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|  | |  | | --- | | **Simulation of Bolts Assem**  **Date: Thursday, October 19, 2023 Designer: Jakob Werle**  **Study name: Static 1**  **Analysis type: Static** | | Table of Contents  [Description 1](#_Toc148620994)  [Assumptions 2](#_Toc148620995)  [Model Information 3](#_Toc148620996)  [Study Properties 4](#_Toc148620997)  [Units 4](#_Toc148620998)  [Material Properties 5](#_Toc148620999)  [Loads and Fixtures 6](#_Toc148621000)  [Connector Definitions 7](#_Toc148621001)  [Interaction Information 8](#_Toc148621002)  [Mesh information 9](#_Toc148621003)  [Sensor Details 9](#_Toc148621004)  [Resultant Forces 10](#_Toc148621005)  [Beams 10](#_Toc148621006)  [Study Results 11](#_Toc148621007)  [Conclusion 14](#_Toc148621008) | |
| Description No Data |

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| Assumptions |

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| Model Information  |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  | | --- | |  |   ****Model name:** Bolts Assem**  ****Current Configuration:** Default** | | | | | ****Solid Bodies**** | | | | | ****Document Name and Reference**** | ****Treated As**** | ****Volumetric Properties**** | ****Document Path/Date Modified**** | | **Cut-Extrude1** | **Solid Body** | ****Mass:8.02085 lb****  ****Volume:31.2699 in^3****  ****Density:0.256504 lb/in^3****  ****Weight:8.01541 lbf**** | ****C:\Users\jakob\software\TU\23FL\CAD\bolts\_in\_class\Bolts Assem take 2\bc1.SLDPRT****  **Oct 19 14:57:50 2023** | | **Cut-Extrude1** | **Solid Body** | ****Mass:8.02085 lb****  ****Volume:31.2699 in^3****  ****Density:0.256504 lb/in^3****  ****Weight:8.01541 lbf**** | ****C:\Users\jakob\software\TU\23FL\CAD\bolts\_in\_class\Bolts Assem take 2\bc1.SLDPRT****  **Oct 19 14:57:50 2023** | |

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| Study Properties  |  |  | | --- | --- | | Study name | Static 1 | | Analysis type | Static | | Mesh type | Solid Mesh | | Thermal Effect: | On | | Thermal option | Include temperature loads | | Zero strain temperature | 298 Kelvin | | Include fluid pressure effects from SOLIDWORKS Flow Simulation | Off | | Solver type | Automatic | | Inplane Effect: | Off | | Soft Spring: | Off | | Inertial Relief: | Off | | Incompatible bonding options | Automatic | | Large displacement | Off | | Compute free body forces | On | | Friction | Off | | Use Adaptive Method: | Off | | Result folder | SOLIDWORKS document (C:\Users\jakob\software\TU\23FL\CAD\bolts\_in\_class\Bolts Assem take 2) | |

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| Units  |  |  | | --- | --- | | Unit system: | English (IPS) | | Length/Displacement | in | | Temperature | Fahrenheit | | Angular velocity | Hertz | | Pressure/Stress | psi | |

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| Material Properties  |  |  |  | | --- | --- | --- | | ****Model Reference**** | ****Properties**** | ****Components**** | |  | |  |  | | --- | --- | | ****Name:**** | **Ductile Iron** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **79,986.1 psi** | | ****Tensile strength:**** | **124,978 psi** | | ****Elastic modulus:**** | **1.74045e+07 psi** | | ****Poisson's ratio:**** | **0.31** | | ****Mass density:**** | **0.256504 lb/in^3** | | ****Shear modulus:**** | **1.11679e+07 psi** | | ****Thermal expansion coefficient:**** | **6.11111e-06 /Fahrenheit** | | **SolidBody 1(Cut-Extrude1)(bc1-1),**  **SolidBody 1(Cut-Extrude1)(bc1-2)** | | **Curve Data:N/A** | | | |

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| **Loads and Fixtures**  | ****Fixture name**** | ****Fixture Image**** | ****Fixture Details**** | | --- | --- | --- | | **On Cylindrical Faces-1** |  | |  |  | | --- | --- | | Entities: | **2 face(s)** | | Type: | **On Cylindrical Faces** | | Translation: | **---, 0 rad., ---** | | Units: | **m** | | | ****Resultant Forces****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Reaction force(lbf)** | **-9.00494e-16** | **-0.349199** | **-2.81022** | **2.83183** | | **Reaction Moment(lbf.in)** | **0** | **0** | **0** | **0** | | | | | **Fixed-1** |  | |  |  | | --- | --- | | Entities: | **1 face(s)** | | Type: | **Fixed Geometry** | | | ****Resultant Forces****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Reaction force(lbf)** | **-10,000** | **-0.155373** | **2.56087** | **10,000** | | **Reaction Moment(lbf.in)** | **0** | **0** | **0** | **0** | | | |  | ****Load name**** | ****Load Image**** | ****Load Details**** | | --- | --- | --- | | **Force-1** |  | |  |  | | --- | --- | | Entities: | **1 face(s)** | | Type: | **Apply normal force** | | Value: | **-10,000 lbf** | | |

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| Connector Definitions **Pin/Bolt/Bearing Connector**   |  |  |  | | --- | --- | --- | | ****Model Reference**** | ****Connector Details**** | ****Strength Details**** | | ****Counterbore with Nut-1**** | |  |  | | --- | --- | | ****Entities:**** | **2 edge(s)** | | ****Type:**** | **Bolt(Head/Nut diameter)(Counterbore)** | | ****Connection Type:**** | **Distributed** | | ****Head diameter:**** | **0.0238125 m** | | ****Nut diameter:**** | **0.0238125 m** | | ****Nominal shank diameter:**** | **0.015875 m** | | ****Material name:**** | **AISI 1020** | | ****Young's modulus:**** | **2e+11 psi** | | ****Poisson's ratio:**** | **0.29** | | ****Thread Count:**** | **11 threads/mm** | | ****Bolt Strength:**** | **85,000 psi** | | ****Safety Factor:**** | **2** | | ****Preload (Axial):**** | **14,400 lbf** | | ****Friction Factor (K):**** | **0.2** | | ****Tight Fit:**** | **No** | | |  |  | | --- | --- | | Bolt Check: | Needs attention | | Calculated FOS: | 1.20929 | | Desired FOS: | 2 | | | ****Connector Forces****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Type** | **X-Component** | **Y-Component** | **Z-Component** | **Resultant** | | **Axial Force (lbf)** | **15,855** | **0** | **0** | **15,855** | | **Shear Force (lbf)** | **0** | **0.60116** | **31.936** | **31.942** | | **Bending moment (lbf.in)** | **0** | **21.575** | **9.6688** | **23.642** | | | | |

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| Interaction Information  | Interaction | Interaction Image | Interaction Properties | | --- | --- | --- | | Local Interaction-1 |  | |  |  | | --- | --- | | Type: | **Contact interaction pair** | | Entities: | **2 face(s)** | | Advanced: | **Surface to surface** | | | ****Contact/Friction force****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Contact Force(lbf)** | **-3.9359E-12** | **0** | **0** | **3.9359E-12** | | | | | Global Interaction |  | |  |  | | --- | --- | | Type: | **Contact (Surface to surface)** | | Components: | **1 component(s)** | | |

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| Mesh information  |  |  | | --- | --- | | Mesh type | Solid Mesh | | Mesher Used: | Blended curvature-based mesh | | Jacobian points for High quality mesh | 16 Points | | Maximum element size | 0.397026 in | | Minimum element size | 0.132341 in | | Mesh Quality | High | | Remesh failed parts independently | Off |  Mesh information - Details  |  |  | | --- | --- | | Total Nodes | 15151 | | Total Elements | 8661 | | Maximum Aspect Ratio | 3.891 | | % of elements with Aspect Ratio < 3 | 99.8 | | Percentage of elements with Aspect Ratio > 10 | 0 | | Percentage of distorted elements | 0 | | Time to complete mesh(hh;mm;ss): | 00:00:03 | | Computer name: | JW-MACHINE | |

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| Sensor Details No Data |

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| Resultant ForcesReaction forces  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | lbf | -10,000 | -0.504743 | -0.249123 | 10,000 |  Reaction Moments  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | lbf.in | 0 | 0 | 0 | 0 | |
| Free body forces  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | lbf | 0.000411637 | -0.000528268 | 8.23275e-05 | 0.000674752 |  Free body moments  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | lbf.in | 0 | 0 | 0 | 8.85075e-33 | |

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| Beams No Data |

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| Study Results  | Name | Type | Min | Max | | --- | --- | --- | --- | | Stress1 | VON: von Mises Stress | 4.348e+05N/m^2  Node: 14345 | 5.068e+08N/m^2  Node: 2 | | **Bolts Assem-Static 1-Stress-Stress1** | | | |  | Name | Type | Min | Max | | --- | --- | --- | --- | | Displacement1 | URES: Resultant Displacement | 0.000e+00m  Node: 7586 | 3.427e-04m  Node: 6974 | | **Bolts Assem-Static 1-Displacement-Displacement1** | | | |  | Name | Type | Min | Max | | --- | --- | --- | --- | | Strain1 | ESTRN: Equivalent Strain | 3.418e-06  Element: 6744 | 2.378e-03  Element: 4042 | | **Bolts Assem-Static 1-Strain-Strain1** | | | |  | Name | Type | | --- | --- | | Pin/Bolt Check1 | Static Bolt & Pin Results | | **Bolts Assem-Static 1-Pin-Bolt Check-Pin-Bolt Check1** | | |

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| Conclusion |

A red object with black text

Description automatically generatedA screenshot of a computer

Description automatically generated