

DESIGN TEMPLATE – BONDED ANCHORS

Anchor Design according to Würth Simplified Anchor Design Method

Actions			
Design value of tensile load		$N_{Sd}^g =$	kN
Number of anchors in the group loaded with tension		$n =$	
Design value of tensile load acting on a single anchor		$N_{Sd}^h = \frac{N_{Sd}^g}{n} =$	kN
Design value of shear load		$V_{Sd}^g =$	
Number of anchors in the group loaded with shear		$n =$	
Design value of shear load acting on a single anchor		$V_{Sd}^h = \frac{V_{Sd}^g}{n} =$	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/mm ²
Characteristic compressive cylinder strength of concrete at 28days		$f_{ck,cyl} =$	N/mm ²
Cracked concrete		Non-cracked concrete	
Structural verification			
$\beta_N = \max(\beta_{N,s}; \beta_{N,p}; \beta_{N,c}; \beta_{N,sp}) =$			
$\beta_N \leq 1$			
$\beta_V = \max(\beta_{V,s}; \beta_{V,sp}; \beta_{V,c}) =$			
$\beta_V \leq 1$			
$\beta_N + \beta_V =$			
$\beta_N + \beta_V \leq 1.2$			

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					$\beta_{N,s} = N_{Sd}^h / N_{Rd,s} =$				
In case of pull-out/pull-through failure									
Basic design value					$N_{Rd,p}^0 =$				kN
Influence of compressive strength of concrete					$f_{b,p} =$				
Influence of anchorage depth									
$h_{ef} =$		mm	$h_{ef,typ} =$		mm	$f_{hef} = h_{ef} / h_{ef,typ}$			
Influence of spacing									
$s_x =$		mm	$s_{cr,p} =$		mm	$s_x / s_{cr,p} =$		$f_{sx,p} =$	
$n_x =$						$s_y / s_{cr,p} =$			$f_{sy,p} =$
$s_y =$		mm							
$n_y =$									
Influence of edge distance									
$c_x =$		mm	$c_{cr,p} =$		mm	$c_x / c_{cr,p} =$		$f_{cx,1,p} =$	
$c_y =$		mm				$c_y / c_{cr,p} =$		$f_{cy,p} =$	
$N_{Rd,p} = N_{Rd,p}^0 \cdot f_{b,N} \cdot f_{hef} \cdot f_{sx,p} \cdot f_{sy,p} \cdot f_{cx,1,p} \cdot f_{cx,2,p} \cdot f_{cy,p}$					Design value		$N_{Rd,p} =$		kN
Ratio between design action and design resistance					$\beta_{N,p} = N_{Sd}^h / N_{Rd,p} =$				
In case of concrete cone failure									
Basic design value					$N_{Rd,c}^0 =$				kN
Influence of compressive strength of concrete					$f_{b,N} =$				
Influence of anchorage depth									
$h_{ef} =$		mm	$h_{ef,typ} =$		mm	$f_{hef} = (h_{ef} / h_{ef,typ})^{1.5} =$			
Influence of spacing									
$s_x =$		mm	$s_{cr,N} =$		mm	$s_x / s_{cr,N} =$		$f_{sx} =$	
$n_x =$						$s_y / s_{cr,N} =$			$f_{sy} =$
$s_y =$		mm							
$n_y =$									
Influence of edge distance									
$c_x =$		mm	$c_{cr,N} =$		mm	$c_x / c_{cr,N} =$		$f_{cx,1} =$	
$c_y =$		mm				$c_y / c_{cr,N} =$		$f_{cy} =$	
$N_{Rd,c} = N_{Rd,c}^0 \cdot f_{b,N} \cdot f_{hef} \cdot f_{sx} \cdot f_{sy} \cdot f_{cx,1} \cdot f_{cx,2} \cdot f_{cy}$					Design value		$N_{Rd,c} =$		kN
Ratio between design action and design resistance					$\beta_{N,c} = N_{Sd}^h / N_{Rd,c} =$				

DESIGN TEMPLATE – BONDED ANCHORS

In case of concrete splitting failure

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

- The edge distance in all direction is $c \geq c_{cr,sp}$ for single fastener and $c \geq 1.2 \cdot c_{cr,sp}$ for fastener groups and the member depth is $h \geq h_{min}$ in both cases.
- The characteristic resistance 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 $w_k \leq 0.3\text{mm}$.

$c_x =$		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						$N_{Rd,c}^0 =$		kN
Influence of compressive strength of concrete						$f_{b,N} =$		
Influence of anchorage depth								
$h_{ef} =$		mm	$h_{ef,typ} =$		mm	$f_{hef} = (h_{ef}/h_{ef,typ})^{1.5} =$		
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	$h/h_{min} =$		$f_h =$
Design value						$N_{Rd,sp} = N_{Rd,c}^0 \cdot f_{b,N} \cdot f_{hef} \cdot f_{sx,sp} \cdot f_{sy,sp} \cdot f_{cx,1,sp} \cdot f_{cx,2,sp} \cdot f_{cy,sp} \cdot f_h$		kN
Ratio between design action and design resistance						$\beta_{N,sp} = N_{Sd}^h / N_{Rd,sp}$		

Resistances						
Calculation of Design values of resistance to shear loads						
In case of steel failure						
Design value			$V_{Rd,s} =$			kN
Ratio between design action and design resistance			$\beta_{V,s} = V_{Sd}^h / V_{Rd,s} =$			
In case of pry-out failure						
			$N_{Rd,c} =$			kN
			$N_{Rd,p} =$			kN
Influence of compressive strength of concrete			$k =$			
			$V_{Rd,cp} = k \cdot \min \{N_{Rd,p}; N_{Rd,c}\}$			
Design value			$V_{Rd,cp} =$			kN
Ratio between design action and design resistance			$\beta_{V,cp} = V_{Sd}^h / V_{Rd,cp} =$			
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 verification.						
Basic design value			$V_{Rd,c}^0 =$			kN
Influence of compressive strength of concrete			$f_{b,V} =$			
Influence of anchorage depth						
$h_{ef} =$		mm	$d =$		mm	$d/h_{ef} =$
			Influence of spacing		$f_{hef,V} =$	
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	$s/c_1 =$
			Influence of edge distance			
$c_1 =$		mm	$d =$		mm	$c_1/d =$
$c_2 =$		mm	$c_1 =$		mm	$c_2/c_1 =$
			Influence of load direction			
In case of a $> 90^\circ$ 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.						
$\alpha =$					$f_\alpha =$	
			Influence of concrete thickness			
$h =$		mm	$c_1 =$		mm	$h/c_1 =$
			$V_{Rd,c} = V_{Rd,c}^0 \cdot f_{b,V} \cdot f_{hef,V} \cdot f_{s,V} \cdot f_{c1,V} \cdot f_{c2,V} \cdot f_\alpha \cdot f_h$			
Design value			$V_{Rd,c} =$			kN
Ratio between design action and design resistance			$\beta_{V,c} = V_{Sd}^g / V_{Rd,c} =$			

CALCULATION GUIDELINE