DESIGN TEMPLATE – METAL ANCHORS

Anchor Design according to Würth Simplified Anchor Design Method

Actions			
Design value of tensile load	$N^{g}_{Sd} =$		kN
Number of anchors in the group loaded with tension	$n =$		
Design value of tensile load acting on a single anchor	$N^{h}_{Sd} = \frac{N^{g}_{Sd}}{n} =$		kN
Design value of shear load	$V^{g}_{Sd} =$		kN
Number of anchors in the group loaded with shear	$n =$		
Design value of shear load acting on a single anchor	$V^{h}_{Sd} = \frac{V^{g}_{Sd}}{n} =$		kN
Anchor data			
Anchor type			
Anchor diameter	M		
Anchorage depth	$h_{ef} =$		mm
Base material			
Compressive strength class of concrete			
Characteristic compressive cube strength of concrete at 28days	$f_{ck,cube} =$		N/mm²
Characteristic compressive cylinder strength of concrete at 28days	$f_{ck,cyl} =$		N/mm²
Cracked concrete		**Non-cracked concrete**	
Structural verification			
	$\beta_N = \max(\beta_{N,s}; \beta_{N,p}; \beta_{N,c}; \beta_{N,sp}) =$		
	$\beta_N \leq 1$		
	$\beta_V = \max(\beta_{V,s}; \beta_{V,cp}; \beta_{V,c}) =$		
	$\beta_V \leq 1$		
	$\beta_N + \beta_V =$		
	$\beta_N + \beta_V \leq 1.2$		

Resistances

Calculation of Design values of resistance to **tension loads**

In case of steel failure			
Desing value	$N_{Rd,s}$ =		kN
Ratio between design action and design resistance	$\beta_{N,s} = N^h_{Sd} / N_{Rd,s}$ =		
In case of pull-out/pull-through failure			
Basic design value	$N^0_{Rd,p}$ =		kN
Influence of compressive strength of concrete	$f_{b,N}$ =		
	$N_{Rd,p} = N^0_{Rd,p} \cdot f_{b,N}$		
Design value	$N_{Rd,p}$ =		kN
Ratio between design action and design resistance	$\beta_{N,p} = N^h_{Sd} / N_{Rd,p}$ =		
In case of concrete cone failure			
Basic design value	$N^0_{Rd,c}$ =		kN
Influence of compressive strength of concrete	$f_{b,N}$ =		
Influence of spacing			

s_x =		mm	$s_{cr,N}$ =		mm	$s_x / s_{cr,N}$ =		f_{sx} =	
n_x =									
s_y =		mm				$s_y / s_{cr,N}$ =		f_{sy} =	
n_y =									

Influence of edge distance

c_x =		mm	$c_{cr,N}$ =		mm	$c_x / c_{cr,N}$ =		$f_{cx,1}$ =	
								$f_{cx,2}$ =	
c_y =		mm				$c_y / c_{cr,N}$ =		f_{cy} =	

	$N_{Rd,c} = N^0_{Rd,c} \cdot f_{b,N} \cdot f_{sx} \cdot f_{sy} \cdot f_{cx,1} \cdot f_{cx,2} \cdot f_{cy}$		
Design value	$N_{Rd,c}$ =		kN
Ratio between design action and design restistance	$\beta_{N,c} = N^h_{Sd} / N_{Rd,c}$ =		

CALCULATION GUIDELINE

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In case of concrete splitting failure

No verification of splitting is required if at least one of the conditions is fullfilled:

a) The edge distance in all directions is $c \geq c_{cr,sp}$ for single fasteners and $c \geq 1.2\ c_{cr,sp}$ for fastener groups and the member depth is $h \geq h_{min}$ in both cases.

b) The characteristic resitance for concrete cone failure and pull-out failure is calculated for cracked concrete and reinforcement resists the splitting forces and limits the crack width to $w_k \leq 0.3$mm.

$c_x =$		mm	$c_{cr,sp} =$		mm			$c_x \geq c_{cr,sp}$		
								$c_x \geq 1.2 \cdot c_{cr,sp}$		
$c_y =$		mm	$1.2 \cdot c_{cr,sp} =$		mm			$c_y \geq c_{cr,sp}$		
								$c_y \geq 1.2 \cdot c_{cr,sp}$		
$h =$		mm	$h_{min} =$		mm			$h \geq h_{min}$		
Basic design value								$N^0_{Rd,c(sp)} =$		kN
Influence of compressive strength of concrete								$f_{b,N} =$		
Influence of spacing										
$s_x =$		mm	$s_{cr,sp} =$		mm	$s_x / s_{cr,sp} =$		$f_{sx,sp} =$		
$n_x =$										
$s_y =$		mm				$s_y / s_{cr,sp} =$		$f_{sy,sp} =$		
$n_y =$										
Influence of edge distance										
$c_x =$		mm	$c_{cr,sp} =$		mm	$c_x / c_{cr,sp} =$		$f_{cx,1,sp} =$		
								$f_{cx,2,sp} =$		
$c_y =$		mm				$c_y / c_{cr,sp} =$		$f_{cy,sp} =$		
$h =$		mm	$h_{min} =$		mm	$h / h_{min} =$		$f_h =$		
$N_{Rd,sp} = N^0_{Rd,c(sp)} \cdot f_{b,N} \cdot f_{sx,sp} \cdot f_{sy,sp} \cdot f_{cx,1,sp} \cdot f_{cx,2,sp} \cdot f_{cy,sp} \cdot f_h$										
Design value								$N_{Rd,sp} =$		kN
Ratio between design action and design restistance								$\beta_{N,sp} = N^h_{Sd} / N_{Rd,sp} =$		

Resistances			
Calculation of Design values of resistance to **shear loads**			
In case of steel failure			
Desing value	$V_{Rd,s} =$		kN
Ratio between design action and design resistance	$\beta_{V,s} = V^h_{Sd} / V_{Rd,s} =$		
In case of pry-out failure			
	$N_{Rd,c} =$		kN
Influence of compressive strength of concrete	$k =$		
	$V_{Rd,cp} = N_{Rd,c} \cdot k$		
Design value	$V_{Rd,cp} =$		kN
Ratio between design action and design resistance	$\beta_{V,cp} = V^h_{Sd} / V_{Rd,cp} =$		
In case of concrete edge failure			
Verification of concrete edge failure may be omitted for single fasteners and groups with an edge distance in all directions $c > \max(10h_{ef}; 60d)$. For anchorages with more than one edge, the resistance for all edges shall be calculated. The smallest value should be used in the verification.			
Basic design value	$V^0_{Rd,c} =$		kN
Influence of compressive strength of concrete	$f_{b,V} =$		
Influence of spacing			
In groups loaded perpendicular to the edge only two adjacent anchors closest and parallel to the edge carry the load. The smallest spacing should be used for the verification.			
s = ___ mm; $c_1 =$ ___ mm; $s/c_1 =$ ___	$f_{s,V} =$		
Influence of edge distance			
$c_2 =$ ___ mm; $c_1 =$ ___ mm; $c_2/c_1 =$ ___	$f_{c2,V} =$		
Influence of load direction			
In case of a > 90° it is assumed that only the component of the shear load parallel to the edge is acting on the anchor. The component acting away from the edge may be neglected for the proof of concrete edge failure.			
$\alpha =$ ___	$f_\alpha =$		
Innfluence of component thickness			
h = ___ mm; $c_1 =$ ___ mm; $h/c_1 =$ ___	$f_h =$		
$V_{Rd,c} = V^0_{Rd,c} \cdot f_{b,V} \cdot f_{s,V} \cdot f_{c2,V} \cdot f_\alpha \cdot f_h$			
Design value	$V_{Rd,c} =$		kN
Ratio between design action and design resistance	$\beta_{V,c} = V^g_{Sd} / V_{Rd,c} =$		