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|  | |  | | --- | | **Simulation of Em\_Cal\_Mesh\_15\_Comparison&Analysis**  **Date: Monday, April 25, 2022 Designer: Avishay\_Mizrahi**  **Study name: Liniar\_Static\_01**  **Analysis type: Static** | | Table of Contents  [Description 1](#_Toc101802383)  [Assumptions 2](#_Toc101802384)  [Study Properties 2](#_Toc101802385)  [Units 3](#_Toc101802386)  [Material Properties 4](#_Toc101802387)  [Loads and Fixtures 6](#_Toc101802388)  [Contact Information 7](#_Toc101802389)  [Mesh information 8](#_Toc101802390)  [Resultant Forces 9](#_Toc101802391)  [Study Results 10](#_Toc101802392)  [Conclusion 19](#_Toc101802393) | |
| Description This mesh was symmetrically distributed, and support was added to the top center using the radial component.  The maximum displacement is at the top center in the direction of gravity. The uniform thickness of the beams is 6.5 mm. |

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| Assumptions There is no friction in the model.  The whole mesh is made up of one part (for the purpose of analysis).  The ring in all models is uniform and made of the same material tested in the simulation.  Fixtures in the model have no movement in any direction. |

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| Study Properties  |  |  | | --- | --- | | Study name | Liniar\_Static\_01 | | 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 | On | | Compute free body forces | On | | Friction | Off | | Use Adaptive Method: | Off | | Result folder | SOLIDWORKS document (C:\MIT\MIT Electron-Ion Collider Project\Mesh comparison and analysis\Em\_Cal\_Mesh\_15\_Comparison&Analysis) | |

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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:**** | **Radial\_Segment** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **6.89476e+06 N/m^2** | | ****Tensile strength:**** | **3.4e+07 N/m^2** | | ****Elastic modulus:**** | **1.72369e+08 N/m^2** | | ****Poisson's ratio:**** | **0.3** | | ****Mass density:**** | **4,199.01 kg/m^3** | | **SolidBody 1(Boss-Extrude1)(Barrel\_Electromagnetic\_Calorimeter\_radial\_segment-1),**  **SolidBody 1(Boss-Extrude1)(Barrel\_Electromagnetic\_Calorimeter\_radial\_segment-10),**  **SolidBody 1(Boss-Extrude1)(Barrel\_Electromagnetic\_Calorimeter\_radial\_segment-11),**  **SolidBody 1(Boss-Extrude1)(Barrel\_Electromagnetic\_Calorimeter\_radial\_segment-12),**  **SolidBody 1(Boss-Extrude1)(Barrel\_Electromagnetic\_Calorimeter\_radial\_segment-2),**  **SolidBody 1(Boss-Extrude1)(Barrel\_Electromagnetic\_Calorimeter\_radial\_segment-3),**  **SolidBody 1(Boss-Extrude1)(Barrel\_Electromagnetic\_Calorimeter\_radial\_segment-4),**  **SolidBody 1(Boss-Extrude1)(Barrel\_Electromagnetic\_Calorimeter\_radial\_segment-5),**  **SolidBody 1(Boss-Extrude1)(Barrel\_Electromagnetic\_Calorimeter\_radial\_segment-6),**  **SolidBody 1(Boss-Extrude1)(Barrel\_Electromagnetic\_Calorimeter\_radial\_segment-7),**  **SolidBody 1(Boss-Extrude1)(Barrel\_Electromagnetic\_Calorimeter\_radial\_segment-8),**  **SolidBody 1(Boss-Extrude1)(Barrel\_Electromagnetic\_Calorimeter\_radial\_segment-9)** | | **Curve Data:N/A** | | | |  | |  |  | | --- | --- | | ****Name:**** | **6061-T6 (SS)** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Max von Mises Stress** | | ****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(Cut-Extrude2)(Em\_CAL\_Barrel\_Support\_Rack\_15\_Matrix-1),**  **SolidBody 1(Cut-Extrude2)(Em\_CAL\_Barrel\_Support\_Rack\_15\_Matrix-10),**  **SolidBody 1(Cut-Extrude2)(Em\_CAL\_Barrel\_Support\_Rack\_15\_Matrix-11),**  **SolidBody 1(Cut-Extrude2)(Em\_CAL\_Barrel\_Support\_Rack\_15\_Matrix-12),**  **SolidBody 1(Cut-Extrude2)(Em\_CAL\_Barrel\_Support\_Rack\_15\_Matrix-2),**  **SolidBody 1(Cut-Extrude2)(Em\_CAL\_Barrel\_Support\_Rack\_15\_Matrix-3),**  **SolidBody 1(Cut-Extrude2)(Em\_CAL\_Barrel\_Support\_Rack\_15\_Matrix-4),**  **SolidBody 1(Cut-Extrude2)(Em\_CAL\_Barrel\_Support\_Rack\_15\_Matrix-5),**  **SolidBody 1(Cut-Extrude2)(Em\_CAL\_Barrel\_Support\_Rack\_15\_Matrix-6),**  **SolidBody 1(Cut-Extrude2)(Em\_CAL\_Barrel\_Support\_Rack\_15\_Matrix-7),**  **SolidBody 1(Cut-Extrude2)(Em\_CAL\_Barrel\_Support\_Rack\_15\_Matrix-8),**  **SolidBody 1(Cut-Extrude2)(Em\_CAL\_Barrel\_Support\_Rack\_15\_Matrix-9),**  **SolidBody 1(Cut-Extrude1)(Em\_CAL\_Barrel\_Support\_Thicker\_Ring-1),**  **SolidBody 1(Cut-Extrude1)(Em\_CAL\_Barrel\_Support\_Thicker\_Ring-3)** | | **Curve Data:N/A** | | | |

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| **Loads and Fixtures**  | ****Fixture name**** | ****Fixture Image**** | ****Fixture Details**** | | --- | --- | --- | | **Fixed-1** |  | |  |  | | --- | --- | | Entities: | **48 face(s)** | | Type: | **Fixed Geometry** | | | ****Resultant Forces****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Reaction force(N)** | **-103.322** | **81,268.3** | **0.0685501** | **81,268.3** | | **Reaction Moment(N.m)** | **0** | **0** | **0** | **0** | | | | | **Roller/Slider-1** |  | |  |  | | --- | --- | | Entities: | **5 face(s)** | | Type: | **Roller/Slider** | | | ****Resultant Forces****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Reaction force(N)** | **-4,879.78** | **219,056** | **0** | **219,110** | | **Reaction Moment(N.m)** | **0** | **0** | **0** | **0** | | | |  | ****Load name**** | ****Load Image**** | ****Load Details**** | | --- | --- | --- | | **Gravity-1** |  | |  |  | | --- | --- | | Reference: | **Top Plane** | | Values: | **0 0 -9.81** | | Units: | **m/s^2** | | |

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| Contact Information  | Contact | Contact Image | Contact 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 | 0.167113 m | | Minimum element size | 0.061676 m | | Mesh Quality | High | | Remesh failed parts independently | Off |  Mesh information - Details  |  |  | | --- | --- | | Total Nodes | 436560 | | Total Elements | 220572 | | Maximum Aspect Ratio | 1,708 | | % of elements with Aspect Ratio < 3 | 15.4 | | Percentage of elements with Aspect Ratio > 10 | 46.8 | | Percentage of distorted elements | 0 | | Time to complete mesh(hh;mm;ss): | 00:00:48 | | Computer name: |  |  Mesh Control Information:  | **Mesh Control Name** | **Mesh Control Image** | **Mesh Control Details** | | --- | --- | --- | | **Control-1987** |  | |  |  | | --- | --- | | Entities: | **12 Solid Body (s)** | | Units: | **m** | | Size: | **0.0685289** | | Ratio: | **0.0685289** | | | **Control-1988** |  | |  |  | | --- | --- | | Entities: | **12 component(s)** | | Units: | **m** | | Size: | **0.0835566** | | Ratio: | **0.0835566** | | |

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| Resultant ForcesReaction forces  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | N | -4,983.1 | 300,324 | -8,303.06 | 300,480 |  Reaction Moments  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | N.m | 0 | 0 | 0 | 0 | |
| Free body forces  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | N | 0 | 0 | 0 | 0 |  Free body moments  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | N.m | 0 | 0 | 0 | 0 | |

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| Study Results  | Name | Type | Min | Max | | --- | --- | --- | --- | | Stress1 | VON: von Mises Stress | 3.8e-04N/mm^2 (MPa)  Node: 39648 | 7.4e+01N/mm^2 (MPa)  Node: 307775 | | **Em\_Cal\_Mesh\_15\_Comparison&Analysis-Liniar\_Static\_01-Stress-Stress1** | | | |  | Name | Type | Min | Max | | --- | --- | --- | --- | | Displacement1 | URES: Resultant Displacement | 0mm  Node: 432343 | 1mm  Node: 17045 | | **Em\_Cal\_Mesh\_15\_Comparison&Analysis-Liniar\_Static\_01-Displacement-Displacement1** | | | |  | Name | Type | Min | Max | | --- | --- | --- | --- | | Displacement2 | URES: Resultant Displacement | 0mm  Node: 432343 | 1.01mm  Node: 17045 | | **Em\_Cal\_Mesh\_15\_Comparison&Analysis-Liniar\_Static\_01-Displacement-Displacement2** | | | |      |  | | --- | |  | | **Image-1** | | **Image Comments:** | | In this image you can see the direction of displacement to estimate the position of support in the next model. | |
| Conclusion |

The motivation for this was to save the volume of material that would interfere with the operation of the detector. I took the No. 7 mesh that passed the aluminum test and compressed it while reducing the thickness of the beams evenly. The calculated volume is 0.57 cubic meters. Improving the following model can be done in the form of reducing gaps between the beams and reducing their uniform thickness.