InDepth
Fastener Validation Software™

AUTOMATED FASTENER EVALUATION SOFTWARE FOR LARGE STRUCTURE ANALYSIS

PRODUCT HIGHLIGHTS

1. **Unique versatile software for Factor of Safety evaluation of large number of fasteners from FE analysis of complex structures with multiple loadcases.**
2. **Includes FOS evaluation for bolts, rivets, pins and spotwelds.**
3. **Supported analysis units - Metric or IPS (mixing of analysis and bolt units allowed).**
4. **FOS computed for static and dynamic loading scenarios.**
5. **Intuitive GUI that takes user through the process in simple and reliable manner.**
6. **Results presentation as Excel file. Color coding allows quick screening and identification of critical connections.**
7. **On the spot modification of bolt sizes and grades for quick design iterations.**

FASTENER DATABASE
SAE, ASTM and ISO Bolts. HUCK® Bolts and Blind Rivets.

STANDARDS
Shigley Method, AISC, EN 13814 and GB-50017

COMPATIBLE SOLVERS
Nastran, ABAQUS, SolidWorks and ANSYS. Data input from solver independent text file with structured loads info.

INTRODUCTION

Fasteners are generally modeled using 1D beam elements in FE analysis. The material specifications and dimension of the fasteners are assigned to the beam elements.

Due to simplified modeling methods of the bolted connection for linear static analysis, element stresses are generally not an accurate method to evaluate bolt safety. Instead, the forces and moments are obtained for the 1D beam elements from the FE analysis and used for FOS calculations.

InDepth Fastener Validation Software™ provides an automated method for FOS evaluation for large number of fasteners from FE analysis of complex structures with multiple loadcases. The software will scan through the direct output files of FE solvers to calculate the FOS of all fasteners.

TECHNICAL DETAILS

The fasteners are evaluated for the following failure criteria:

- Tension
- Slip
- Shear
- Combined Tension and Slip FoS
- Combined Tension and Shear FoS

By default, fasteners are evaluated as per the following methods and standards. FOS is computed for both static and dynamic* loading scenarios:

- Shigley Methodology (Mechanical Engineering Design Book).
- AISC (ANSI-AISC-360-16 - Section-J3)
- GB
- EN 13814-2004)

** Fatigue FOS evaluated in Shigley method only based on available endurance data.*

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support@indepthengsol.com

Built-in Bolt Database along with flexibility of using external bolt data:

- Inch Series – SAE Gr5, SAE Gr7, SAE Gr8, ASTM A325, ASTM A354 GR BC, ASTM A354 GR BD and ASTM A490.
- Metric Series – ISO CL 8.8, ISO CL 10.9, ISO CL 12.9.
- HUCK® Bolts and Blind Rivets
- Other fasteners can be included upon request

Suggested input parameters and FOS requirements in the software based on test data and best practices from previous experiences in the field. Flexibility for user to modify these parameters as needed.

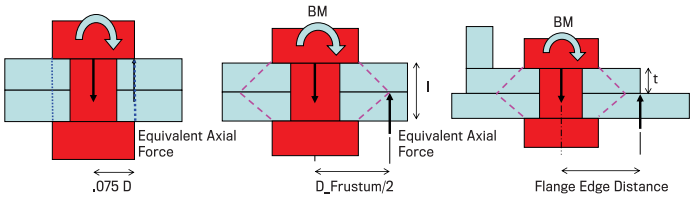
InDepth Fastener Validation Software™ is FE solver neutral. Default output data file from following solvers can be interfaced as input file using the softwares' GUI.

- Nastran (.f06)
- ABAQUS Standard (.dat)
- Solidworks
- ANSYS
- User input from solver independent text file with structured loads info
- Other solvers can be supported upon request

BOLT PRYING AND JOINT STIFFNESS CALCULATIONS

Since contacts between clamped parts and bolt head are generally not included in linear static simulations, FE analysis generates bending moment in the beam elements representing the bolts. InDepth Fastener Validation Software™ converts this bending moment into and equivalent axial force (Prying Force). This equivalent axial force is used in tensile FOS calculations.

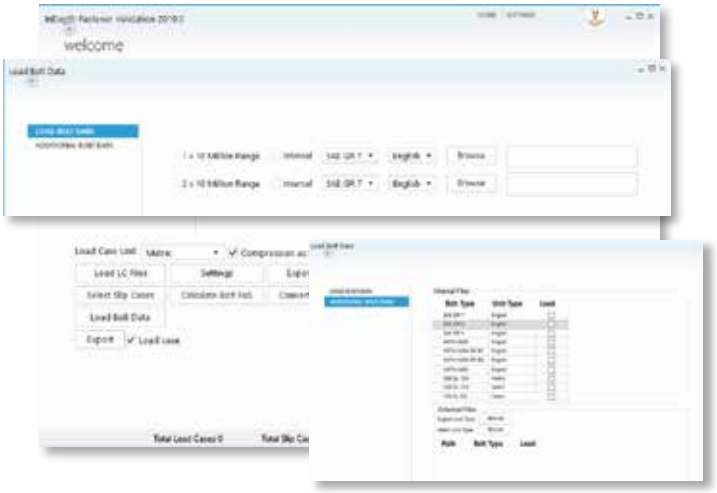
Conservative calculations of the equivalent axial force initially by assuming prying to occur about the bolt head. Prying distance can be updated by user to radius of pressure cone (frustum radius) or flange edge based on actual geometry of the bolted joint.



Default conservative joint stiffness value used for FOS calculation per Shigley method. Can be updated by user using the joint stiffness calculator available in the exported excel file. Calculator uses the Rotscher pressure cone method with constant frustum angle of 30° as available in Shigley's Mechanical Engineering Design.

GUI AND RESULTS OUTPUT

Intuitive and easy to use GUI allows for easy import of fastener loads data from FE solvers, selection of loadcases for FOS evaluation and analysis. Ordered numbering of beam elements during FE analysis allows for automatic fastener grade and size assignment. Analysis of FOS for 1000's of fastener across large number of loadcases in a matter of minutes!



Fastener FOS results are exported as an Excel file. Precise presentation and color coding of results allows easy identification of critical joints. Editable Excel file allows progressive fine tuning of calculation parameters and on-the spot changes to bolt size, bolt grade etc. to accommodate design iterations.

ABOUT INDEPTH ENGINEERING SOLUTIONS

We are a full-service provider to the amusement park and themed entertainment, automotive, aerospace and other industries. Our capabilities include blue sky design and concept development, mechanical & structural design, computer aided engineering, electrical & controls, fabrication, testing and installation.

InDepth
Engineering Solutions

+1 248.436.4865
850 Stephenson Hwy., Ste 322
Troy, MI 48083
www.indepthengsol.com