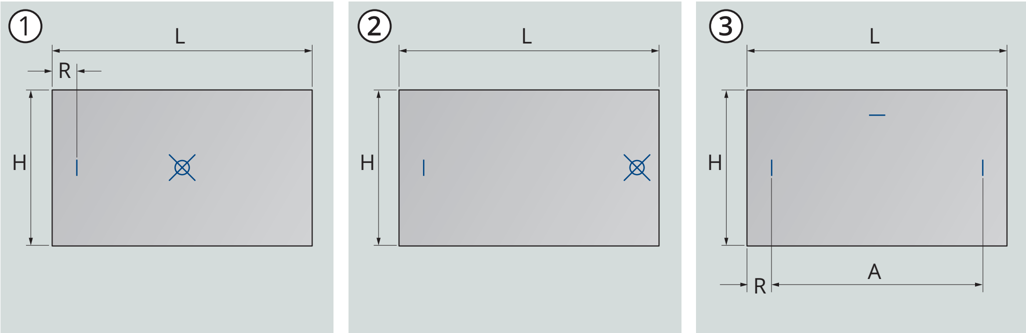
Sandwich Anchor System

Dimensioning bases

PFEIFER

Static models

LOAD CASE A: Without rotation of the element:



Symbols:
- = cylinder anchor
- | = flat anchor/Delta anchor/ SPA anchor/connector pin cross

Determination of the stress for bearing anchors

① $V_{Ed} = L \cdot H \cdot V \cdot 25\ kN/m^3 \cdot 1{,}35$

② $V_{Ed} = \dfrac{L \cdot H \cdot V \cdot 25\ kN/m^3 \cdot 1{,}35}{2}$

③ $V_{Ed} = \dfrac{L \cdot H \cdot V \cdot 25\ kN/m^3 \cdot 1{,}35}{2}$

Variables:
- L = length of facing layer
- H = height of facing layer
- V = thickness of facing layer
- A = distance between load bearing anchors
- R = distance between torsion anchor and edge

Determination of the stress for retaining anchors/torsion anchors

① $V_{Ed,\ Torsion} = \dfrac{0{,}05 \cdot L}{0{,}45 \cdot L - R} \cdot [L \cdot H \cdot V \cdot 25\ kN/m^3 \cdot 1{,}35]$

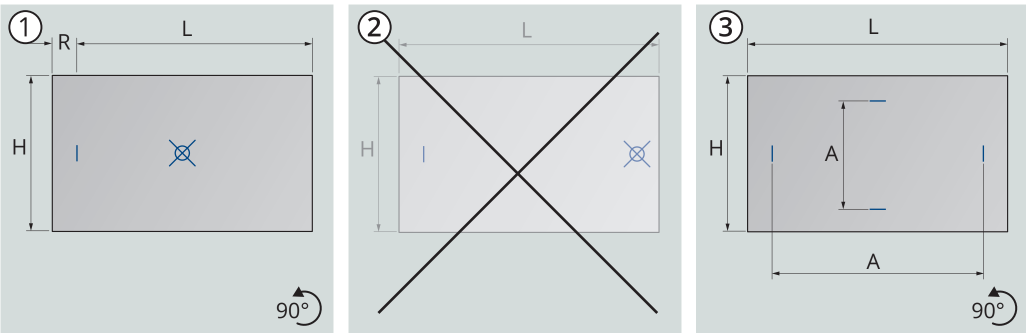
② No retaining/torsion anchors required

③ $V_{Ed,\ Retaining} = 0{,}1 \cdot [L \cdot H \cdot V \cdot 25\ kN/m^3 \cdot 1{,}35]$

Caution:

The stresses determined here via the dead weight alone must be compared with the design resistances (see tables).

LOAD CASE B: With rotation of the element:



Caution:

In the case of rotation of the elements, the determination of the retaining/torsion anchors can be dispensed with. Instead, the bearing anchors are arranged in both axes.

Notice:

When dimensioning with two bearing anchors with different distances to the centre of gravity, they must be taken into account according to the ratio and the anchor stress.

Reinforcement – spacings – anchor height

Surface reinforcement in general

Permissible types of reinforcement: Reinforcing steel bar B500A/B according to DIN 488, reinforcement mesh B500A/B according to DIN 488 or reinforcement made of stainless steel.

Table 1: Minimum reinforcement of the concrete layers of a sandwich wall

Facing layer V < 100 mm	Facing or load bearing layer V ≥ 100 mm bzw. T ≥ 100 mm
Minimum reinforcement, single-layer, central a_s ≥ 1,88 cm²/m per direction (e.g. Q188)	Minimum reinforcement, two-layer, near to surface a_s ≥ 1,88 cm²/m per direction and layer (e.g. Q188)

Notice:

In each case the existing concrete cover has to be compared with the required concrete cover. If necessary stainless steel reinforement has to be used.

ZA Cylinder Anchor

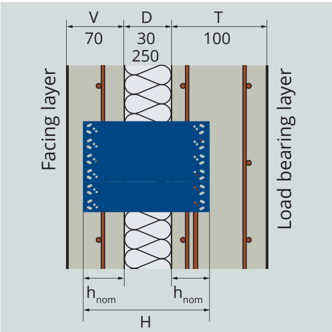
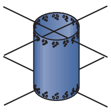


Table 2: Minimum embedment depth h_{nom}

Thickness of facing layer h_v	Thickness of thermal insulation layer h_D [mm]	
	30–90	100–200
70 [mm]	55	60
80 [mm]	60	65
90–120 [mm]	60	70

Table 3: Anchoring reinforcement for cylinder anchor (through round hole)

Installation method	Type	
	51–1,5 76–1,5 102–1,5	2 x 2 Ø 6 mm, L = 500 mm

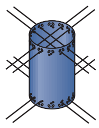
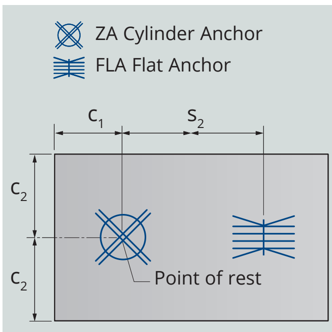
Installation method	Type	
	127–1,5 153–1,5 178–1,5 204–1,5 229–1,5 255–1,5 280–1,5	Anchoring bars B500A/B 2 x 4 Ø 6 mm, L = 700 mm

Table 4: Minimum axis and edge distances

middle diameter d	51–102 mm	127–280 mm
$c_{1.min}$ / $c_{2.min}$ [mm]	300	400
$s_{1.min}$ / $s_{2.min}$ [mm]	500	600



Notice:

The cylinder anchor is always regarded as a point of rest of movement.

Table 5: Required anchor height h

Thickness of facing layer V [mm]	Thickness of thermal insulation layer D [mm]: 30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250
70	150 mm	150 mm	175 mm	175 mm	200 mm	200 mm	200 mm	225 mm	260 mm	260 mm	260 mm	260 mm	300 mm	300 mm	300 mm	300 mm	340 mm	340 mm	not available	not available	not available	not available	not available
80	150 mm	175 mm	175 mm	200 mm	200 mm	200 mm	225 mm	260 mm	260 mm	260 mm	260 mm	300 mm	300 mm	300 mm	300 mm	340 mm	340 mm	340 mm	not available	not available	not available	not available	not available
90	150 mm	175 mm	175 mm	200 mm	200 mm	200 mm	225 mm	260 mm	260 mm	260 mm	300 mm	300 mm	300 mm	300 mm	340 mm	340 mm	340 mm	340 mm	not available	not available	not available	not available	not available
100	150 mm	175 mm	175 mm	200 mm	200 mm	200 mm	225 mm	260 mm	260 mm	260 mm	300 mm	300 mm	300 mm	300 mm	340 mm	340 mm	340 mm	340 mm	not available	not available	not available	not available	not available
110	150 mm	175 mm	175 mm	200 mm	200 mm	200 mm	225 mm	260 mm	260 mm	260 mm	300 mm	300 mm	300 mm	300 mm	340 mm	340 mm	340 mm	340 mm	not available	not available	not available	not available	not available
120	150 mm	175 mm	175 mm	200 mm	200 mm	200 mm	225 mm	260 mm	260 mm	260 mm	300 mm	300 mm	300 mm	300 mm	340 mm	340 mm	340 mm	340 mm	not available	not available	not available	not available	not available

Reinforcement – spacings – anchor height

FLA Flat Anchor

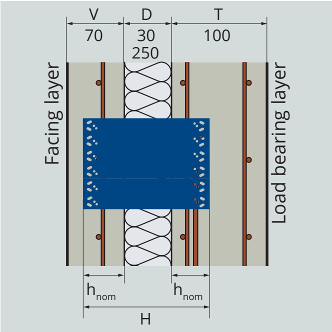
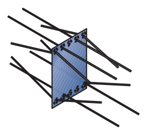
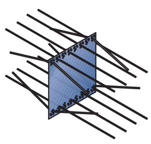


Table 6: Minimum embedment depth h_{nom}

Minimum embedment depth	Thickness of thermal insulation layer h_D [mm] 30–250 mm
h_{nom} [mm]	55

Table 7: Anchoring reinforcement – flat anchor

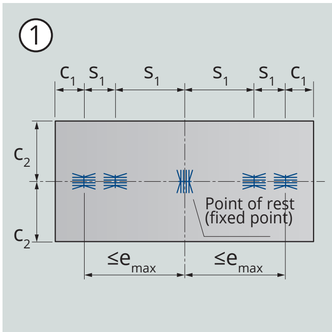
Installation method	Length L [mm]	Anchoring bars B500 A/B
	8	2 x 4 Ø 6 mm mit L = 400 mm
	120 160, 200 240, 280 320, 360 400	2 x 5 Ø 6 mm mit L = 400 mm 2 x 6 Ø 6 mm mit L = 400 mm 2 x 7 Ø 6 mm mit L = 400 mm

Notice:

In each case the existing concrete cover has to be compared with the required concrete cover. If necessary stainless steel reinforement has to be used.

Table 8: Minimum axis and edge distances

anchorage length L	80–400 mm
$c_{1.min}$ / $c_{2.min}$ [mm]	300
$s_{1.min}$ / $s_{2.min}$ [mm]	500



Notice:

The maximum distances to the point of rest of movement are to be taken from the currently valid building authority approval.

Table 9: Required anchor height h

<table>
<tr><th rowspan="2">Thickness of facing layer V [mm]</th><th colspan="23">Thickness of thermal insulation layer D [mm]</th></tr>
<tr><th>30</th><th>40</th><th>50</th><th>60</th><th>70</th><th>80</th><th>90</th><th>100</th><th>110</th><th>120</th><th>130</th><th>140</th><th>150</th><th>160</th><th>170</th><th>180</th><th>190</th><th>200</th><th>210</th><th>220</th><th>230</th><th>240</th><th>250</th></tr>
<tr><td>70–80</td><td>150</td><td colspan="3">175mm</td><td colspan="2">200mm</td><td colspan="3">225mm</td><td colspan="3">260mm</td><td colspan="2">280mm</td><td colspan="2">300mm</td><td colspan="2">320mm</td><td colspan="2">340mm</td><td colspan="3">360mm</td></tr>
<tr><td>90</td><td>150</td><td colspan="2">175mm</td><td colspan="3">200mm</td><td colspan="2">225mm</td><td colspan="4">260mm</td><td colspan="2">280mm</td><td colspan="2">300mm</td><td colspan="2">320mm</td><td colspan="2">340mm</td><td colspan="2">360mm</td><td>–</td></tr>
<tr><td>100–120</td><td>150</td><td colspan="3">175mm</td><td colspan="2">200mm</td><td colspan="3">225mm</td><td colspan="3">260mm</td><td colspan="2">280mm</td><td colspan="2">300mm</td><td colspan="2">320mm</td><td colspan="2">340mm</td><td colspan="3">360mm</td></tr>
</table>

Reinforcement – spacings – anchor height

Delta Anchors

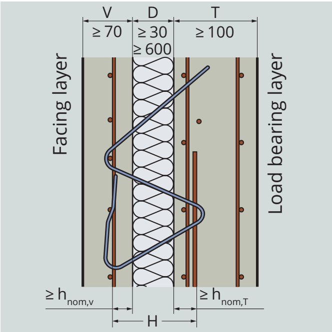


Table 10: Minimum embedment depth h_{nom}

Thickness of facing layer v	70 mm	80 mm	90 mm	≥ 100 mm
$h_{nom,v} = h_{nom,T}$ [mm]	35 + Ø	40 + Ø	45 + Ø	35 + Ø

Notice:

Installation and load bearing capacity of the Delta bearing anchor are not bound to to any particular direction.

Table 11: Anchoring reinforcement – Delta anchor

DTA	∅ 6 mm	∅ 8 mm	∅ 10 mm
Facing layer[1)]	1 x ∅ 8, L = 400 mm		
Load bearing layer[1)]	1 x ∅ 8, L = 400 mm und 2 x ∅ 8, L = 600 mm		

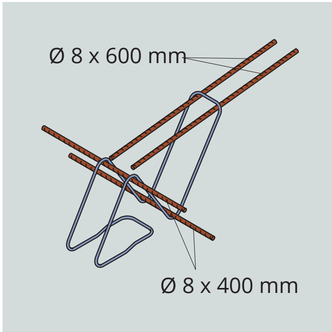


Table 12: Minimum axis and edge distances

DTA	∅ 6 mm	∅ 8 mm	∅ 10 mm
$C_{1,min}$ [mm]	200		
$C_{2,min}$ [mm]	$0{,}5 \cdot L + 100 = 0{,}9 \cdot H + 100$		
$S_{1,min}$ [mm]	400		
$S_{2,min}$ [mm]	$L + 200 = 1{,}8 \cdot H + 200$		

Notice:

The maximum distances to the point of rest of movement are to be taken from the current valid building authority approval.

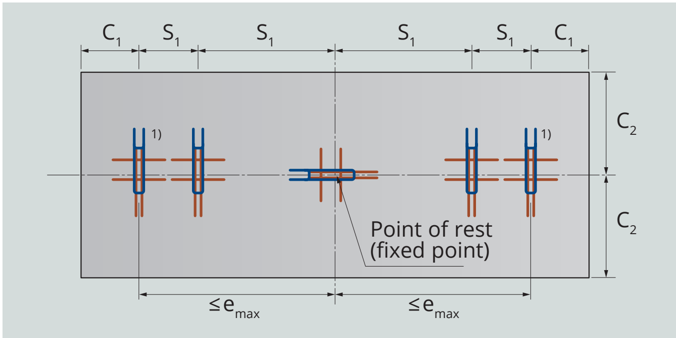


Table 13: Required anchor height H [mm]

<table>
<tr><th rowspan="2">Thickness of facing layer V [mm]</th><th colspan="23">Thickness of thermal insulation layer D [mm]</th></tr>
<tr><th>30</th><th>40</th><th>50</th><th>60</th><th>70</th><th>80</th><th>90</th><th>100</th><th>110</th><th>120</th><th>130</th><th>140</th><th>150</th><th>160</th><th>170</th><th>180</th><th>190</th><th>200</th><th>210</th><th>220</th><th>230</th><th>240</th><th>250</th></tr>
<tr><td>70</td><td colspan="8">180</td><td colspan="2">200</td><td colspan="2">220</td><td colspan="2">240</td><td colspan="2">260</td><td colspan="2">280</td><td colspan="2">300</td><td colspan="2">320</td><td>340</td></tr>
<tr><td>80</td><td colspan="7">180</td><td colspan="2">200</td><td colspan="2">220</td><td colspan="2">240</td><td colspan="2">260</td><td colspan="2">280</td><td colspan="2">300</td><td colspan="2">320</td><td colspan="2">340</td></tr>
<tr><td>90</td><td colspan="6">180</td><td colspan="2">200</td><td colspan="2">220</td><td colspan="2">240</td><td colspan="2">260</td><td colspan="2">280</td><td colspan="2">300</td><td colspan="2">320</td><td colspan="2">340</td><td>360</td></tr>
<tr><td>> 100</td><td colspan="8">180</td><td colspan="2">200</td><td colspan="2">220</td><td colspan="2">240</td><td colspan="2">260</td><td colspan="2">280</td><td colspan="2">300</td><td colspan="2">320</td><td>340</td></tr>
</table>

Reinforcement – spacings – anchor height

SPA anchor

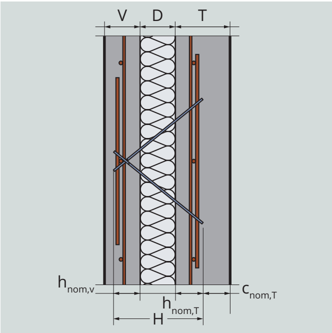
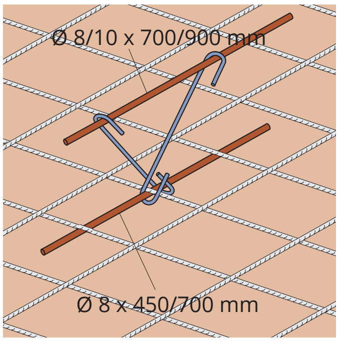


Table 14: Minimum embedment depths, minimum component thicknesses and minimum concrete covers

Bearing anchor type		SPA-1-05 SPA-2-05	SPA-1-07 SPA-2-07	SPA-1-08 SPA-2-08	SPA-1-09 SPA-2-09	SPA-1-10 SPA-2-10
Ø	[mm]	5,0	6,5	8,0	8,5	10
V	[mm]	≥ 70				
$h_{nom,v}$	[mm]	49	50	52	53	54
T	[mm]	≥ 100				
$h_{nom,T}$	[mm]	55				
$c_{nom,T}$	[mm]	≥ 25				
H	[mm]	$D + h_{nom,v} + h_{nom,T}$				



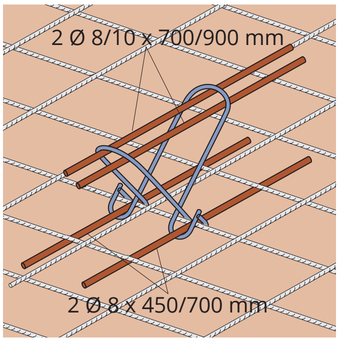


Table 15: Anchoring reinforcement

<table>
<tr><th colspan="2">Bearing anchor type</th><th>SPA-1-05
SPA-2-05</th><th>SPA-1-07
SPA-2-07</th><th>SPA-1-08
SPA-2-08</th><th>SPA-1-09
SPA-2-09</th><th>SPA-1-10
SPA-2-10</th></tr>
<tr><td rowspan="3">Facing layer</td><td>SPA-1</td><td colspan="5">1 x Ø 8 mm</td></tr>
<tr><td>SPA-2</td><td colspan="5">2 x Ø 8 mm</td></tr>
<tr><td></td><td colspan="2">450 mm</td><td colspan="3">700 mm</td></tr>
<tr><td rowspan="5">Load bearing layer</td><td>SPA-1</td><td colspan="2">1 x Ø 8 mm</td><td colspan="3">1 x Ø 10 mm</td></tr>
<tr><td rowspan="2">SPA-2</td><td colspan="2">2 x Ø 8 mm</td><td colspan="3">2 x Ø 10 mm</td></tr>
<tr><td colspan="5">(additional transverse bar in facing layer with positive method1); 1 x Ø 8 mm, l = 300 mm, see Appendix 18, Fig. 6 b, according to approval)</td></tr>
<tr><td>H < 340 mm</td><td colspan="5">700 mm</td></tr>
<tr><td>H ≥ 340 mm</td><td colspan="5">900 mm</td></tr>
</table>

[1] Positive process: Load bearing layer is manufactured first

Table 16: Minimum edge and axis spacings

Bearing anchor type		SPA-1-05 SPA-2-05	SPA-1-07 SPA-2-07	SPA-1-08 SPA-2-08	SPA-1-09 SPA-2-09	SPA-1-10 SPA-2-10
$s_{1,min}/s_{2,min}$	SPA-1	220 mm				
	SPA-2	300 mm				
$c_{1,min}/c_{2,min}$	SPA-1	110 mm				
	SPA-2	150 mm				

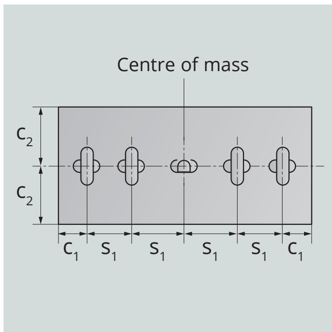


Table 17: Required anchor height H [mm]

<table>
<tr><th rowspan="2">Thickness of facing layer V [mm]</th><th colspan="23">Thickness of thermal insulation layer D [mm]</th></tr>
<tr><th>30</th><th>40</th><th>50</th><th>60</th><th>70</th><th>80</th><th>90</th><th>100</th><th>110</th><th>120</th><th>130</th><th>140</th><th>150</th><th>160</th><th>170</th><th>180</th><th>190</th><th>200</th><th>210</th><th>220</th><th>230</th><th>240</th><th>250</th></tr>
<tr><td>70–100</td><td colspan="2">160 mm</td><td colspan="2">180 mm</td><td colspan="2">200 mm</td><td colspan="2">220 mm</td><td colspan="2">240 mm</td><td colspan="2">260 mm</td><td colspan="2">280 mm</td><td colspan="2">300 mm</td><td colspan="2">320 mm</td><td colspan="2">340 mm</td><td colspan="2">360 mm</td><td>380 mm</td></tr>
<tr><td>> 100</td><td colspan="2">160 mm</td><td colspan="2">180 mm</td><td colspan="2">200 mm</td><td colspan="2">220 mm</td><td colspan="2">240 mm</td><td colspan="2">260 mm</td><td colspan="2">280 mm</td><td colspan="2">300 mm</td><td colspan="2">320 mm</td><td colspan="2">340 mm</td><td colspan="2">360 mm</td><td>380 mm</td></tr>
</table>

Notice:

Solutions up to an insulation layer thickness of 400 mm are available upon request.

VNK Connector Pin Cross

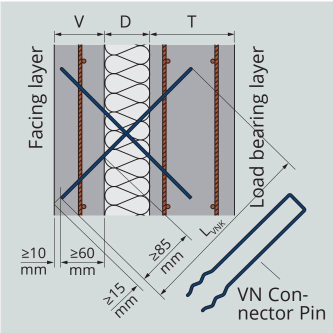
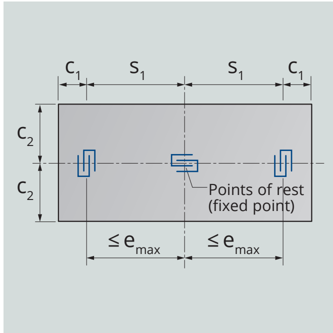


Table 18: Minimum axis and edge distances

Diameter Connector pin cross	**VNK 5**	**VNK 6**
$c_{II,min}$[2] [mm]	$0{,}5 \cdot h_D + 200$	
$c_{\perp,min}$[3] [mm]	200	
$s_{II,min}$[2] [mm]	$h_D + 400$	
$s_{\perp,min}$[3] [mm]	400	

[2] in load direction
$s_1 \geq s_{\perp,min}$
$s_2 \geq \max(s_{\perp,min}; s_{II,min})$

[3] transverse to load direction



Notice:

The maximum distances to the point of rest of movement are to be taken from the current valid building authority approval.

Table 19: Required connector pin height h [mm]

<table>
<tr><th rowspan="2">Thickness of facing layer V [mm]</th><th colspan="23">Thickness of thermal insulation layer D [mm]</th></tr>
<tr><th>30</th><th>40</th><th>50</th><th>60</th><th>70</th><th>80</th><th>90</th><th>100</th><th>110</th><th>120</th><th>130</th><th>140</th><th>150</th><th>160</th><th>170</th><th>180</th><th>190</th><th>200</th><th>210</th><th>220</th><th>230</th><th>240</th><th>250</th></tr>
<tr><td>70–120</td><td>220</td><td colspan="2">240</td><td>260</td><td>280</td><td colspan="2">300</td><td>320</td><td colspan="2">340</td><td>360</td><td>380</td><td colspan="2">400</td><td>420</td><td colspan="2">440</td><td>460</td><td>480</td><td colspan="2">500</td><td>520</td><td>540</td></tr>
</table>

VN Connector Pin / AB Clip-on Stirrup / AN Clip-on Pin

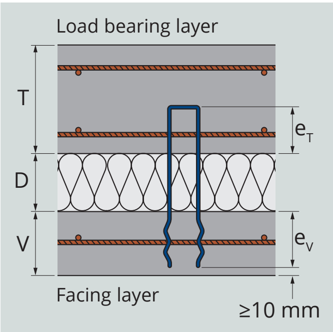


Table 20: Minimum embedment depths [mm]

	VN	AN	AB
e_V	≥ 60	$V/2 + Ø_{AN}$	$V/2 + Ø_{AB}$
e_T	≥ 60	≥ 65	≥ 60

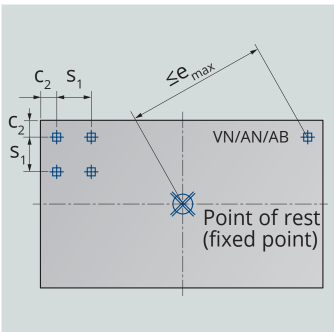


Table 21: Minimum axis and edge distances

	VN	AN	AB
$c_{1,min}$ / $c_{2.min}$ [mm]	≥ 100		
$s_{1.min}$ / $s_{2.min}$ [mm]	≥ 200		
s_{max}	= 1200 (also applies to double pins!!!)		

Notice:

The maximum distances to the point of rest of movement are to be taken from the current valid building authority approval.

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