance Section | $V_{Rk,s,f,t}$ | Refer to Fire Resistance Section |
| Seismic | $V^0_{Rd,c,sis}$ | Refer to Seismic Section | $V^0_{Rd,s,sis}$ | Refer to Seismic Section |

NOTE: Design Shear Capacity is the minimum of Concrete Shear and Steel Shear Capacities.

## STEP 6 Combined loading and specification

### Checkpoint 6

**Check**
**$N^*/\phi N_{ur} + V^*/\phi V_{ur} \leq 1.2$,**
**if not satisfied return to step 1**

### Specify

Ramset™ Trubolt™ Hot Dip Galv. Anchor,
(Anchor Size) (Part Number)
Maximum fixed thickness to be (t) mm.

### Example

Ramset™ Trubolt™ Hot Dip Galv. Anchor, M12 T12140GH.
Maximum fixed thickness to be 20mm. To be installed in accordance to Ramset™ Installation Instructions.