|  |  |  |  |
| --- | --- | --- | --- |
|  | |  | | --- | | **Simulation of Quiz 6**  **Date: Thursday, November 2, 2023 Designer: Jakob Werle**  **Study name: Static 2**  **Analysis type: Static** | | Table of Contents  [Description 1](#_Toc149829765)  [Assumptions 2](#_Toc149829766)  [Model Information 3](#_Toc149829767)  [Study Properties 4](#_Toc149829768)  [Units 4](#_Toc149829769)  [Material Properties 5](#_Toc149829770)  [Loads and Fixtures 6](#_Toc149829771)  [Connector Definitions 7](#_Toc149829772)  [Interaction Information 8](#_Toc149829773)  [Mesh information 9](#_Toc149829774)  [Sensor Details 9](#_Toc149829775)  [Resultant Forces 9](#_Toc149829776)  [Beams 10](#_Toc149829777)  [Study Results 11](#_Toc149829778)  [Conclusion 14](#_Toc149829779) | |
| Description No Data |

|  |
| --- |
| Assumptions |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model Information  |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  | | --- | |  |   ****Model name:** Quiz 6**  ****Current Configuration:** Default** | | | | | ****Solid Bodies**** | | | | | ****Document Name and Reference**** | ****Treated As**** | ****Volumetric Properties**** | ****Document Path/Date Modified**** | | **Bolt Hole x 2** | **Solid Body** | ****Mass:2.38417 lb****  ****Volume:8.57059 in^3****  ****Density:0.27818 lb/in^3****  ****Weight:2.38255 lbf**** | ****D:\NOT SOFTWARE\TU23FL-CAD-Q6\Hitch 7-3.SLDPRT****  **Nov 2 14:30:02 2023** | | **Cut-Extrude1** | **Solid Body** | ****Mass:3.61118 lb****  ****Volume:12.7334 in^3****  ****Density:0.283599 lb/in^3****  ****Weight:3.60873 lbf**** | ****D:\NOT SOFTWARE\TU23FL-CAD-Q6\Hitch Channel 7-3.SLDPRT****  **Nov 2 14:30:02 2023** | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Study Properties  |  |  | | --- | --- | | Study name | Static 2 | | 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 (D:\NOT SOFTWARE\TU23FL-CAD-Q6) | |

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Material Properties  |  |  |  | | --- | --- | --- | | ****Model Reference**** | ****Properties**** | ****Components**** | |  | |  |  | | --- | --- | | ****Name:**** | **Alloy Steel** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **89,984.6 psi** | | ****Tensile strength:**** | **104,982 psi** | | ****Elastic modulus:**** | **3.04579e+07 psi** | | ****Poisson's ratio:**** | **0.28** | | ****Mass density:**** | **0.27818 lb/in^3** | | ****Shear modulus:**** | **1.1458e+07 psi** | | ****Thermal expansion coefficient:**** | **7.22222e-06 /Fahrenheit** | | **SolidBody 1(Bolt Hole x 2)(Hitch 7-3-1)** | | **Curve Data:N/A** | | | |  | |  |  | | --- | --- | | ****Name:**** | **ASTM A36 Steel** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **36,259.4 psi** | | ****Tensile strength:**** | **58,015.1 psi** | | ****Elastic modulus:**** | **2.90075e+07 psi** | | ****Poisson's ratio:**** | **0.26** | | ****Mass density:**** | **0.283599 lb/in^3** | | ****Shear modulus:**** | **1.15015e+07 psi** | | **SolidBody 1(Cut-Extrude1)(Hitch Channel 7-3-1)** | | **Curve Data:N/A** | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Loads and Fixtures**  | ****Fixture name**** | ****Fixture Image**** | ****Fixture Details**** | | --- | --- | --- | | **Fixed-1** |  | |  |  | | --- | --- | | Entities: | **2 face(s)** | | Type: | **Fixed Geometry** | | | ****Resultant Forces****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Reaction force(lbf)** | **440** | **220** | **5.4885e-05** | **491.935** | | **Reaction Moment(lbf.in)** | **0** | **0** | **0** | **0** | | | |  | ****Load name**** | ****Load Image**** | ****Load Details**** | | --- | --- | --- | | **Remote Load (Distributed connection)-1** |  | |  |  | | --- | --- | | Entities: | **1 face(s)** | | Connection Type: | **Distributed** | | Weighting Factor: | **Default (Constant)** | | Coordinate System: | **Coordinate System1** | | Translational Components: | **440 lbf,-220 lbf,---** | | Rotational Components: | **---,---,---** | | Reference coordinates: | **0 1.616 0 in** | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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:**** | **0.75 in** | | ****Nut diameter:**** | **0.75 in** | | ****Nominal shank diameter:**** | **0.5 in** | | ****Material name:**** | **Custom** | | ****Young's modulus:**** | **3e+07 psi** | | ****Poisson's ratio:**** | **0.3** | | ****Preload (Torque):**** | **1,340 lbf.in** | | ****Friction Factor (K):**** | **0.2** | | ****Tight Fit:**** | **No** | | **No Data** | | ****Connector Forces****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Type** | **X-Component** | **Y-Component** | **Z-Component** | **Resultant** | | **Axial Force (lbf)** | **-13,434** | **-4.1562e-12** | **0** | **13,434** | | **Shear Force (lbf)** | **0** | **-33.391** | **-37.622** | **50.302** | | **Bending moment (lbf.in)** | **-1.0492e-14** | **33.912** | **-21.093** | **39.937** | | | | | ****Counterbore with Nut-2**** | |  |  | | --- | --- | | ****Entities:**** | **2 edge(s)** | | ****Type:**** | **Bolt(Head/Nut diameter)(Counterbore)** | | ****Connection Type:**** | **Distributed** | | ****Head diameter:**** | **0.75 in** | | ****Nut diameter:**** | **0.75 in** | | ****Nominal shank diameter:**** | **0.5 in** | | ****Material name:**** | **Custom** | | ****Young's modulus:**** | **3e+07 psi** | | ****Poisson's ratio:**** | **0.3** | | ****Preload (Torque):**** | **1,340 lbf.in** | | ****Friction Factor (K):**** | **0.2** | | ****Tight Fit:**** | **No** | | **No Data** | | ****Connector Forces****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Type** | **X-Component** | **Y-Component** | **Z-Component** | **Resultant** | | **Axial Force (lbf)** | **-13,429** | **-4.1546e-12** | **0** | **13,429** | | **Shear Force (lbf)** | **0** | **-97.257** | **40.412** | **105.32** | | **Bending moment (lbf.in)** | **3.8267e-15** | **-12.369** | **-46.708** | **48.318** | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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)** | **-2.2488E-11** | **0** | **0** | **2.2488E-11** | | | | | Global Interaction |  | |  |  | | --- | --- | | Type: | **Bonded** | | Components: | **1 component(s)** | | Options: | **Independent mesh** | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Mesh information  |  |  | | --- | --- | | Mesh type | Solid Mesh | | Mesher Used: | Curvature-based mesh | | Jacobian points for High quality mesh | 16 Points | | Maximum element size | 0.554582 in | | Minimum element size | 0.110916 in | | Mesh Quality | High | |

|  |
| --- |
| Sensor Details No Data |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Resultant ForcesReaction forces  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | lbf | 440 | 220 | 5.4885e-05 | 491.935 |  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 | -0.0101975 | -0.000584553 | -0.000156307 | 0.0102155 |  Free body moments  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | lbf.in | 0 | 0 | 0 | 8.85075e-33 | |

|  |
| --- |
| Beams No Data |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Study Results  | Name | Type | Min | Max | | --- | --- | --- | --- | | Stress1 | VON: von Mises Stress | 5.750e+01psi  Node: 4974 | 6.705e+04psi  Node: 4370 | | **Quiz 6-Static 2-Stress-Stress1** | | | |  | Name | Type | Min | Max | | --- | --- | --- | --- | | Displacement1 | URES: Resultant Displacement | 0.000e+00in  Node: 3493 | 1.805e-02in  Node: 41 | | **Quiz 6-Static 2-Displacement-Displacement1** | | | |  | Name | Type | Min | Max | | --- | --- | --- | --- | | Strain1 | ESTRN: Equivalent Strain | 3.092e-06  Element: 2367 | 1.554e-03  Element: 6477 | | **Quiz 6-Static 2-Strain-Strain1** | | | |  | Name | Type | Min | Max | | --- | --- | --- | --- | | Stress2 | CP: Contact Pressure | 0.000psi  Node: 1 | 44,417.719psi  Node: 687 | | **Quiz 6-Static 2-Stress-Stress2** | | | | |

|  |
| --- |
| Conclusion |