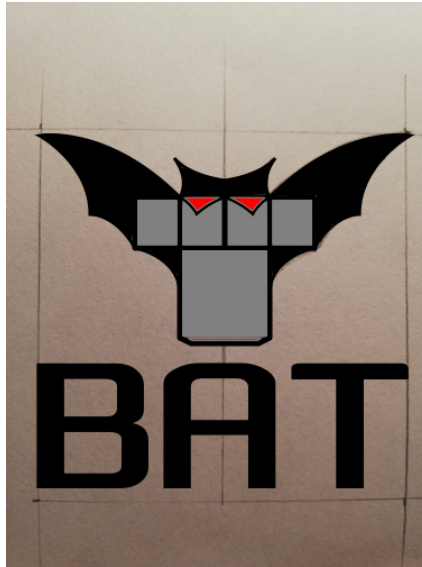


# BAT - Bolt Analysis Tool



## User Manual

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# Symbols and Abbreviations

## Symbols

$\alpha_A$	tightening factor
$\alpha_b$	coeff. of lin. thermal expansion of the bolt
$\alpha_c$	coeff. of lin. thermal expansion of the clamped part (plate)
$\delta_b$	elastic compliance of the bolt
$\delta_c$	elastic compliance of the clamped part (plate)
$\lambda$	under-head bearing angle of bolt
$\mu_{th}$	coeff. of friction in bolt thread
$\mu_{uh}$	coeff. of friction under bolt head
$\nu$	bolt utilization factor
$\varphi$	helix angle / slope of bolt thread
$\Phi$	load factor of concentric joint (also: force ratio or relative compliance factor)
$\Phi_n$	load factor for concentric clamping and concentric force load introduction via the clamped parts
$\rho$	friction angle in bolt thread
$\sigma_n$	normal stress in the bolt
$\sigma_v$	von-Mises stress in the bolt
$\tau$	shear stress in the bolt
$A_1$	nominal cross section of threaded bolt
$A_3$	minimal thread cross section
$A_p$	pitch cross section of threaded bolt
$A_s$	stress cross section of threaded bolt
$d$	nominal threaded bolt diameter
$d_2$	pitch diameter of threaded bolt
$d_3$	minimal diameter of threaded bolt
$d_h$	minimal contact diameter under bolt head
$d_s$	stress diameter of threaded bolt
$F_A$	external, axial bolt load
$F_M$	preload after tightening / assembly preload
$F_{PA}$	additional axial plate load
$F_Q$	external, shear bolt load

$F_{SA}$	additional axial bolt load
$F_V$	service preload incl. embedding and thermal influence
$f_Z$	plastic deformation due to embeddding
$F_Z$	preload loss due to embedding
$l_K$	joint clamped length
$M_p$	prevailing torque of bolt locking device
$n$	load introduction factor
$p$	pitch of bolt thread

### **Abbreviations**

BAT	Bolt Analysis Tool
TBJ	through-bolt joint
TTJ	tapped thread joint

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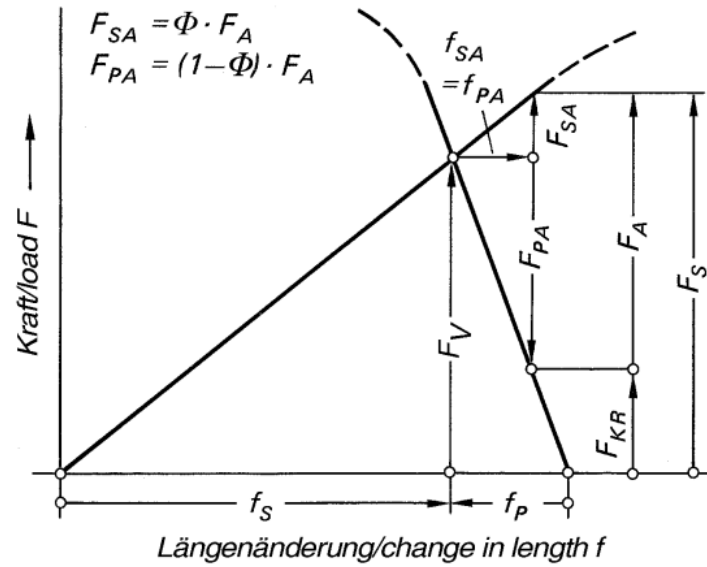
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# 1 Introduction

This document will include the BAT (Bolt Analysis Tool) User Manual [1] [2] [3].

$$p(\Theta|\mathbf{y}) = \frac{p(\mathbf{y}|\Theta) p(\Theta)}{p(\mathbf{y})}, \quad (1.1)$$



**Figure 1.1:** Joint diagram for the working state of a concentrically loaded bolted joint with  $n = 1$  [3]

## 2 Joint Geometry

text

### 3 References

- [1] Guidelines for threaded fasteners. ESA Guideline ESA PSS-03-208 Issue 1, Structures and Mechanism Division ESTEC, December 1989.
- [2] Space engineering - threaded fasteners handbook. ECSS Handbook ECSS-E-HB-32-23A, ECSS European Cooperation for Space Standardization, 16 April 2010.
- [3] Systematic calculation of highly stressed bolted joints - joints with one cylindrical bolt. VDI Guideline VDI2230 Part 1, VDI - Verein Deutscher Ingenieure, November 2015.