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|  | |  | | --- | | **Simulation of Motor Mount Assembly**  **Date: Thursday, December 12, 2024 Designer: Solidworks**  **Study name: Static 1**  **Analysis type: Static** | | Table of Contents  [Description 1](#_Toc184856685)  [Assumptions 2](#_Toc184856686)  [Model Information 3](#_Toc184856687)  [Study Properties 8](#_Toc184856688)  [Units 8](#_Toc184856689)  [Material Properties 9](#_Toc184856690)  [Loads and Fixtures 12](#_Toc184856691)  [Connector Definitions 12](#_Toc184856692)  [Interaction Information 13](#_Toc184856693)  [Mesh information 14](#_Toc184856694)  [Sensor Details 15](#_Toc184856695)  [Resultant Forces 15](#_Toc184856696)  [Beams 15](#_Toc184856697)  [Study Results 16](#_Toc184856698)  [Conclusion 16](#_Toc184856699) | |
| Description No Data |

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| Assumptions  |  |  | | --- | --- | | Original Model | Model Analyzed | |

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| Model Information  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | |  | | --- | |  |   ****Model name:** Motor Mount Assembly**  ****Current Configuration:** Default** | | | | | | | | ****Solid Bodies**** | | | | | | | | ****Document Name and Reference**** | ****Treated As**** | | ****Volumetric Properties**** | | ****Document Path/Date Modified**** | | | **Boss-Extrude1** | **Solid Body** | | ****Mass:0.752776 kg****  ****Volume:9.65097e-05 m^3****  ****Density:7,800 kg/m^3****  ****Weight:7.3772 N**** | | ****D:\Documents\\_School\\_Sac State 2024\ME 190\CSUS-Senior-Project\CAD\bike assembly\bottom bracket.SLDPRT****  **Nov 27 13:42:53 2024** | | | **Boss-Extrude1** | **Solid Body** | | ****Mass:0.00930208 kg****  ****Volume:1.19257e-06 m^3****  ****Density:7,800 kg/m^3****  ****Weight:0.0911603 N**** | | ****D:\Documents\\_School\\_Sac State 2024\ME 190\CSUS-Senior-Project\CAD\motor assembly\11T sprocket.SLDPRT****  **Nov 27 13:42:53 2024** | | | **Tap Drill for M4x0.7 Tap1** | **Solid Body** | | ****Mass:0.0340757 kg****  ****Volume:1.26206e-05 m^3****  ****Density:2,700 kg/m^3****  ****Weight:0.333942 N**** | | ****D:\Documents\\_School\\_Sac State 2024\ME 190\CSUS-Senior-Project\CAD\motor assembly\bottom bracket ring.SLDPRT****  **Nov 27 20:08:54 2024** | | | **Tap Drill for M4x0.7 Tap1** | **Solid Body** | | ****Mass:0.0340757 kg****  ****Volume:1.26206e-05 m^3****  ****Density:2,700 kg/m^3****  ****Weight:0.333942 N**** | | ****D:\Documents\\_School\\_Sac State 2024\ME 190\CSUS-Senior-Project\CAD\motor assembly\bottom bracket ring.SLDPRT****  **Nov 27 20:08:54 2024** | | | **Cut-Extrude2** | **Solid Body** | | ****Mass:0.110832 kg****  ****Volume:1.40828e-05 m^3****  ****Density:7,870 kg/m^3****  ****Weight:1.08615 N**** | | ****D:\Documents\\_School\\_Sac State 2024\ME 190\CSUS-Senior-Project\CAD\motor assembly\bottom pipe clamp.SLDPRT****  **Nov 27 13:42:53 2024** | | | **EndChamfer** | **Solid Body** | | ****Mass:0.00274326 kg****  ****Volume:3.42908e-07 m^3****  ****Density:8,000 kg/m^3****  ****Weight:0.026884 N**** | | ****c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\nuts\hex nuts\hex nut style 1\_am.sldprt****  **Nov 1 14:14:35 2024** | | | **EndChamfer** | **Solid Body** | | ****Mass:0.00274326 kg****  ****Volume:3.42908e-07 m^3****  ****Density:8,000 kg/m^3****  ****Weight:0.026884 N**** | | ****c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\nuts\hex nuts\hex nut style 1\_am.sldprt****  **Nov 1 14:14:35 2024** | | | **EndChamfer** | **Solid Body** | | ****Mass:0.00274326 kg****  ****Volume:3.42908e-07 m^3****  ****Density:8,000 kg/m^3****  ****Weight:0.026884 N**** | | ****c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\nuts\hex nuts\hex nut style 1\_am.sldprt****  **Nov 1 14:14:35 2024** | | | **EndChamfer** | **Solid Body** | | ****Mass:0.00274326 kg****  ****Volume:3.42908e-07 m^3****  ****Density:8,000 kg/m^3****  ****Weight:0.026884 N**** | | ****c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\nuts\hex nuts\hex nut style 1\_am.sldprt****  **Nov 1 14:14:35 2024** | | | **EndChamfer** | **Solid Body** | | ****Mass:0.00274326 kg****  ****Volume:3.42908e-07 m^3****  ****Density:8,000 kg/m^3****  ****Weight:0.026884 N**** | | ****c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\nuts\hex nuts\hex nut style 1\_am.sldprt****  **Nov 1 14:14:35 2024** | | | **EndChamfer** | **Solid Body** | | ****Mass:0.00274326 kg****  ****Volume:3.42908e-07 m^3****  ****Density:8,000 kg/m^3****  ****Weight:0.026884 N**** | | ****c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\nuts\hex nuts\hex nut style 1\_am.sldprt****  **Nov 1 14:14:35 2024** | | | **EndChamfer** | **Solid Body** | | ****Mass:0.00274326 kg****  ****Volume:3.42908e-07 m^3****  ****Density:8,000 kg/m^3****  ****Weight:0.026884 N**** | | ****c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\nuts\hex nuts\hex nut style 1\_am.sldprt****  **Nov 1 14:14:35 2024** | | | **EndChamfer** | **Solid Body** | | ****Mass:0.00274326 kg****  ****Volume:3.42908e-07 m^3****  ****Density:8,000 kg/m^3****  ****Weight:0.026884 N**** | | ****c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\nuts\hex nuts\hex nut style 1\_am.sldprt****  **Nov 1 14:14:35 2024** | | | **Boss-Extrude10** | **Solid Body** | | ****Mass:0.000864324 kg****  ****Volume:1.09993e-07 m^3****  ****Density:7,858 kg/m^3****  ****Weight:0.00847038 N**** | | ****D:\Documents\\_School\\_Sac State 2024\ME 190\CSUS-Senior-Project\CAD\motor assembly\motor.SLDPRT****  **Nov 27 18:49:23 2024** | | | **Cut-Extrude13** | **Solid Body** | | ****Mass:4.77804 kg****  ****Volume:0.000608048 m^3****  ****Density:7,858 kg/m^3****  ****Weight:46.8248 N**** | | ****D:\Documents\\_School\\_Sac State 2024\ME 190\CSUS-Senior-Project\CAD\motor assembly\motor.SLDPRT****  **Nov 27 18:49:23 2024** | | | **Ø6.0mm Dowel Hole1** | **Solid Body** | | ****Mass:0.256231 kg****  ****Volume:9.49004e-05 m^3****  ****Density:2,700 kg/m^3****  ****Weight:2.51107 N**** | | ****D:\Documents\\_School\\_Sac State 2024\ME 190\CSUS-Senior-Project\CAD\motor assembly\mounting plate.SLDPRT****  **Dec 11 21:18:13 2024** | | | **Hex** | **Solid Body** | | ****Mass:0.00496189 kg****  ****Volume:6.20237e-07 m^3****  ****Density:8,000 kg/m^3****  ****Weight:0.0486266 N**** | | ****c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\bolts and screws\socket head screws\socket button head cap screw\_am.sldprt****  **Oct 31 16:35:57 2024** | | | **Hex** | **Solid Body** | | ****Mass:0.00496189 kg****  ****Volume:6.20237e-07 m^3****  ****Density:8,000 kg/m^3****  ****Weight:0.0486266 N**** | | ****c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\bolts and screws\socket head screws\socket button head cap screw\_am.sldprt****  **Oct 31 16:35:57 2024** | | | **Hex** | **Solid Body** | | ****Mass:0.00496189 kg****  ****Volume:6.20237e-07 m^3****  ****Density:8,000 kg/m^3****  ****Weight:0.0486266 N**** | | ****c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\bolts and screws\socket head screws\socket button head cap screw\_am.sldprt****  **Oct 31 16:35:57 2024** | | | **Hex** | **Solid Body** | | ****Mass:0.00496189 kg****  ****Volume:6.20237e-07 m^3****  ****Density:8,000 kg/m^3****  ****Weight:0.0486266 N**** | | ****c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\bolts and screws\socket head screws\socket button head cap screw\_am.sldprt****  **Oct 31 16:35:57 2024** | | | **Hex** | | **Solid Body** | | **Mass:0.00496189 kg**  **Volume:6.20237e-07 m^3**  **Density:8,000 kg/m^3**  **Weight:0.0486266 N** | | **c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\bolts and screws\socket head screws\socket button head cap screw\_am.sldprt**  **Oct 31 16:35:57 2024** | | **Hex** | | **Solid Body** | | **Mass:0.00496189 kg**  **Volume:6.20237e-07 m^3**  **Density:8,000 kg/m^3**  **Weight:0.0486266 N** | | **c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\bolts and screws\socket head screws\socket button head cap screw\_am.sldprt**  **Oct 31 16:35:57 2024** | | **Hex** | | **Solid Body** | | **Mass:0.00171035 kg**  **Volume:2.13793e-07 m^3**  **Density:8,000 kg/m^3**  **Weight:0.0167614 N** | | **c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\bolts and screws\socket head screws\socket button head cap screw\_am.sldprt**  **Oct 31 16:35:57 2024** | | **Hex** | | **Solid Body** | | **Mass:0.00171035 kg**  **Volume:2.13793e-07 m^3**  **Density:8,000 kg/m^3**  **Weight:0.0167614 N** | | **c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\bolts and screws\socket head screws\socket button head cap screw\_am.sldprt**  **Oct 31 16:35:57 2024** | | **Hex** | | **Solid Body** | | **Mass:0.00171035 kg**  **Volume:2.13793e-07 m^3**  **Density:8,000 kg/m^3**  **Weight:0.0167614 N** | | **c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\bolts and screws\socket head screws\socket button head cap screw\_am.sldprt**  **Oct 31 16:35:57 2024** | | **Hex** | | **Solid Body** | | **Mass:0.00171035 kg**  **Volume:2.13793e-07 m^3**  **Density:8,000 kg/m^3**  **Weight:0.0167614 N** | | **c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\bolts and screws\socket head screws\socket button head cap screw\_am.sldprt**  **Oct 31 16:35:57 2024** | | **Hex** | | **Solid Body** | | **Mass:0.00496189 kg**  **Volume:6.20237e-07 m^3**  **Density:8,000 kg/m^3**  **Weight:0.0486266 N** | | **c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\bolts and screws\socket head screws\socket button head cap screw\_am.sldprt**  **Oct 31 16:35:57 2024** | | **Hex** | | **Solid Body** | | **Mass:0.00496189 kg**  **Volume:6.20237e-07 m^3**  **Density:8,000 kg/m^3**  **Weight:0.0486266 N** | | **c:\program files\solidworks corp\solidworks toolbox\browser\ansi metric\bolts and screws\socket head screws\socket button head cap screw\_am.sldprt**  **Oct 31 16:35:57 2024** | | **Cut-Extrude1** | **Solid Body** | | ****Mass:0.0483991 kg****  ****Volume:6.14982e-06 m^3****  ****Density:7,870 kg/m^3****  ****Weight:0.474311 N**** | | ****D:\Documents\\_School\\_Sac State 2024\ME 190\CSUS-Senior-Project\CAD\motor assembly\top pipe clamp.SLDPRT****  **Nov 27 20:08:54 2024** | | |

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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 (D:\Documents\\_School\\_Sac State 2024\ME 190\FEA) | |

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| Units  |  |  | | --- | --- | | Unit system: | SI (MKS) | | Length/Displacement | mm | | Temperature | Kelvin | | Angular velocity | Rad/sec | | Pressure/Stress | N/m^2 | |

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| Material Properties  |  |  |  |  |  | | --- | --- | --- | --- | --- | | ****Model Reference**** | ****Properties**** | ****Components**** | | | |  | |  |  | | --- | --- | | ****Name:**** | **Plain Carbon Steel** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **2.20594e+08 N/m^2** | | ****Tensile strength:**** | **3.99826e+08 N/m^2** | | ****Elastic modulus:**** | **2.1e+11 N/m^2** | | ****Poisson's ratio:**** | **0.28** | | ****Mass density:**** | **7,800 kg/m^3** | | ****Shear modulus:**** | **7.9e+10 N/m^2** | | ****Thermal expansion coefficient:**** | **1.3e-05 /Kelvin** | | **SolidBody 1(Boss-Extrude1)(bike assembly-3/bottom bracket-1),**  **SolidBody 1(Boss-Extrude1)(motor assembly-2/11T sprocket-1)** | | | | **Curve Data:N/A** | | | | | |  | |  |  | | --- | --- | | ****Name:**** | **6061-T6 (SS)** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **2.75e+08 N/m^2** | | ****Tensile strength:**** | **3.1e+08 N/m^2** | | ****Elastic modulus:**** | **6.9e+10 N/m^2** | | ****Poisson's ratio:**** | **0.33** | | ****Mass density:**** | **2,700 kg/m^3** | | ****Shear modulus:**** | **2.6e+10 N/m^2** | | ****Thermal expansion coefficient:**** | **2.4e-05 /Kelvin** | | **SolidBody 1(Tap Drill for M4x0.7 Tap1)(motor assembly-2/bottom bracket ring-1),**  **SolidBody 1(Tap Drill for M4x0.7 Tap1)(motor assembly-2/bottom bracket ring-2),**  **SolidBody 1(Ø6.0mm Dowel Hole1)(motor assembly-2/mounting plate-3)** | | | | **Curve Data:N/A** | | | | | |  | |  |  | | --- | --- | | ****Name:**** | **Galvanized Steel** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **2.03943e+08 N/m^2** | | ****Tensile strength:**** | **3.56901e+08 N/m^2** | | ****Elastic modulus:**** | **2e+11 N/m^2** | | ****Poisson's ratio:**** | **0.29** | | ****Mass density:**** | **7,870 kg/m^3** | | **SolidBody 1(Cut-Extrude2)(motor assembly-2/bottom pipe clamp-1),**  **SolidBody 1(Cut-Extrude1)(motor assembly-2/top pipe clamp-1)** | | | | **Curve Data:N/A** | | | | | | |  | |  |  | | --- | --- | | ****Name:**** | **AISI 316 Stainless Steel Sheet (SS)** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Max von Mises Stress** | | ****Yield strength:**** | **1.72369e+08 N/m^2** | | ****Tensile strength:**** | **5.8e+08 N/m^2** | | ****Elastic modulus:**** | **1.93e+11 N/m^2** | | ****Poisson's ratio:**** | **0.27** | | ****Mass density:**** | **8,000 kg/m^3** | | ****Thermal expansion coefficient:**** | **1.6e-05 /Kelvin** | | **SolidBody 1(EndChamfer)(motor assembly-2/hex nut style 1\_am-12),**  **SolidBody 1(EndChamfer)(motor assembly-2/hex nut style 1\_am-13),**  **SolidBody 1(EndChamfer)(motor assembly-2/hex nut style 1\_am-2),**  **SolidBody 1(EndChamfer)(motor assembly-2/hex nut style 1\_am-3),**  **SolidBody 1(EndChamfer)(motor assembly-2/hex nut style 1\_am-4),**  **SolidBody 1(EndChamfer)(motor assembly-2/hex nut style 1\_am-5),**  **SolidBody 1(EndChamfer)(motor assembly-2/hex nut style 1\_am-8),**  **SolidBody 1(EndChamfer)(motor assembly-2/hex nut style 1\_am-9),**  **SolidBody 1(Hex)(motor assembly-2/socket button head cap screw\_am-10),**  **SolidBody 1(Hex)(motor assembly-2/socket button head cap screw\_am-11),**  **SolidBody 1(Hex)(motor assembly-2/socket button head cap screw\_am-12),**  **SolidBody 1(Hex)(motor assembly-2/socket button head cap screw\_am-13),**  **SolidBody 1(Hex)(motor assembly-2/socket button head cap screw\_am-16),**  **SolidBody 1(Hex)(motor assembly-2/socket button head cap screw\_am-17),**  **SolidBody 1(Hex)(motor assembly-2/socket button head cap screw\_am-3),**  **SolidBody 1(Hex)(motor assembly-2/socket button head cap screw\_am-4),**  **SolidBody 1(Hex)(motor assembly-2/socket button head cap screw\_am-5),**  **SolidBody 1(Hex)(motor assembly-2/socket button head cap screw\_am-7),**  **SolidBody 1(Hex)(motor assembly-2/socket button head cap screw\_am-8),**  **SolidBody 1(Hex)(motor assembly-2/socket button head cap screw\_am-9)** | | | | **Curve Data:N/A** | | | | | | | |  | |  |  | | --- | --- | | ****Name:**** | **1023 Carbon Steel Sheet (SS)** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **2.82685e+08 N/m^2** | | ****Tensile strength:**** | **4.25e+08 N/m^2** | | ****Elastic modulus:**** | **2.05e+11 N/m^2** | | ****Poisson's ratio:**** | **0.29** | | ****Mass density:**** | **7,858 kg/m^3** | | ****Shear modulus:**** | **8e+10 N/m^2** | | ****Thermal expansion coefficient:**** | **1.2e-05 /Kelvin** | | **SolidBody 1(Boss-Extrude10)(motor assembly-2/motor-1),**  **SolidBody 2(Cut-Extrude13)(motor assembly-2/motor-1)** | | | | **Curve Data:N/A** | | | | | | | | |

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| **Loads and Fixtures**  | ****Fixture name**** | ****Fixture Image**** | ****Fixture Details**** | | --- | --- | --- | | **Fixed Hinge-1** |  | |  |  | | --- | --- | | Entities: | **2 face(s)** | | Type: | **Fixed Hinge** | | | **Fixed-1** |  | |  |  | | --- | --- | | Entities: | **1 face(s)** | | Type: | **Fixed Geometry** | |  | ****Load name**** | ****Load Image**** | ****Load Details**** | | --- | --- | --- | | **Torque-1** |  | |  |  | | --- | --- | | Entities: | **1 face(s), 2 Solid Body (s)** | | Reference: | **Face< 1 >** | | Type: | **Apply torque** | | Value: | **-1.22 N.m** | | | **Force-1** |  | |  |  | | --- | --- | | Entities: | **1 edge(s)** | | Reference: | **Edge< 1 >** | | Type: | **Apply force** | | Values: | **---, ---, -,100 N** | | |

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| Connector Definitions No Data |

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| Interaction Information  | Interaction | Interaction Image | Interaction Properties | | --- | --- | --- | | Global Interaction |  | |  |  | | --- | --- | | Type: | **Bonded** | | Components: | **1 component(s)** | | Options: | **Independent mesh** | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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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 | 18.9854 mm | | Minimum element size | 3.79708 mm | | Mesh Quality | High | | Remesh failed parts independently | Off |  Mesh information - Details  |  |  | | --- | --- | | Total Nodes | 3196091 | | Total Elements | 2174868 | | Maximum Aspect Ratio | 640.25 | | % of elements with Aspect Ratio < 3 | 99.5 | | Percentage of elements with Aspect Ratio > 10 | 0.0945 | | Percentage of distorted elements | 0 | | Time to complete mesh(hh;mm;ss): | 00:01:17 | | Computer name: | DESKTOP |  Mesh Control Information:  | **Mesh Control Name** | **Mesh Control Image** | **Mesh Control Details** | | --- | --- | --- | | **Control-13** |  | |  |  | | --- | --- | | Entities: | **29 Solid Body (s)** | | Units: | **mm** | | Size: | **4.74635** | | Ratio: | **4.74635** | | |

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| Sensor Details  | Sensor name | Location | Sensor Details | | --- | --- | --- | | Mass1 |  | Value : 7,912.87 g  Entities :  Result :Stress  Component :VON: von Mises Stress  Criterion :Model Max  Step Criterion : Across all Steps  Step No.:1  Alert Value: NA | | Stress1 |  | Value : 2.184e+08 N/m^2  Entities :  Result :Stress  Component :VON: von Mises Stress  Criterion :Model Max  Step Criterion : Across all Steps  Step No.:1  Alert Value: NA | | Displacement1 |  | Value : 1.380e-01 mm  Entities :  Result :Displacement  Component :URES: Resultant Displacement  Criterion :Model Max  Step Criterion : Across all Steps  Step No.:1  Alert Value: NA | |

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| Resultant Forces No Data |
| No Data |

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| Beams No Data |

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| Study Results No Data |

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| Conclusion |