



Prestressed bolt connection

i Calculation without errors.

ii Project information

? Input section

1.0 Loading of the connection, basic parameters of the calculation.

1.1 Calculation units

Imperial (lbf, in, HP....)

1.2 Loading conditions, connection type

1.3 Design of the bolt connection

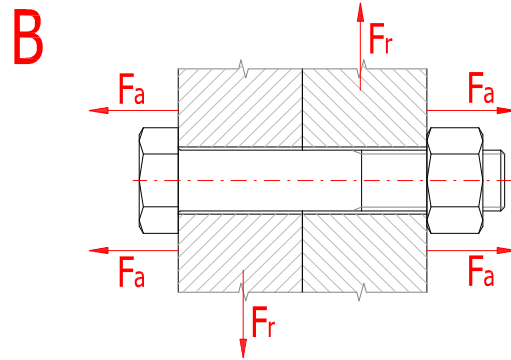
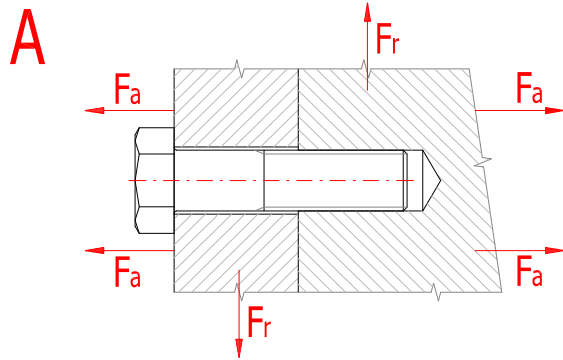
B ... Bolt connection with a through bolt

1.4 Loading of the bolt connection

Loading in the bolt axis

1.5 The course of loading

Repeated loading



1.6 Loading of the connection

1.7 Maximum axial force

F_{amax}

1000,00

[lb]

1.8 Minimum axial force

F_{amin}

0,00

[lb]

1.9 Maximum radial force

F_r

0,00

[lb]

2.0 Operational and mounting parameters of the connection.

2.1 Desired coefficient of tightness (prestressing) of the connection

q_a

1,000

2.2 Desired safety against side shift

q_r

1,500

2.3 Desired safety of the bolt at the yield point

n_s

2,000

2.4 Friction coefficient in threads

μ_t

0,150

2.5 Friction coefficient in seating face of the head (nut) of the bolt

μ_c

0,150

2.6 Friction coefficient between the connected surfaces

μ_q

0,200

2.7 Consider additional bending stresses

No

2.8 Deviation of perpendicularity of the bolt head seating surface

δ

0,100

[°]

2.9 Consider effects of operational temperature to connection prestressing

No

2.10 Operational deviation of bolt temperature

ΔT_b

70,0

[° F]

2.11 Operational deviation of parts temperature

ΔT_m

90,0

[° F]

2.12 Consider reduction of mounting prestressing using deformation of the joint

No

2.13 Plastic permanent deformation (settlement) of the connection

ΔL

0,0050

[in]

2.14 Factor of implementation of operational force

2.15 Coefficient of implementation of the operational force

n

0,500

2.16 Distance of the point of action of the force from bolt head

L_{F1}

0,000

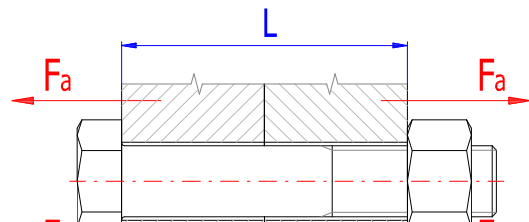
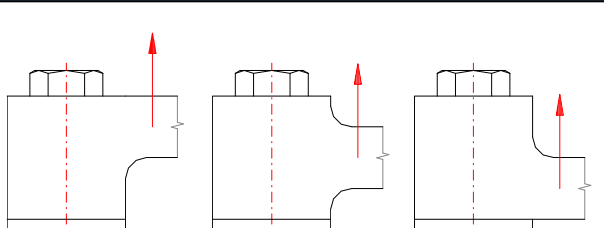
[in]

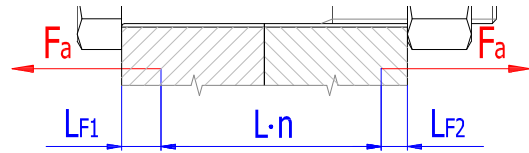
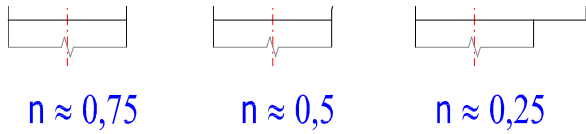
2.17 Distance of the point of action of the force from the nut

L_{F2}

0,000

[in]





2.18 **Parameters of connection exposed to dynamic (fatigue) loading**

2.19 Thread design

2.20 Desired service life of the connection in thousands of cycles

2.21 Desired reliability of the connection

2.22 Desired dynamic (fatigue) safety

Cut thread	▼	
Infinite life	▼	
95	▼	[%]
n_f	2,000	

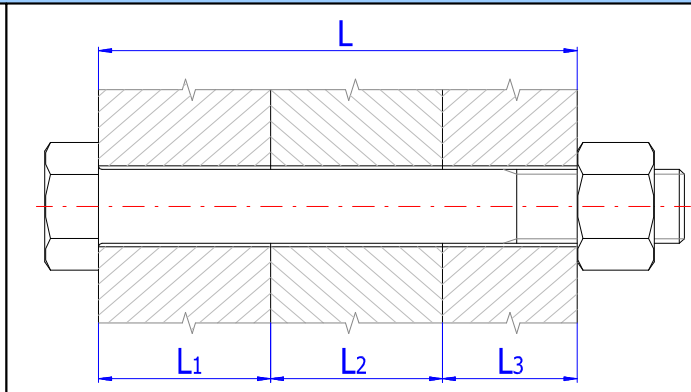
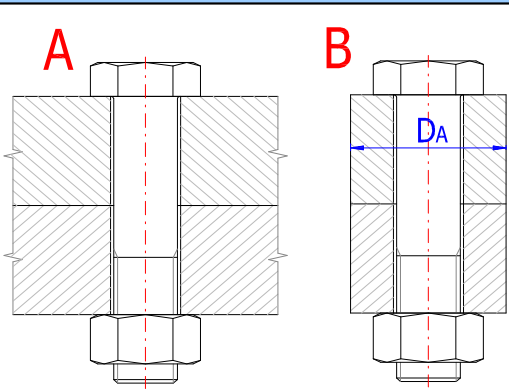
3.0 **Design, dimensions and material of connected parts.**

3.1 Design of connected parts

3.2 Number of clamped parts

3.4 Total height of the clamped parts

A ... Plate	▼	
i	3	
L	4,500	[in]



3.5	L_i	E	α	p_A	Material
Part 1	0,800	30500	6,5	102	Carbon steel 1045 ▼
Part 2	1,700	30000	6,5	71	Structural steel A284 D ▼
Part 3	2,000	16700	5	131	Cast iron with laminar graphite A48-40B ▼

4.0 **Design of connecting bolt.**

4.1 **Preliminary design of minimum thread diameters**

	SAE 1	SAE 2	SAE 4	SAE 5	SAE 5.2	SAE 7	SAE 8
MC	M12	M10	M8	M8	M8	M8	M6
MF	M12	M10	M8	M8	M8	M8	M8
UNC	7/16	3/8	5/16	5/16	5/16	5/16	1/4
UNF	7/16	3/8	5/16	5/16	5/16	1/4	1/4
UNEF	7/16	3/8	1/4	5/16	5/16	1/4	1/4

4.2 **Material of the bolt**

4.3 Strength class of the bolt

4.4 Modulus of elasticity in tension

4.5 Ultimate tensile strength

4.6 Yield strength

4.7 Heat expansion coefficient

4.8 Density

SAE 5	▼	
E	30000	[ksi]
S_u	120	[ksi]
S_y	92	[ksi]
α	6,5	[$10^{-6}/^{\circ}F$]
ρ	490	[lb/ft ³]

4.9 **Thread parameters**

4.10 Thread type

4.11 Thread size

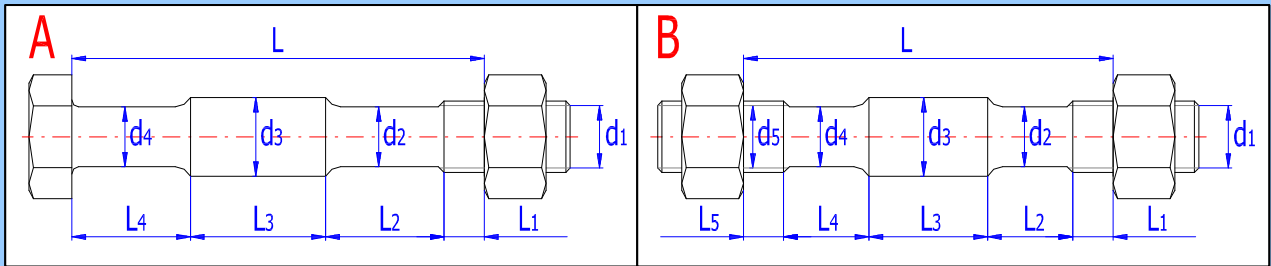
4.12 Basic major diameter

4.13 Thread pitch

4.14 Minor diameter

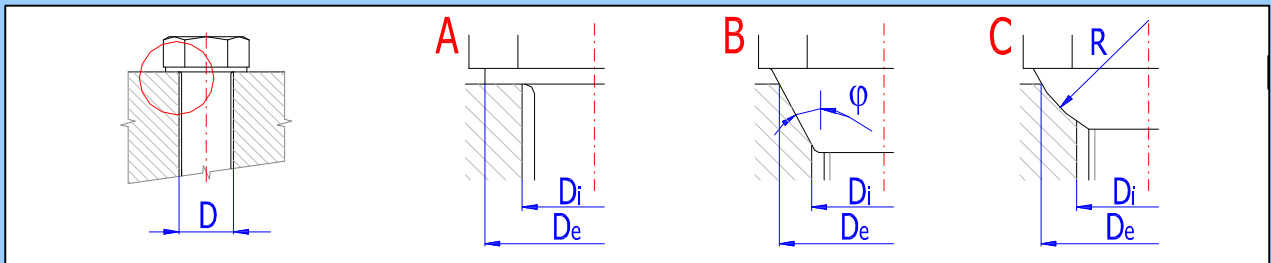
Unified inch thread - Coarse series	▼	
3/8	▼	
d	0,3750	[in]
p	0,0625	[in]
d_r	0,2938	[in]

- 4.15 Pitch diameter d_m [in]
 4.16 **Design and geometry of the bolt**
 4.17 Bolt type
 4.18 Number of bolt sections with different cross-section areas i
 4.19 Total height of the clamped parts L [in]



		1	2	3	4	5	6	
4.20 Bolt section								
4.21 Length	L_i	4,500	0,000	0,000	0,000	0,000	0,000	[in]
4.22 Diameter	d_i	0,314	0,000	0,000	0,000	0,000	0,000	[in]

- 4.23 **Geometry of the connection**
 4.24 Design of seating faces below heads (nuts) of bolts
 4.25 Hole diameter D [in]
 4.26 Outer diameter of the seating face D_e [in]
 4.27 Inner diameter of the seating face D_i [in]

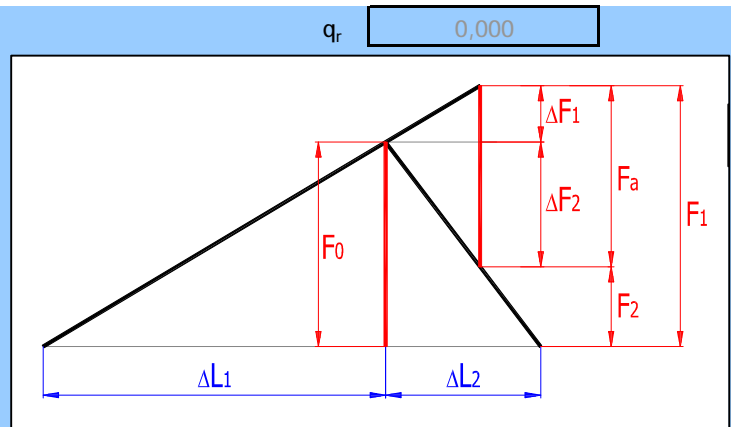


Results section

5.0 Prestressing, force conditions and operational diagram of the connection.

5.1 Stiffness constants of the connections			
5.2 Stiffness of the connecting bolt	c_b	489361,53	[lb/in]
5.3 Stiffness of the clamped parts	c_m	4308093,03	[lb/in]
5.4 Resulting stiffness of the group of surcharged parts of the joint	c_1	463061,66	[lb/in]
5.5 Resulting stiffness of the group of relieved parts of the joint	c_2	8616186,06	[lb/in]
5.6 Mounting prestressing of the connection			
5.7 Maximum axis component of the operational force	F_a	1000	[lb]
5.8 Maximum radial component of the operational force	F_r	0	[lb]
5.9 Minimum needed clamping force for transfer of the radial force	F_{cmin}	0	[lb]
5.10 Part of the operational force additionally loading the bolt	ΔF_1	51,00	[lb]
5.11 Part of the operational force relieving the clamped parts	ΔF_2	949,00	[lb]
5.12 Assembly prestressing of the joint	F_0	1949,0	<input checked="" type="checkbox"/> [lb]
5.13 Tightening torque	M	11,54	[lb ft]
5.14 Force conditions of the loaded connection			
5.15 Change of prestressing due to heating of the connection	ΔF_{0T}	0,00	[lb]
5.16 Loss of prestressing due to deformation of the connection	ΔF_{0L}	0,00	[lb]
5.17 Operating prestressing of the connection	F_0'	1949,00	[lb]
5.18 Residual prestressing of clamped parts of the connection	F_2	1000,00	[lb]
5.19 Resulting internal axis force in the bolt	F_1	2000,00	[lb]
5.20 Coefficient of tightness (prestressing) of the connection	q_a	1,000	

5.21 Safety against side shift



6.0 Strength checks of the connection.

6.1 **Strength checks of statically loaded bolt connections**

6.2 Tensile stress in bolt core from the maximum axis force	σ	29,50	[ksi]
6.3 Torsional stress in bolt core from tightening moment	τ	13,83	[ksi]
6.4 Additional bending stress	σ_b	0,00	[ksi]
6.5 Resulting reduced stress in the bolt core	σ_{red}	38,00	[ksi]
6.6 Yield point of the bolt material	S_y	92	[ksi]
6.7 Safety at yield point	n	2,42	

6.8 **Check of pressure in seating face of the bolt head**

6.9 Pressure in the bolt head (nut) seating face	p	15,63	[ksi]
6.10 Permitted pressure in the marginal clamped part	p_A	102	[ksi]

6.11 **Strength check of dynamically loaded bolt connection**

6.12 Medium axis force of the cycle	F_m	1974,50	[lb]
6.13 Amplitude of the axis force of the cycle	F_a	25,50	[lb]
6.14 Medium cycle stress in the thread core	σ_m	29,12	[ksi]
6.15 Cycle stress amplitude in the thread core	σ_a	0,38	[ksi]
6.16 Basic fatigue limit in tension of the given bolt material	σ_e'	56,9	[ksi]
6.17 Corrected fatigue limit in tension of the given bolt	σ_e	12	[ksi]
6.18 Fatigue limit in tension with a limited service life	σ_f	12	[ksi]
6.19 Max. fatigue strength of the bolt for the given course of loading	σ_A	8,30	[ksi]
6.20 Dynamic safety in tension	n_σ	22,06	
6.21 Safety in torsion	n_τ	3,84	
6.22 Resulting dynamic safety	n	21,29	

7.0 Graphical output, CAD systems

7.1 2D drawing output to:	DXF File		
7.2 Design of the bolt head	Hexagonal head		
7.3 Design of the nut	Hexagonal nut		
7.4 Number of washers below the bolt head	0		
7.5 Number of washers below the nut	1		
7.6 Calculation clamping height	L	4,5	[in]
7.7 Actual height of clamped parts	L_c	4,500	<input checked="" type="checkbox"/> [in]

Diagram illustrating the clamping height L and the actual height of clamped parts L_c in a bolted joint. The drawing shows a bolted joint with a hexagonal head and nut. The clamping height L is the distance between the bolt head and the nut. The actual height of clamped parts L_c is the distance between the bolt head and the nut, including the thickness of the clamped parts.