



Fundamentals of Bolted Joint Analysis Training Topics

*Training delivered by Matrix Engineering, an approved
provider of Bolt Science® Training.*



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Following is a summary of potential training topics that can be delivered to suit a company's or organization's specific requirements. Customization may include unique fastener sizes, materials or conditions, particular problems, or other topics the client provides.

Introduction to Course

- *Introductions*
- *Primary Bolted Joint Application Types*
- *Bolted Joints – More to it than you may have thought!*
- *Dunning-Kruger Effect*
- *Reference Books and Standards*

Overview of Bolted Joint Analysis and FEA Methods

- *Commercially Available Software*
- *Typical Calculations in BJA Software*
- *Where FEA Shines*
- *Load Applied to Bolted Joint vs. the Bolt*
- *FEA Best Practices*
- *Common Modeling Techniques*
- *Advantages/Disadvantages of each method.*
- *Validation of FEA and Reporting*
- *Factors often missed in FEA.*

Fatigue Life Prediction of Bolts

- *Overview of Fatigue Life Prediction of Bolts*
- *Endurance Limit Explanation*
- *Endurance Limit Values – Bickford*
- *Endurance Limit Calculations using Marin Equation – Shigley*
- *Endurance Limit Values for SHCS – Unbrako*
- *Endurance Limit Values in VDI 2230 Part 1*
- *Commentary on Fatigue Guidelines in ASME B&PVC*
- *Treatment of Fatigue in NASA 5020B*

Interpretation of FEA Results for Fatigue Life Prediction of Bolts

- *FEA is Superior to Analytical Methods for Fatigue*
- *The theoretical loaded cases which cause bending in bolts.*
- *Interpretation of FEA Results in Fatigue Calculations*
- *Typical Steps to Use FEA Results in Fatigue Calculations*

Interpretation of FEA Results to Predict Joint Slip Failure Mechanisms

- *Rigid Body Model for Slip in Bolted Joints*
- *Elastic Model for Slip in Bolted Joints*
- *Simplified FEA Model*
- *Failure Mechanisms Associated with Joint Slip*
- *Fretting at the Joint Interface*
- *Self-loosening of the Threaded Fastener*
- *Bending Fatigue Fractures*

Bolted Joint FEA Example: A Comparison of Methods and Results

- *Simple Rigid Body – Free Body Diagram*
- *Various Ways to Simulate Structure with FEA*
- *Pre-Loaded - 3D Bolts with Contact*
- *Preloaded – Beams with Contact*



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- *Stiff Beams – No Contact*
- *Using FEA Simulation Results for Evaluating Bolt Fatigue*

Training Course Instructor

Jon Ness, PE, will present the training course. Jon has over 32 years of engineering and design experience in developing mobile equipment components and sub-systems, including dynamically loaded bolted joints. His work has included the design of multiple gearboxes, powertrain systems, engine installations, and developing test and validation plan strategies. He has taught numerous classes related to Failure Modes and Effects Analysis and Bolted Joint Design for design engineers.