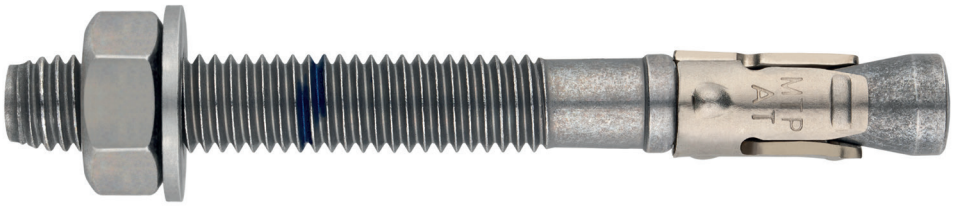
# Through-bolt expansion anchor with controlled torque, for use in cracked and non cracked concrete

# MTP-AT

ETA Assessed Option 1. Atlantis shaft. A4 Stainless clip.



## PRODUCT INFORMATION

### DESCRIPTION
Metallic anchor, with male thread, expansion by controlled torque.

### OFFICIAL DOCUMENTATION
- AVCP-1219-CPR-0053.
- ETA 12/0397 option 1.
- Declaration of Performance DoP MTP.

### SIZES
M8x50 to M20x200.

### DESIGN LOAD RANGE
From 5,0 to 30,6 kN (non cracked).
From 2,8 to 19,4 kN (cracked).

### BASE MATERIAL
Concrete class from C20/25 to C50/60 cracked or non-cracked, with or without fibres.

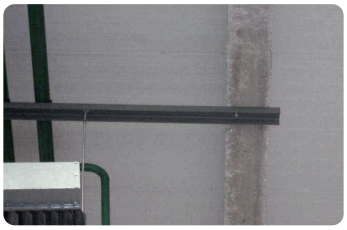

### ASSESSMENTS
- Option 1 (Cracked and non-cracked concrete)
- Fire Resistance R30-120
- Seismic C1 M10÷M16
- Sesimic C2 M12÷M16

### CHARACTERISTICS AND BENEFITS
- Easy installation.
- Use in cracked and non-craked concrete, with or without fibres.
- Use for medium-heavy duty loads.
- Pre-installation or through the drill-hole of the fixture.
- Variety of lengths and diameters: flexibility in assembly.
- For static and quasi-static loads.
- Available at INDEXcal.

### MATERIALS
**Shaft:** Cold-formed steel, Atlantis ≥ 8 µm.
**Washer:** DIN 125 or DIN 9021, Atlantis ≥ 8 µm.
**Nut:** DIN 934, Atlantis ≥ 8 µm.

**Clip:** A4 Stainless steel

### APPLICATIONS
- Anchor plates.
- Metallic structures.
- Bridges.
- Urban fitments.
- Protective fences.
- Catenaries.
- Elevators.
- Pipe supports.



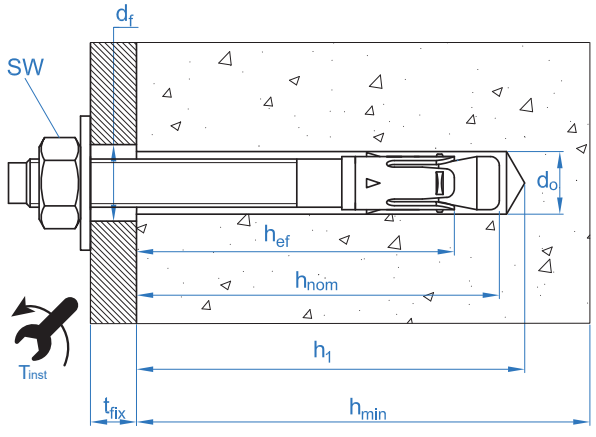
## MECHANICAL PROPERTIES

| | | | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| **Cone area section** | | | | | | | |
| $A_s$ | ($mm^2$) | Cone area section | 22,9 | 41,8 | 55,4 | 103,9 | 176,7 |
| $f_{u,s}$ | ($N/mm^2$) | Chracteristic tension resistance | 790 | 750 | 730 | 700 | 660 |
| $f_{y,s}$ | ($N/mm^2$) | Yield strength | 632 | 600 | 585 | 560 | 530 |
| **Threaded area section** | | | | | | | |
| $A_s$ | ($mm^2$) | Cone area section | 36,6 | 58,0 | 84,3 | 157,0 | 245,0 |
| $f_{u,s}$ | ($N/mm^2$) | Chracteristic tension resistance | 600 | 600 | 600 | 600 | 600 |
| $f_{y,s}$ | ($N/mm^2$) | Yield Strength | 480 | 480 | 480 | 480 | 480 |

## INSTALLATION DATA

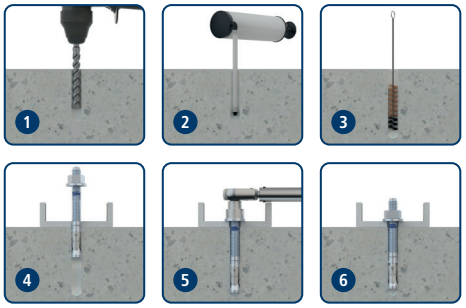
| SIZE | | | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| Code | | | AP08XXX | AP10XXX | AP12XXX | AP16XXX | AP20XXX |
| $d_0$ | Nominal diameter of drill bit | [mm] | 8 | 10 | 12 | 16 | 20 |
| $T_{ins}$ | Installation torque moment | [Nm] | 20 | 40 | 60 | 100 | 200 |
| $d_f \leq$ | Diameter of clearance hole in the fixture | [mm] | 9 | 12 | 14 | 18 | 22 |
| $h_1$ | Minimum drill hole depth | [mm] | 60 | 75 | 85 | 105 | 125 |
| $h_{nom}$ | Installation depth | [mm] | 55 | 68 | 80 | 97 | 114 |
| $h_{ef}$ | Effective embedment depth | [mm] | 48 | 60 | 70 | 85 | 100 |
| $h_{min}$ | Minimum base material thickness | [mm] | 100 | 120 | 140 | 170 | 200 |
| $t_{fix}$ | Maximum thickness of fixture | [mm] | L - 66 | L - 80 | L - 96 | L - 117 | L-138 |
| $s_{cr,N}$ | Critical spacing | [mm] | 144 | 180 | 210 | 255 | 300 |
| $c_{cr,N}$ | Critical edge distance | [mm] | 72 | 90 | 105 | 128 | 150 |
| $s_{cr,sp}$ | Critical distance (splitting) | [mm] | 288 | 300 | 350 | 425 | 500 |
| $c_{cr,sp}$ | Critical edge distance (splitting) | [mm] | 144 | 150 | 175 | 213 | 250 |
| $s_{min}$ | Minimum spacing | [mm]<br>[mm] | 40<br>55 | 40<br>70 | 60<br>75 | 65<br>95 | 95<br>105 |
| $c_{min}$ | Minimum edge distance | [mm]<br>[mm] | 45<br>55 | 45<br>90 | 55<br>110 | 70<br>115 | 95<br>105 |
| SW | Installation wrench | | 13 | 17 | 19 | 24 | 30 |

*L = Total anchor length



| Code | INSTALLATION PRODUCTS |
|---|---|
| | Hammer drill |
| BHDSXXXXX | Concrete Drill bits |
| MOBOMBA | Blow pump |
| MORCEPKIT | Cleaning Brush |
| DOMTAXX | Installation hammering tool |
| | Torque wrench |
| | Hexagonal socket |

**INSTALLATION**




# MTP-AT

## Resistances in C20/25 concrete for an isolated anchor, without effects of edge distance or spacing

**Characteristic Resistance $N_{Rk}$ and $V_{Rk}$**

| TENSION | | | | | | | | SHEAR | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | | | M8 | M10 | M12 | M16 | M20 | Size | | | M8 | M10 | M12 | M16 | M20 |
| $N_{Rk}$ | Non-cracked concrete | [kN] | 9,0 | 18,0 | 20,0 | 36,0 | 48,0 | $V_{Rk}$ | Non-cracked concrete | [kN] | 11,9 | 20,3 | 29,5 | 54,9 | 85,7 |
| $N_{Rk}$ | Cracked concrete | [kN] | 5,0 | 9,5 | 12,0 | 25,0 | 32,0 | $V_{Rk}$ | Cracked concrete | [kN] | 11,4 | 20,3 | 29,5 | 54 | 68,9 |

**Design Resistance $N_{Rd}$ and $V_{Rd}$**

| TENSION | | | | | | | | SHEAR | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | | | M8 | M10 | M12 | M16 | M20 | Size | | | M8 | M10 | M12 | M16 | M20 |
| $N_{Rd}$ | Non-cracked concrete | [kN] | 5,0 | 12,0 | 13,3 | 24,0 | 32,0 | $V_{Rd}$ | Non-cracked concrete | [kN] | 9,5 | 16,2 | 23,6 | 43,9 | 68,6 |
| $N_{Rd}$ | Cracked concrete | [kN] | 2,8 | 6,3 | 8,0 | 16,7 | 21,3 | $V_{Rd}$ | Cracked concrete | [kN] | 9,1 | 16,2 | 23,6 | 43,2 | 55,1 |

**Maximum Loads Recommended $N_{rec}$ and $V_{rec}$**

| TENSION | | | | | | | | SHEAR | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | | | M8 | M10 | M12 | M16 | M20 | Size | | | M8 | M10 | M12 | M16 | M20 |
| $N_{rec}$ | Non-cracked concrete | [kN] | 3,6 | 8,6 | 9,5 | 17,1 | 22,9 | $V_{rec}$ | Non-cracked concrete | [kN] | 6,8 | 11,6 | 16,9 | 31,4 | 49,0 |
| $N_{rec}$ | Cracked concrete | [kN] | 2,0 | 4,5 | 5,7 | 11,9 | 15,2 | $V_{rec}$ | Cracked concrete | [kN] | 6,5 | 11,6 | 16,9 | 30,9 | 39,4 |

## Simplified calculation method

**European Technical Assessment ETA 12/0397**

Simplified version of the calculation method according to Eurocode 2 EN 1992-4. Resistance is calculated according to the data shown in assessment 12/0397.

- Influence of concrete strength.
- Influence of edge distance.
- Influence of spacing between anchors.
- Influence of reinforcements.
- Influence of base material thickness.
- Influence of load application angle.
- Valid for a group of two anchors.

The calculation method is based on the following simplification: **Different loads do not act on individual anchors, without eccentricity.**

INDEXcal

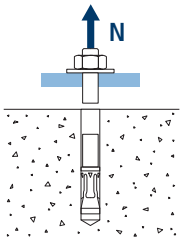
For a more accurate calculation and to take more constructive provisions into account, we recommend using our calculation program INDEXcal. It may be easily downloaded from our website **www.indexfix.com**

# MTP-AT

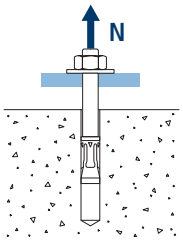
## TENSION LOADS

- Steel design resistance: $N_{Rd,s}$
- Pull-out design resistance: $N_{Rd,p} = N^{o}_{Rd,p} \cdot \Psi_{c}$
- Concrete cone design resistance: $N_{Rd,c} = N^{o}_{Rd,c} \cdot \Psi_{b} \cdot \Psi_{s,N} \cdot \Psi_{c,N} \cdot \Psi_{re,N}$
- Concrete splitting design resistance: $N_{Rd,sp} = N^{o}_{Rd,c} \cdot \Psi_{b} \cdot \Psi_{s,sp} \cdot \Psi_{c,sp} \cdot \Psi_{re,N} \cdot \Psi_{h,sp}$

| Steel Design resistance | | | | | | | |
|---|---|---|---|---|---|---|---|
| $N_{Rd,s}$ | | | | | | | |
| Size | | | M8 | M10 | M12 | M16 | M20 |
| $N^{o}_{Rd}$ | Non-cracked concrete | [kN] | 12,1 | 20,9 | 26,9 | 49,9 | 80,0 |

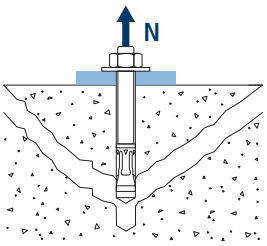


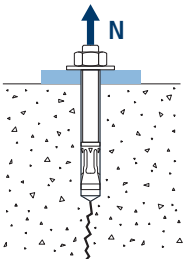

| Pull-out design resistance | | | | | | | |
|---|---|---|---|---|---|---|---|
| $N_{Rd,p} = N^{o}_{Rd,p} \cdot \Psi_{c}$ | | | | | | | |
| Size | | | M8 | M10 | M12 | M16 | M20 |
| $N^{o}_{Rd,p}$ | Non-cracked concrete | [kN] | 5,00 | 12,00 | 13,33 | 24,00 | 32,00 |
| $N^{o}_{Rd,p}$ | Cracked concrete | [kN] | 2,78 | 6,33 | 8,00 | 16,67 | 21,33 |




| Concrete cone design resistance | | | | | | | |
|---|---|---|---|---|---|---|---|
| $N_{Rd,c} = N^{o}_{Rd,c} \cdot \Psi_{b} \cdot \Psi_{s,N} \cdot \Psi_{c,N} \cdot \Psi_{re,N}$ | | | | | | | |
| Concrete splitting design resistance* | | | | | | | |
| $N_{Rd,sp} = N^{o}_{Rd,c} \cdot \Psi_{b} \cdot \Psi_{s,sp} \cdot \Psi_{c,sp} \cdot \Psi_{re,N} \cdot \Psi_{h,sp}$ | | | | | | | |
| Size | | | M8 | M10 | M12 | M16 | M20 |
| $N^{o}_{Rd,c}$ | Non-cracked concrete | [kN] | 9,1 | 15,2 | 19,2 | 25,7 | 32,8 |
| $N^{o}_{Rd,c}$ | Cracked concrete | [kN] | 6,4 | 10,7 | 13,5 | 18,0 | 23,0 |

*Concrete splitting design resistance must only be considered for non-cracked concrete.

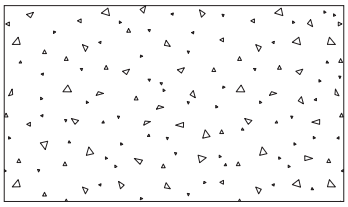


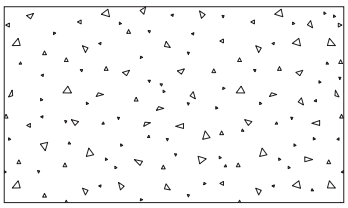
# MTP-AT

## Coefficients of influence

| Influence of concrete strength resistance in pul-out failure $\Psi_c$ | | | | | | |
|---|---|---|---|---|---|---|
| | | M8 | M10 | M12 | M16 | M20 |
| $\Psi_c$ | C 20/25 | 1,00 | | | | |
| | C 30/37 | 1,22 | 1,17 | 1,22 | 1,22 | 1,17 |
| | C 40/50 | 1,41 | 1,31 | 1,41 | 1,41 | 1,31 |
| | C 50/60 | 1,58 | 1,43 | 1,58 | 1,58 | 1,43 |

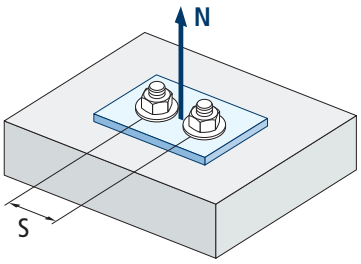


| Influence of concrete strength in concret cone and splitting failure $\Psi_b$ | | | | | | |
|---|---|---|---|---|---|---|
| | | M8 | M10 | M12 | M16 | M20 |
| $\Psi_b$ | C 20/25 | 1,00 | | | | |
| | C 30/37 | 1,22 | | | | |
| | C 40/50 | 1,41 | | | | |
| | C 50/60 | 1,58 | | | | |



$$\Psi_b = \sqrt{\frac{f_{ck,cube}}{25}} \geq 1$$

# MTP-AT

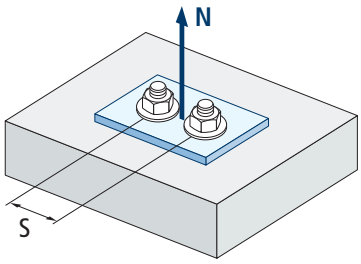



$$\Psi_{s,N} = 0{,}5 + \frac{s}{2 \cdot S_{cr,N}} \leq 1$$

| Influence of spacing (concrete cone) $\Psi_{s,N}$ | | | | | |
|---|---|---|---|---|---|
| s [mm] | MTP-AT | | | | |
| | M8 | M10 | M12 | M16 | M20 |
| 40 | 0,64 | 0,61 | | | |
| 50 | 0,67 | 0,64 | | | |
| 55 | 0,69 | 0,65 | | Invalid value | |
| 60 | 0,71 | 0,67 | 0,64 | | |
| 65 | 0,73 | 0,68 | 0,65 | 0,63 | |
| 70 | 0,74 | 0,69 | 0,67 | 0,64 | |
| 80 | 0,78 | 0,50 | 0,50 | 0,66 | |
| 85 | 0,80 | 0,74 | 0,70 | 0,67 | |
| 90 | 0,81 | 0,75 | 0,71 | 0,68 | |
| 95 | 0,83 | 0,76 | 0,73 | 0,69 | 0,66 |
| 100 | 0,85 | 0,78 | 0,74 | 0,70 | 0,67 |
| 105 | 0,86 | 0,79 | 0,75 | 0,71 | 0,68 |
| 110 | 0,88 | 0,81 | 0,76 | 0,72 | 0,68 |
| 120 | 0,92 | 0,83 | 0,79 | 0,74 | 0,70 |
| 125 | 0,93 | 0,85 | 0,80 | 0,75 | 0,71 |
| 126 | 0,94 | 0,85 | 0,80 | 0,75 | 0,71 |
| 128 | 0,94 | 0,86 | 0,80 | 0,75 | 0,71 |
| 130 | 0,95 | 0,86 | 0,81 | 0,75 | 0,72 |
| 135 | 0,97 | 0,88 | 0,82 | 0,76 | 0,73 |
| 144 | 1,00 | 0,90 | 0,84 | 0,78 | 0,74 |
| 150 | | 0,92 | 0,86 | 0,79 | 0,75 |
| 165 | | 0,96 | 0,89 | 0,82 | 0,78 |
| 170 | | 0,97 | 0,90 | 0,83 | 0,78 |
| 180 | | 1,00 | 0,93 | 0,85 | 0,80 |
| 195 | | | 0,96 | 0,88 | 0,83 |
| 200 | | | 0,98 | 0,89 | 0,83 |
| 210 | | | 1,00 | 0,91 | 0,85 |
| 220 | | | | 0,93 | 0,87 |
| 225 | | | | 0,94 | 0,88 |
| 252 | | | | 0,99 | 0,92 |
| 255 | | | | 1,00 | 0,93 |
| 260 | | | | | 0,93 |
| 300 | | Value without reduction = 1 | | | 1,00 |
| 309 | | | | | |
| 310 | | | | | |
| 375 | | | | | |

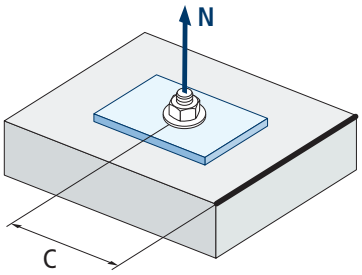
# MTP-AT

| Influence of spacing (concrete splitting) $\Psi_{s,sp}$ | | | | | |
|---|---|---|---|---|---|
| s [mm] | MTP-AT | | | | |
| | M8 | M10 | M12 | M16 | M20 |
| 40 | 0,57 | 0,57 | | | |
| 50 | 0,59 | 0,58 | | | |
| 55 | 0,60 | 0,59 | | Invalid value | |
| 60 | 0,60 | 0,60 | 0,59 | | |
| 65 | 0,61 | 0,61 | 0,59 | 0,58 | |
| 70 | 0,62 | 0,62 | 0,60 | 0,58 | |
| 80 | 0,64 | 0,63 | 0,61 | 0,59 | |
| 85 | 0,65 | 0,64 | 0,62 | 0,60 | |
| 90 | 0,66 | 0,65 | 0,63 | 0,61 | |
| 95 | 0,66 | 0,66 | 0,64 | 0,61 | 0,60 |
| 100 | 0,67 | 0,67 | 0,64 | 0,62 | 0,60 |
| 110 | 0,69 | 0,68 | 0,66 | 0,63 | 0,61 |
| 125 | 0,72 | 0,71 | 0,68 | 0,65 | 0,63 |
| 128 | 0,72 | 0,71 | 0,68 | 0,65 | 0,63 |
| 135 | 0,73 | 0,73 | 0,69 | 0,66 | 0,64 |
| 140 | 0,74 | 0,73 | 0,70 | 0,66 | 0,64 |
| 150 | 0,76 | 0,75 | 0,71 | 0,68 | 0,65 |
| 160 | 0,78 | 0,77 | 0,73 | 0,69 | 0,66 |
| 165 | 0,79 | 0,78 | 0,74 | 0,69 | 0,67 |
| 168 | 0,79 | 0,78 | 0,74 | 0,70 | 0,67 |
| 180 | 0,81 | 0,80 | 0,76 | 0,71 | 0,68 |
| 192 | 0,83 | 0,82 | 0,77 | 0,73 | 0,69 |
| 200 | 0,85 | 0,83 | 0,79 | 0,74 | 0,70 |
| 210 | 0,86 | 0,85 | 0,80 | 0,75 | 0,71 |
| 220 | 0,88 | 0,87 | 0,81 | 0,76 | 0,72 |
| 260 | 0,95 | 0,93 | 0,87 | 0,81 | 0,76 |
| 280 | 0,99 | 0,97 | 0,90 | 0,83 | 0,78 |
| 288 | 1,00 | 0,98 | 0,91 | 0,84 | 0,79 |
| 300 | | 1,00 | 0,93 | 0,85 | 0,80 |
| 336 | | | 0,98 | 0,90 | 0,84 |
| 350 | | | 1,00 | 0,91 | 0,85 |
| 360 | | | | 0,92 | 0,86 |
| 412 | | | | 0,98 | 0,91 |
| 425 | | | | 1,00 | 0,93 |
| 500 | Value without reduction = 1 | | | | 1,00 |
| 510 | | | | | |
| 560 | | | | | |




$$\Psi_{s,sp} = 0{,}5 + \frac{s}{2 \cdot S_{cr,sp}} \leq 1$$

# MTP-AT



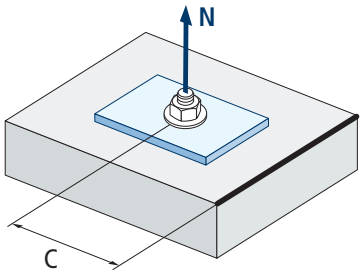

$$\Psi_{c,sp} = 0{,}35 + \frac{0{,}5 \cdot c}{C_{cr,sp}} + \frac{0{,}15 \cdot c^2}{C_{cr,sp}^{\ 2}} \leq 1$$

| Influence of concrete edge distance (splitting) $\Psi_{c,sp}$ | | | | | |
|---|---|---|---|---|---|
| c [mm] | MTP-AT | | | | |
| | M8 | M10 | M12 | M16 | M20 |
| 45 | 0,52 | 0,51 | | | |
| 50 | 0,54 | 0,53 | | | |
| 55 | 0,56 | 0,55 | 0,52 | Invalid value | |
| 60 | 0,58 | 0,57 | 0,54 | | |
| 65 | 0,61 | 0,59 | 0,56 | | |
| 70 | 0,63 | 0,62 | 0,57 | 0,53 | |
| 75 | 0,65 | 0,64 | 0,59 | 0,54 | |
| 80 | 0,67 | 0,66 | 0,61 | 0,56 | |
| 83 | 0,69 | 0,67 | 0,62 | 0,57 | |
| 84 | 0,69 | 0,68 | 0,62 | 0,57 | |
| 85 | 0,70 | 0,68 | 0,63 | 0,57 | |
| 90 | 0,72 | 0,70 | 0,65 | 0,59 | |
| 95 | 0,75 | 0,73 | 0,67 | 0,60 | 0,56 |
| 100 | 0,77 | 0,75 | 0,68 | 0,62 | 0,57 |
| 105 | 0,79 | 0,77 | 0,70 | 0,63 | 0,59 |
| 110 | 0,82 | 0,80 | 0,72 | 0,65 | 0,60 |
| 125 | 0,90 | 0,87 | 0,78 | 0,70 | 0,64 |
| 128 | 0,91 | 0,89 | 0,80 | 0,70 | 0,65 |
| 130 | 0,92 | 0,90 | 0,80 | 0,71 | 0,65 |
| 135 | 0,95 | 0,92 | 0,82 | 0,73 | 0,66 |
| 140 | 0,98 | 0,95 | 0,85 | 0,74 | 0,68 |
| 144 | 1,00 | 0,97 | 0,86 | 0,76 | 0,69 |
| 150 | | 1,00 | 0,89 | 0,78 | 0,70 |
| 168 | | | 0,97 | 0,84 | 0,75 |
| 175 | | | 1,00 | 0,86 | 0,77 |
| 180 | | | | 0,88 | 0,79 |
| 206 | | | | 0,97 | 0,86 |
| 213 | | | | 1,00 | 0,88 |
| 250 | Value without reduction = 1 | | | | 1,00 |
| 255 | | | | | |
| 280 | | | | | |

# MTP-AT

## Influence of concrete edge distance (concrete cone) $\Psi_{c,N}$

| c [mm] | MTP-AT | | | | |
|---|---|---|---|---|---|
| | M8 | M10 | M12 | M16 | M20 |
| 40 | 0,67 | 0,60 | | | |
| 50 | 0,77 | 0,67 | | | |
| 53 | 0,80 | 0,70 | | Invalid value | |
| 60 | 0,87 | 0,75 | 0,68 | | |
| 63 | 0,90 | 0,77 | 0,70 | | |
| 65 | 0,92 | 0,79 | 0,72 | 0,64 | |
| 70 | 0,98 | 0,83 | 0,75 | 0,67 | |
| 72 | 1,00 | 0,85 | 0,76 | 0,68 | |
| 75 | | 0,87 | 0,78 | 0,69 | |
| 80 | | 0,91 | 0,82 | 0,72 | |
| 83 | | 0,94 | 0,84 | 0,74 | |
| 85 | | 0,96 | 0,85 | 0,75 | |
| 90 | | 1,00 | 0,89 | 0,78 | |
| 95 | | | 0,93 | 0,80 | 0,73 |
| 100 | | | 0,96 | 0,83 | 0,75 |
| 105 | | | 1,00 | 0,86 | 0,77 |
| 110 | | | | 0,89 | 0,80 |
| 113 | | | | 0,91 | 0,81 |
| 125 | | | | 0,98 | 0,87 |
| 126 | | | | 0,99 | 0,88 |
| 128 | | | | 1,00 | 0,89 |
| 135 | | | | | 0,92 |
| 150 | | Value without reduction = 1 | | | 1,00 |
| 155 | | | | | |
| 188 | | | | | |

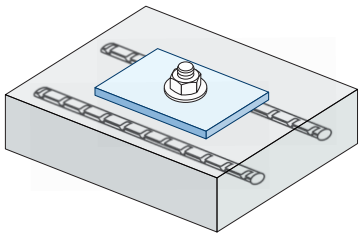



$$\Psi_{c,N} = 0{,}35 + \frac{0{,}5 \cdot c}{C_{cr,N}} + \frac{0{,}15 \cdot c^2}{C_{cr,N}^2} \leq 1$$

## Influence of reinforcements $\Psi_{re,N}$

| $\Psi_{re,N}$ | MTP-AT | | | | |
|---|---|---|---|---|---|
| | M8 | M10 | M12 | M16 | M20 |
| | 0,74 | 0,80 | 0,85 | 0,93 | 1,00 |

*This factor only applies for a high density of reinforcements. If in the area of the anchor there are reinforcements with a distancing of ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a distancing of ≥ 100 mm, a $f_{re,N}$ = 1 factor may be applied.

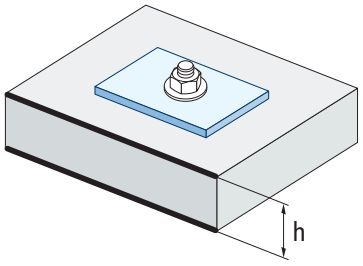


$$\Psi_{re,N} = 0{,}5 + \frac{h_{ef}}{200} \leq 1$$

## Influence of base material thickness $\Psi_{h,sp}$

| $\Psi_{h,sp}$ | MTP-AT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| h/hef | 2,00 | 2,20 | 2,40 | 2,60 | 2,80 | 3,00 | 3,20 | 3,40 | 3,60 | ≥3,68 |
| $\Psi_{h,sp}$ | 1,00 | 1,07 | 1,13 | 1,19 | 1,25 | 1,31 | 1,37 | 1,42 | 1,48 | 1,50 |

$$\Psi_{h,sp} = \left(\frac{h}{2 \cdot h_{ef}}\right)^{2/3} \leq 1{,}5$$

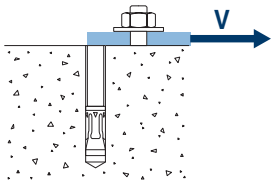


# MTP-AT

## SHEAR LOADS

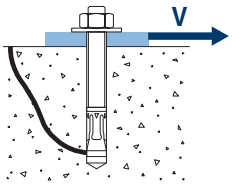
- Steel design resistance without lever arm: $V_{Rd,s}$
- Pry-out design resistance: $V_{Rd,cp} = k \cdot N^{o}_{Rd,c}$
- Concrete edge design resistance: $V_{Rd,c} = V^{o}_{Rd,c} \cdot \Psi_{b} \cdot \Psi_{se,V} \cdot \Psi_{c,V} \cdot \Psi_{re,V} \cdot \Psi_{\alpha,V} \cdot \Psi_{h,V}$

| Steel design resistance | | | | | | |
|---|---|---|---|---|---|---|
| $V_{Rd,s}$ | | | | | | |
| Size | | M8 | M10 | M12 | M16 | M20 |
| $V_{Rd,s}$ | [kN] | 9,52 | 16,24 | 23,6 | 43,92 | 68,56 |

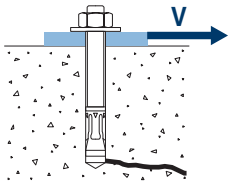



| Pry-out design resistance* | | | | | | |
|---|---|---|---|---|---|---|
| $V_{Rd,cp} = k \cdot N^{o}_{Rd,c}$ | | | | | | |
| Size | | M8 | M10 | M12 | M16 | M20 |
| k | | 1 | 2 | 2 | 2 | 2 |

* $N^{o}_{Rd,c}$ Concrete cone design resistance for tension loads



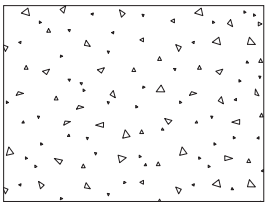

| Concrete edge resistance | | | | | | | |
|---|---|---|---|---|---|---|---|
| $V_{Rd,c} = V^{o}_{Rd,c} \cdot \Psi_{b} \cdot \Psi_{se,V} \cdot \Psi_{c,V} \cdot \Psi_{re,V} \cdot \Psi_{\alpha,V} \cdot \Psi_{h,V}$ | | | | | | | |
| Size | | | M8 | M10 | M12 | M16 | M20 |
| $V^{o}_{Rd,c}$ | Non-cracked concrete | [kN] | 6,2 | 8,9 | 11,5 | 15,9 | 20,8 |
| | Cracked concrete | [kN] | 4,4 | 6,3 | 8,1 | 11,3 | 14,7 |



# MTP-AT

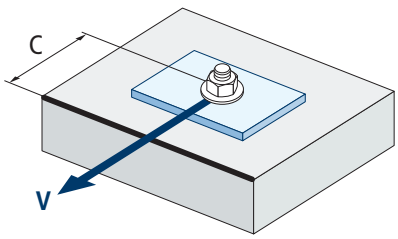
## Coefficients of influence

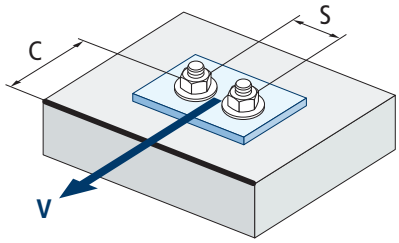
| Influence of concrete strength in concrete edge failure $\Psi_b$ | | | | | | |
|---|---|---|---|---|---|---|
| | | M8 | M10 | M12 | M16 | M20 |
| $\Psi_b$ | C 20/25 | 1,00 | | | | |
| | C 30/37 | 1,22 | | | | |
| | C 40/50 | 1,41 | | | | |
| | C 50/60 | 1,55 | | | | |



$$\Psi_b = \sqrt{\frac{f_{ck,cube}}{25}} \geq 1$$

| Influence of edge distance and spacing $\Psi_{se,V}$ | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FOR ONE ANCHOR ONLY | | | | | | | | | | | | | | | | | |
| $c/h_{ef}$ | 0,50 | 0,75 | 1,00 | 1,25 | 1,50 | 1,75 | 2,00 | 2,25 | 2,50 | 2,75 | 3,00 | 3,25 | 3,50 | 3,75 | 4,00 | 4,50 | 5,00 |
| Isolated | 0,35 | 0,65 | 1,00 | 1,40 | 1,84 | 2,32 | 2,83 | 3,38 | 3,95 | 4,56 | 5,20 | 5,86 | 6,55 | 7,26 | 8,00 | 9,55 | 11,18 |
| FOR TWO ANCHORS | | | | | | | | | | | | | | | | | |
| s/c | $c/h_{ef}$ | 0,50 | 0,75 | 1,00 | 1,25 | 1,50 | 1,75 | 2,00 | 2,25 | 2,50 | 2,75 | 3,00 | 3,25 | 3,50 | 3,75 | 4,00 | 4,50 | 5,00 |
| | 1,0 | 0,24 | 0,43 | 0,67 | 0,93 | 1,22 | 1,54 | 1,89 | 2,25 | 2,64 | 3,04 | 3,46 | 3,91 | 4,37 | 4,84 | 5,33 | 6,36 | 7,45 |
| | 1,5 | 0,27 | 0,49 | 0,75 | 1,05 | 1,38 | 1,74 | 2,12 | 2,53 | 2,96 | 3,42 | 3,90 | 4,39 | 4,91 | 5,45 | 6,00 | 7,16 | 8,39 |
| | 2,0 | 0,29 | 0,54 | 0,83 | 1,16 | 1,53 | 1,93 | 2,36 | 2,81 | 3,29 | 3,80 | 4,33 | 4,88 | 5,46 | 6,05 | 6,67 | 7,95 | 9,32 |
| | 2,5 | 0,32 | 0,60 | 0,92 | 1,28 | 1,68 | 2,12 | 2,59 | 3,09 | 3,62 | 4,18 | 4,76 | 5,37 | 6,00 | 6,66 | 7,33 | 8,75 | 10,25 |
| | ≥3,0 | 0,35 | 0,65 | 1,00 | 1,40 | 1,84 | 2,32 | 2,83 | 3,38 | 3,95 | 4,56 | 5,20 | 5,86 | 6,55 | 7,26 | 8,00 | 9,55 | 11,18 |

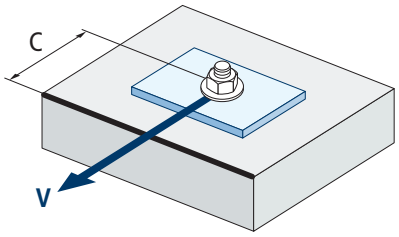



$$\Psi_{se,V} = \left(\frac{c}{h_{ef}}\right)^{1,5}$$

$$\Psi_{se,V} = \left(\frac{c}{h_{ef}}\right)^{1,5} \cdot \left(1 + \frac{s}{3 \cdot c}\right) \cdot 0,5 \leq \left(\frac{c}{h_{ef}}\right)^{1,5}$$

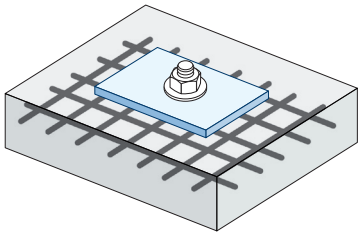
# MTP-AT



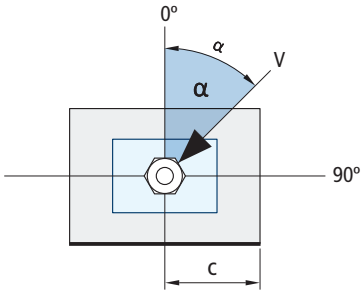

$$\psi_{c,V} = \left(\frac{d}{c}\right)^{0,20}$$

| Influence of concrete edge distance $\psi_{c,V}$ | | | | | |
|---|---|---|---|---|---|
| c [mm] | MTP-AT | | | | |
| | M8 | M10 | M12 | M16 | M20 |
| 40 | | | | | |
| 45 | | | | | |
| 50 | 0,69 | | | Invalid value | |
| 55 | 0,68 | | | | |
| 60 | 0,67 | 0,70 | | | |
| 65 | 0,66 | 0,69 | 0,71 | | |
| 70 | 0,65 | 0,68 | 0,70 | | |
| 80 | 0,63 | 0,66 | 0,68 | | |
| 85 | 0,62 | 0,65 | 0,68 | 0,72 | |
| 90 | 0,62 | 0,64 | 0,67 | 0,71 | |
| 100 | 0,60 | 0,63 | 0,65 | 0,69 | 0,72 |
| 105 | 0,60 | 0,62 | 0,65 | 0,69 | 0,72 |
| 110 | 0,59 | 0,62 | 0,64 | 0,68 | 0,71 |
| 120 | 0,58 | 0,61 | 0,63 | 0,67 | 0,70 |
| 125 | 0,58 | 0,60 | 0,63 | 0,66 | 0,69 |
| 130 | 0,57 | 0,60 | 0,62 | 0,66 | 0,69 |
| 135 | 0,57 | 0,59 | 0,62 | 0,65 | 0,68 |
| 140 | 0,56 | 0,59 | 0,61 | 0,65 | 0,68 |
| 150 | 0,56 | 0,58 | 0,60 | 0,64 | 0,67 |
| 160 | 0,55 | 0,57 | 0,60 | 0,63 | 0,66 |
| 170 | 0,54 | 0,57 | 0,59 | 0,62 | 0,65 |
| 175 | 0,54 | 0,56 | 0,59 | 0,62 | 0,65 |
| 180 | 0,54 | 0,56 | 0,58 | 0,62 | 0,64 |
| 190 | 0,53 | 0,55 | 0,58 | 0,61 | 0,64 |
| 200 | 0,53 | 0,55 | 0,57 | 0,60 | 0,63 |
| 210 | 0,52 | 0,54 | 0,56 | 0,60 | 0,62 |
| 220 | 0,52 | 0,54 | 0,56 | 0,59 | 0,62 |
| 230 | 0,51 | 0,53 | 0,55 | 0,59 | 0,61 |
| 240 | 0,51 | 0,53 | 0,55 | 0,58 | 0,61 |
| 250 | 0,50 | 0,53 | 0,54 | 0,58 | 0,60 |
| 260 | 0,50 | 0,52 | 0,54 | 0,57 | 0,60 |
| 270 | 0,49 | 0,52 | 0,54 | 0,57 | 0,59 |
| 280 | 0,49 | 0,51 | 0,53 | 0,56 | 0,59 |
| 290 | 0,49 | 0,51 | 0,53 | 0,56 | 0,59 |
| 300 | 0,48 | 0,51 | 0,53 | 0,56 | 0,58 |

| Influence of reinforcements $\Psi_{re,V}$ | | | |
|---|---|---|---|
| | Without perimetral reinforcements | Perimetral reinforcements ≥ Ø12 mm | Perimetral reinforcements with brackets ≤ 100 mm |
| Non-cracked concrete | 1 | 1 | 1 |
| Cracked concrete | 1 | 1,2 | 1,4 |

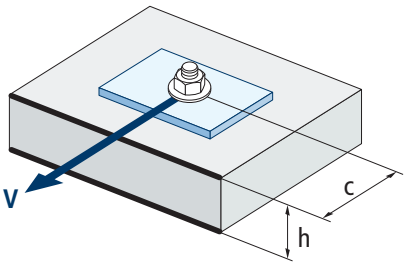


| Influence of load application angle $\Psi_{\alpha,V}$ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Angle, α(°) | 0° | 10° | 20° | 30° | 40° | 50° | 60° | 70° | 80° | 90° |
| $\Psi_{\alpha,V}$ | 1,00 | 1,01 | 1,05 | 1,13 | 1,24 | 1,40 | 1,64 | 1,97 | 2,32 | 2,50 |




$$\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos \alpha_v)^2 + \left(\frac{\sin \alpha_v}{2,5}\right)^2}} \geq 1$$

| Influence of base material thickness $\Psi_{h,V}$ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MTP-AT | | | | | | | | | | |
| h/c | 0,15 | 0,30 | 0,45 | 0,60 | 0,75 | 0,90 | 1,05 | 1,20 | 1,35 | ≥1,5 |
| $\Psi_{h,V}$ | 0,32 | 0,45 | 0,55 | 0,63 | 0,71 | 0,77 | 0,84 | 0,89 | 0,95 | 1,00 |




$$\Psi_{h,V} = \left(\frac{h}{1,5 \cdot c}\right)^{0,5} \geq 1,0$$

# MTP-AT

## FIRE RESISTANCE

| Characteristic Resistance* | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TENSION | | | | | SHEAR | | | | |
| | M8 | M10 | M12 | M16 | M20 | M8 | M10 | M12 | M16 | M20 |
| RF30 | 0,4 | 0,9 | 1,7 | 3,1 | 4,9 | 0,4 | 0,9 | 1,7 | 3,1 | 4,9 |
| RF60 | 0,3 | 0,8 | 1,3 | 2,4 | 3,7 | 0,3 | 0,8 | 1,3 | 2,4 | 3,7 |
| RF90 | 0,3 | 0,6 | 1,1 | 2,0 | 3,2 | 0,3 | 0,6 | 1,1 | 2,0 | 3,2 |
| RF120 | 0,2 | 0,5 | 0,8 | 1,6 | 2,5 | 0,2 | 0,5 | 0,8 | 1,6 | 2,5 |

*The safety factor for design resistance under fire exposure is $\gamma_{M,fi}$=1 (in abscence of other national regulations). As a eresult the Characteristic Resistance is the same as Design Resistance.

| Maximum Load Recommended | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TENSION | | | | | SHEAR | | | | |
| | M8 | M10 | M12 | M16 | M20 | M8 | M10 | M12 | M16 | M20 |
| RF30 | 0,3 | 0,6 | 1,2 | 2,2 | 3,5 | 0,3 | 0,6 | 1,2 | 2,2 | 3,5 |
| RF60 | 0,2 | 0,6 | 0,9 | 1,7 | 2,6 | 0,2 | 0,6 | 0,9 | 1,7 | 2,6 |
| RF90 | 0,2 | 0,4 | 0,8 | 1,4 | 2,3 | 0,2 | 0,4 | 0,8 | 1,4 | 2,3 |
| RF120 | 0,1 | 0,4 | 0,6 | 1,1 | 1,8 | 0,1 | 0,4 | 0,6 | 1,1 | 1,8 |

## RANGE

| Code | Seismic assessment | Size | Maximum thickness of fixture | Axle letter (length) | | |
|---|---|---|---|---|---|---|
| APAT08075 | - | M8 x 75 Ø8 | 9 | C | 100 | 600 |
| APAT08095 | - | M8 x 95 Ø8 | 29 | E | 100 | 600 |
| APAT08115 | - | M8 x 115 Ø8 | 49 | G | 100 | 400 |
| APAT10090 | C1 | M10 x 90 Ø10 | 10 | E | 100 | 400 |
| APAT10105 | C1 | M10 x 105 Ø10 | 25 | F | 50 | 300 |
| APAT10115 | C1 | M10 x 115 Ø10 | 35 | G | 50 | 200 |
| APAT10135 | C1 | M10 x 135 Ø10 | 55 | H | 50 | 200 |
| APAT10165 | C1 | M10 x 165 Ø10 | 85 | K | 50 | 200 |
| APAT10185 | C1 | M10 x 185 Ø10 | 105 | L | 50 | 150 |
| APAT12100 | C1&C2 | M12 x 100 Ø12 | 4 | E | 50 | 200 |
| APAT12110 | C1&C2 | M12 x 110 Ø12 | 14 | F | 50 | 200 |

| Code | Seismic assessment | Size | Maximum thickness of fixture | Axle letter (length) | | |
|---|---|---|---|---|---|---|
| APAT12120 | C1&C2 | M12 x 120 Ø12 | 24 | G | 50 | 200 |
| APAT12130 | C1&C2 | M12 x 130 Ø12 | 34 | H | 50 | 200 |
| APAT12150 | C1&C2 | M12 x 150 Ø12 | 54 | I | 50 | 100 |
| APAT12180 | C1&C2 | M12 x 180 Ø12 | 84 | L | 50 | 150 |
| APAT12200 | C1&C2 | M12 x 200 Ø12 | 104 | M | 50 | 150 |
| APAT16145 | C1&C2 | M16 x 145 Ø16 | 28 | I | 25 | 100 |
| APAT16175 | C1&C2 | M16 x 175 Ø16 | 58 | K | 25 | 50 |
| APAT16220 | C1&C2 | M16 x 220 Ø16 | 103 | O | 25 | 50 |
| APAT20170 | - | M20 x 170 Ø20 | 32 | K | 20 | 40 |
| APAT20200 | - | M20 x 200 Ø20 | 62 | N | 20 | 40 |