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|  | |  | | --- | | **Simulation of borderless\_simplified\_panel\_reverse3pt**  **Date: Monday, May 17, 2021 Designer: Solidworks**  **Study name: reverse3pt\_bend**  **Analysis type: Static** | | Table of Contents  [Description 1](#_Toc72148252)  [Assumptions 2](#_Toc72148253)  [Model Information 2](#_Toc72148254)  [Study Properties 4](#_Toc72148255)  [Units 5](#_Toc72148256)  [Material Properties 6](#_Toc72148257)  [Loads and Fixtures 8](#_Toc72148258)  [Connector Definitions 8](#_Toc72148259)  [Contact Information 9](#_Toc72148260)  [Mesh information 11](#_Toc72148261)  [Sensor Details 12](#_Toc72148262)  [Resultant Forces 13](#_Toc72148263)  [Beams 13](#_Toc72148264)  [Study Results 14](#_Toc72148265)  [Conclusion 17](#_Toc72148266) | |
| Description No Data |

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| Assumptions |

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| Model Information  |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  | | --- | |  |   ****Model name:** borderless\_simplified\_panel\_reverse3pt**  ****Current Configuration:** Default** | | | | | ****Solid Bodies**** | | | | | ****Document Name and Reference**** | ****Treated As**** | ****Volumetric Properties**** | ****Document Path/Date Modified**** | | **Boss-Extrude1** | **Solid Body** | ****Mass:0.0106851 kg****  ****Volume:4.87902e-06 m^3****  ****Density:2,190 kg/m^3****  ****Weight:0.104714 N**** | ****C:\Users\Natha\Desktop\Caltech 2020-2024\NASA\_Big\_Idea\_Challenge\GrabCAD\Current\Mechanical\v4\_Eggdee\Parts\adhesive\_v4.1.SLDPRT****  **May 16 13:19:20 2021** | | **Boss-Extrude1** | **Solid Body** | ****Mass:0.0106851 kg****  ****Volume:4.87902e-06 m^3****  ****Density:2,190 kg/m^3****  ****Weight:0.104714 N**** | ****C:\Users\Natha\Desktop\Caltech 2020-2024\NASA\_Big\_Idea\_Challenge\GrabCAD\Current\Mechanical\v4\_Eggdee\Parts\adhesive\_v4.1.SLDPRT****  **May 16 13:19:20 2021** | | **Split Line1** | **Solid Body** | ****Mass:0.595015 kg****  ****Volume:0.000236117 m^3****  ****Density:2,520 kg/m^3****  ****Weight:5.83115 N**** | ****C:\Users\Natha\Desktop\Caltech 2020-2024\NASA\_Big\_Idea\_Challenge\GrabCAD\Current\Mechanical\v4\_Eggdee\Simplified\_Parts\bplate\_simplified\_reverse3pt\_borderless.SLDPRT****  **May 17 10:56:03 2021** | | **Boss-Extrude1** | **Solid Body** | ****Mass:0.00831385 kg****  ****Volume:5.85483e-06 m^3****  ****Density:1,420 kg/m^3****  ****Weight:0.0814758 N**** | ****C:\Users\Natha\Desktop\Caltech 2020-2024\NASA\_Big\_Idea\_Challenge\GrabCAD\Current\Mechanical\v4\_Eggdee\Simplified\_Parts\pcb\_simplified\_nofillet.SLDPRT****  **May 16 16:25:29 2021** | | **Fillet1** | **Solid Body** | ****Mass:0.0319938 kg****  ****Volume:1.59969e-05 m^3****  ****Density:2,000 kg/m^3****  ****Weight:0.313539 N**** | ****C:\Users\Natha\Desktop\Caltech 2020-2024\NASA\_Big\_Idea\_Challenge\GrabCAD\Current\Mechanical\v4\_Eggdee\Parts\power\_supply\_pcb\_mockup\_v4.2.SLDPRT****  **May 15 11:00:41 2021** | | **Fillet1** | **Solid Body** | ****Mass:0.0269748 kg****  ****Volume:1.89963e-05 m^3****  ****Density:1,420 kg/m^3****  ****Weight:0.264353 N**** | ****C:\Users\Natha\Desktop\Caltech 2020-2024\NASA\_Big\_Idea\_Challenge\GrabCAD\Current\Mechanical\v4\_Eggdee\Simplified\_Parts\separation\_layer\_simplified.SLDPRT****  **May 16 13:10:37 2021** | | **Split Line1** | **Solid Body** | ****Mass:0.0494616 kg****  ****Volume:1.24903e-05 m^3****  ****Density:3,960 kg/m^3****  ****Weight:0.484723 N**** | ****C:\Users\Natha\Desktop\Caltech 2020-2024\NASA\_Big\_Idea\_Challenge\GrabCAD\Current\Mechanical\v4\_Eggdee\Simplified\_Parts\tplate\_simplified\_reverse3pt.SLDPRT****  **May 17 05:27:24 2021** | |

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| Study Properties  |  |  | | --- | --- | | Study name | reverse3pt\_bend | | 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 | FFEPlus | | 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\Natha\Desktop\Caltech 2020-2024\NASA\_Big\_Idea\_Challenge\GrabCAD\Current\Mechanical\v4\_Eggdee\Simplified\_Parts\5.16\_Reverse3pt\_Bend\_Simplified\_Borderless) | |

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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:**** | **STYCAST 2850FT/Catalyst 23LV** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Tensile strength:**** | **1.0549e+08 N/m^2** | | ****Compressive strength:**** | **1.19969e+08 N/m^2** | | ****Elastic modulus:**** | **6.413e+09 N/m^2** | | ****Mass density:**** | **2,190 kg/m^3** | | **SolidBody 1(Boss-Extrude1)(adhesive\_v4.1-1),**  **SolidBody 1(Boss-Extrude1)(adhesive\_v4.1-2)** | | **Curve Data:N/A** | | | |  | |  |  | | --- | --- | | ****Name:**** | **Macor** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **3.3e+07 N/m^2** | | ****Tensile strength:**** | **3.3e+07 N/m^2** | | ****Compressive strength:**** | **3.45e+08 N/m^2** | | ****Elastic modulus:**** | **6.69e+10 N/m^2** | | ****Poisson's ratio:**** | **0.29** | | ****Mass density:**** | **2,520 kg/m^3** | | ****Shear modulus:**** | **2.55e+10 N/m^2** | | ****Thermal expansion coefficient:**** | **8e-06 /Kelvin** | | **SolidBody 1(Split Line1)(bplate\_simplified\_reverse3pt\_borderless-1)** | | **Curve Data:N/A** | | | |  | |  |  | | --- | --- | | ****Name:**** | **Kapton HN** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **6.9e+07 N/m^2** | | ****Tensile strength:**** | **2.31e+08 N/m^2** | | ****Compressive strength:**** | **2.31e+08 N/m^2** | | ****Elastic modulus:**** | **2.76e+09 N/m^2** | | ****Poisson's ratio:**** | **0.34** | | ****Mass density:**** | **1,420 kg/m^3** | | ****Thermal expansion coefficient:**** | **20 /Kelvin** | | **SolidBody 1(Boss-Extrude1)(pcb\_simplified\_nofillet-1),**  **SolidBody 1(Fillet1)(separation\_layer\_simplified-1)** | | **Curve Data:N/A** | | | |  | |  |  | | --- | --- | | ****Name:**** | **FR4** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **3.45e+08 N/m^2** | | ****Tensile strength:**** | **3.45e+08 N/m^2** | | ****Compressive strength:**** | **3.5e+08 N/m^2** | | ****Elastic modulus:**** | **2.156e+10 N/m^2** | | ****Poisson's ratio:**** | **0.136** | | ****Mass density:**** | **2,000 kg/m^3** | | **SolidBody 1(Fillet1)(power\_supply\_pcb\_mockup\_v4.2-1)** | | **Curve Data:N/A** | | | |  | |  |  | | --- | --- | | ****Name:**** | **Alumina** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Tensile strength:**** | **3e+08 N/m^2** | | ****Compressive strength:**** | **3e+09 N/m^2** | | ****Elastic modulus:**** | **3.7e+11 N/m^2** | | ****Poisson's ratio:**** | **0.22** | | ****Mass density:**** | **3,960 kg/m^3** | | ****Shear modulus:**** | **1.5e+11 N/m^2** | | ****Thermal expansion coefficient:**** | **7e-06 /Kelvin** | | **SolidBody 1(Split Line1)(tplate\_simplified\_reverse3pt-1)** | | **Curve Data:N/A** | | | |

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| **Loads and Fixtures**  | ****Fixture name**** | ****Fixture Image**** | ****Fixture Details**** | | --- | --- | --- | | **Fixed-1** |  | |  |  | | --- | --- | | Entities: | **1 face(s)** | | Type: | **Fixed Geometry** | | | ****Resultant Forces****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Reaction force(N)** | **-2.76566e-05** | **972** | **1.90735e-05** | **972** | | **Reaction Moment(N.m)** | **0** | **0** | **0** | **0** | | | |  | ****Load name**** | ****Load Image**** | ****Load Details**** | | --- | --- | --- | | **Force-1** |  | |  |  | | --- | --- | | Entities: | **2 face(s)** | | Type: | **Apply normal force** | | Value: | **486 N** | | |

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| Connector Definitions No Data |

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| Contact Information  | Contact | Contact Image | Contact Properties | | --- | --- | --- | | Contact Set-1 |  | |  |  | | --- | --- | | Type: | **Bonded contact pair** | | Entities: | **2 face(s)** | | | ****Contact/Friction force****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Contact Force(N)** | **0** | **327.32** | **0** | **327.32** | | | | | Contact Set-2 |  | |  |  | | --- | --- | | Type: | **Bonded contact pair** | | Entities: | **2 face(s)** | | | ****Contact/Friction force****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Contact Force(N)** | **0** | **110.87** | **0** | **110.87** | | | | | Contact Set-3 |  | |  |  | | --- | --- | | Type: | **Bonded contact pair** | | Entities: | **2 face(s)** | | | ****Contact/Friction force****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Contact Force(N)** | **1.9884E-14** | **164.91** | **1.7412E-06** | **164.91** | | | | | Contact Set-4 |  | |  |  | | --- | --- | | Type: | **Bonded contact pair** | | Entities: | **10 face(s)** | | | ****Contact/Friction force****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Contact Force(N)** | **-0.0012356** | **94.429** | **-0.83698** | **94.433** | | | | | Component Contact-1 |  | |  |  | | --- | --- | | Type: | **No penetration (Surface to surface)** | | Components: | **7 component(s)** | | |

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| Mesh information  |  |  | | --- | --- | | Mesh type | Solid Mesh | | Mesher Used: | Standard mesh | | Automatic Transition: | Off | | Include Mesh Auto Loops: | Off | | Jacobian points | 4 Points | | Element Size | 0.2 in | | Tolerance | 0.01 in | | Mesh Quality Plot | High | | Remesh failed parts with incompatible mesh | Off |  Mesh information - Details  |  |  | | --- | --- | | Total Nodes | 82924 | | Total Elements | 44869 | | Maximum Aspect Ratio | 182.12 | | % of elements with Aspect Ratio < 3 | 33.8 | | % of elements with Aspect Ratio > 10 | 45.9 | | % of distorted elements(Jacobian) | 0 | | Time to complete mesh(hh;mm;ss): | 00:00:12 | | Computer name: | THICCO | |  | |  Mesh Control Information:  | **Mesh Control Name** | **Mesh Control Image** | **Mesh Control Details** | | --- | --- | --- | | **Control-1** |  | |  |  | | --- | --- | | Entities: | **2 Solid Body (s)** | | Units: | **in** | | Size: | **0.195** | | Ratio: | **0.195** | | |

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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 | N | -2.76566e-05 | 972 | 1.90735e-05 | 972 |  Reaction Moments  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | N.m | 0 | 0 | 0 | 0 | |
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| Beams No Data |

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| Study Results  | Name | Type | Min | Max | | --- | --- | --- | --- | | Stress1 | VON: von Mises Stress | 3.225e+02 N/m^2  Node: 65685 | 1.877e+07 N/m^2  Node: 52065 | | **borderless\_simplified\_panel\_reverse3pt-reverse3pt\_bend-Stress-Stress1** | | | |  | Name | Type | Min | Max | | --- | --- | --- | --- | | Displacement1 | URES: Resultant Displacement | 0.000e+00 mm  Node: 27861 | 2.366e-02 mm  Node: 73913 | | **borderless\_simplified\_panel\_reverse3pt-reverse3pt\_bend-Displacement-Displacement1** | | | |  | Name | Type | Min | Max | | --- | --- | --- | --- | | Strain1 | ESTRN: Equivalent Strain | 1.016e-08  Element: 36808 | 2.523e-04  Element: 34371 | | **borderless\_simplified\_panel\_reverse3pt-reverse3pt\_bend-Strain-Strain1** | | | |  | Name | Type | Min | Max | | --- | --- | --- | --- | | Factor of Safety1 | Mohr-Coulomb Stress | 1.809e+00  Node: 36709 | 3.000e+00  Node: 1 | | **borderless\_simplified\_panel\_reverse3pt-reverse3pt\_bend-Factor of Safety-Factor of Safety1** | | | | |

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| Conclusion |