

Evo Design s.r.l.		Calculation No.		
CALCULATION SHEET <small>onlinestructuraldesign.com</small>		SAMPLE		
		Project No. SAMPLE		
Project Title:	DEMO PROJECT	Calc. By	Date	Rev.
Subject/Feature:	Bolt Preloading Force - Classes 8.8 and 10.9 (Eurocode 3)	MN	today	0
		Checked By	Date	
		MN	today	
Bolt preloading force - Classes 8.8 and 10.9 (Eurocode 3)		per EN 1993-1-8 and EN 1090-2		
Input	Output			
Bolt type, class and diameter	Bolt design preload (tension in bolt)			
Partial factors for steel bolts	Bolt torque reference value for tightening (slip resistant connection)			
	Bolt torque value for tightening (non-slip resistant connection)			
Bolts Type	20	bolt diameter - d		
$A_s =$	245	mm^2	bolt effective area in threaded region	
Bolt class	10.9	per EN 1993-1-8 Section 3 Table 3.1		
Bolt yield strength	$f_{yb} =$	900	N/mm^2	bolt classes recommended by the Eurocode; The National Annex may exclude certain bolt classes.
		Bolt ultimate tensile strength	$f_{ub} =$	1000
				N/mm^2
Partial factor for steel bolts	$\gamma_{M2} =$	1.25	per EN 1993-1-8 Section 2 Table 2.1	
	$\gamma_{M7} =$	1.1	partial safety factors recommended by the Eurocode; Numerical values for safety factors may be defined in the National Annex	
Bolt design strength	$f_{yd} = f_y / \gamma_{M2}$			
	$f_{yd} =$	720.0	N/mm^2	
Bolt design tension resistance	$F_{t,Rd} = f_{yd} * A_s$			
	$F_{t,Rd} =$	176.40	kN	
Bolt design preload	$F_{p,Cd} = 0.7 * f_{ub} * A_s / \gamma_{M7}$		per EN 1993-1-8 Section 3.6.1 Formula (3.1)	
	$F_{p,Cd} =$	155.91	kN	
			for preloaded bolts in accordance with 3.1.2(1) (i.e. only bolt assemblies of classes 8.8 and 10.9)	
Torque reference values for bolt tightening	$M_r = k_m * d * F_{p,Cd}$		per EN 1090-2 Section 8.5.2 Paragraph a) - 1) and 2)	
	$k_m =$	0.2	k-class (K1 or K2) and k_m value declared by the fastener manufacturer	
			(normally $k=0.2$ for typical steel, $k=0.2$ for zinc-plated, $k=0.18$ for lubricated, $k=0.16$ for cadmium-plated)	
	$M_r =$	623.6	N*m	
			torque value when the connection is slip resistant	
	$50 \% * F_{p,Cd} =$	77.95	kN	
			per EN 1993-1-8 Section 3.4.2, Note: If preload is not explicitly used in the design calculations for slip resistances but is required for execution purposes or as a quality measure (e.g. for durability) then the level of preload can be specified in the National Annex.	
Torque value when there is no slip resistance specified in the design	$M_{r(\text{non slip})} =$	311.8	N*m	
			value for 50 % of the bolt preload capacity	
References:				
EN 1090-2:2008 Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures				
EN 1993-1-8:2005 - Eurocode 3: Design of steel structures - Part 1-8: Design of joints				