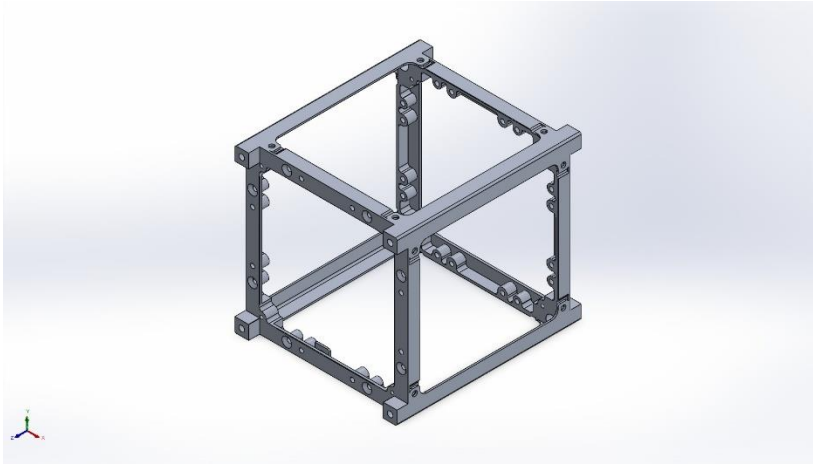


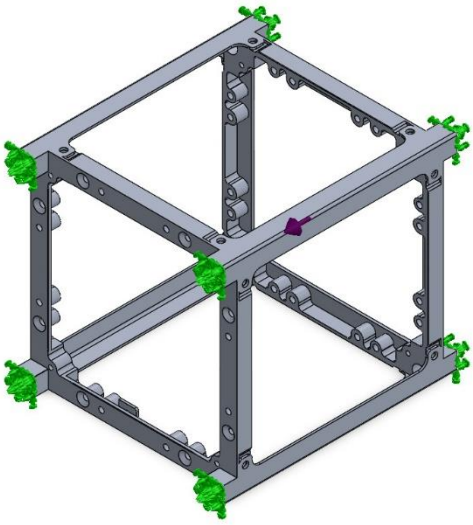
1Unit CubeSat

Simulation of 1Unit CubeSat Aluminum

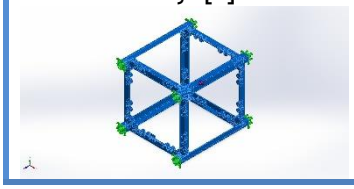
Designer: KSF Space
Study name: Dynamic
Analysis type: Linear dynamic analysis (Random Vibration)

Table of Contents

Model Information



Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties
Body1[1] 	Solid Body	**Mass:0.0938515 kg** **Volume:3.47598e-05 m^3** **Density:2,700 kg/m^3** **Weight:0.919744 N**

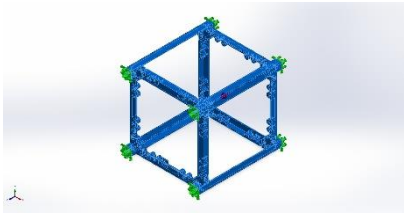
Study Properties

Study name	Dynamic 1
Analysis type	Linear dynamic analysis (Random Vibration)
Mesh type	Solid Mesh
Number of frequencies	15
Decouple the mixed free body modes	Off
Solver type	FFEPlus
Soft Spring:	Off
Incompatible bonding options	Automatic
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Lower frequency limit	20 Hz
Upper frequency limit	3,000 Hz
Number of output frequencies	10
Correlation	Fully correlated

Units

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

Material Properties

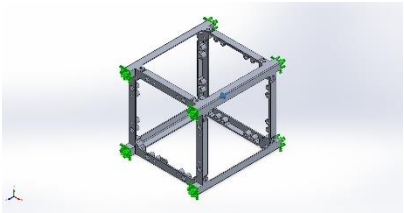
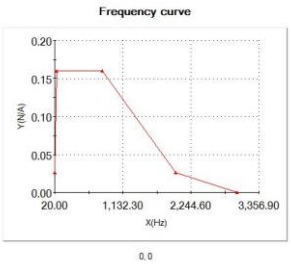
Model Reference	Properties	Components
	**Name:** 6061-T6 (SS) **Model type:** Linear Elastic Isotropic **Default failure criterion:** Max von Mises Stress **Yield strength:** 2.75e+08 N/m^2 **Tensile strength:** 3.1e+08 N/m^2 **Elastic modulus:** 6.9e+10 N/m^2 **Poisson's ratio:** 0.33 **Mass density:** 2,700 kg/m^3 **Shear modulus:** 2.6e+10 N/m^2 **Thermal expansion coefficient:** 2.4e-05 /Kelvin	SolidBody 1(Body1[1])(1 units solid)
Curve Data:N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-2		**Entities:** 8 face(s) **Type:** Fixed Geometry

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	1.17496e-13	1.16099e-13	2.12142e-12	2.12784e-12
Reaction Moment(N.m)	0	0	0	0

Load name	Load Image	Load Details	Function Curve
Base Excitation-1		**Type:** Acceleration **Translation:** ---, ---, 1 **Units:** in **Phase Angle:** 0 **Units:** deg	 Frequency curve

Mesh information

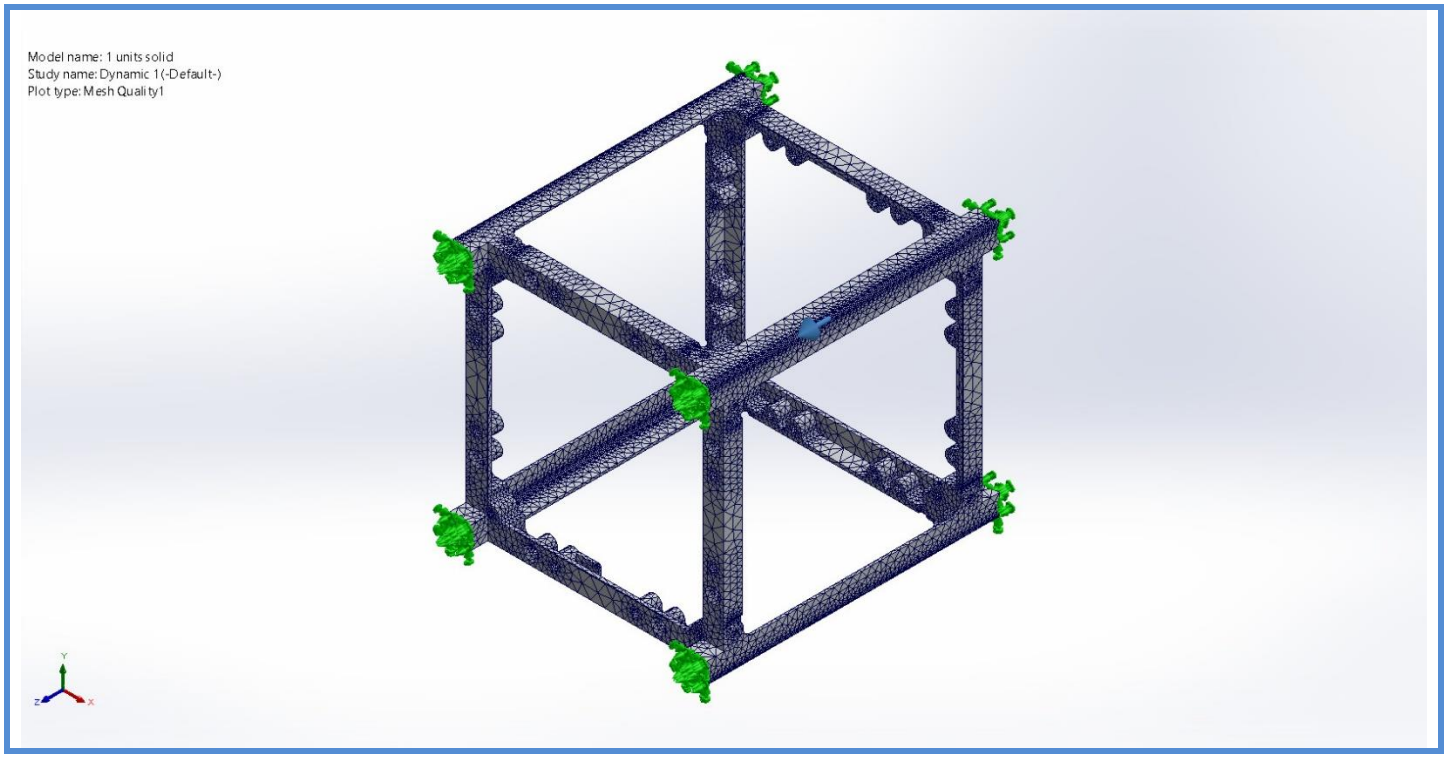
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	8.30303 mm
Minimum element size	0.415152 mm
Mesh Quality	High

Mesh information - Details

Total Nodes	223944
Total Elements	131509
Maximum Aspect Ratio	30.744
% of elements with Aspect Ratio < 3	94.6
Percentage of elements with Aspect Ratio > 10	0.437
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:17
Computer name:	

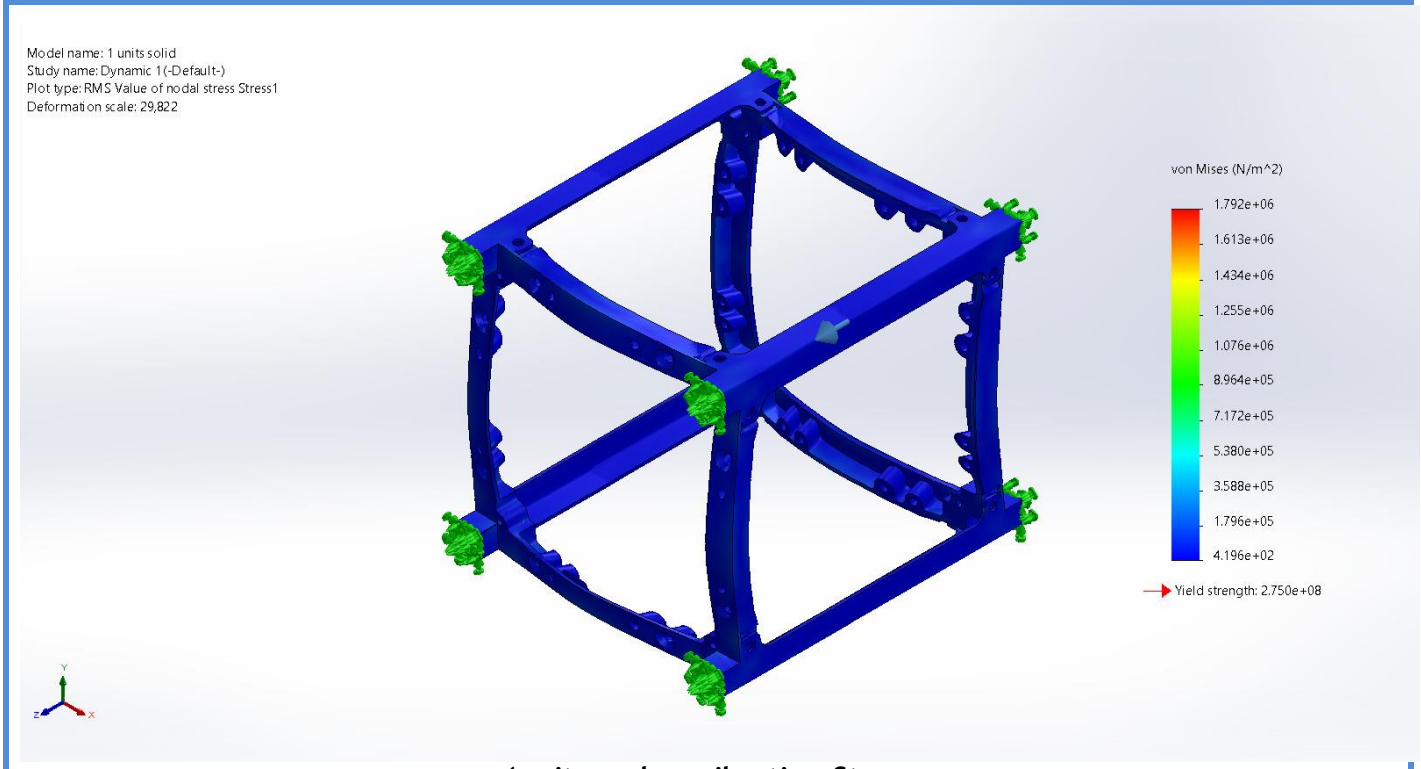
Mesh Quality Plots

Name	Type	Min	Max
Quality1	Mesh	-	-



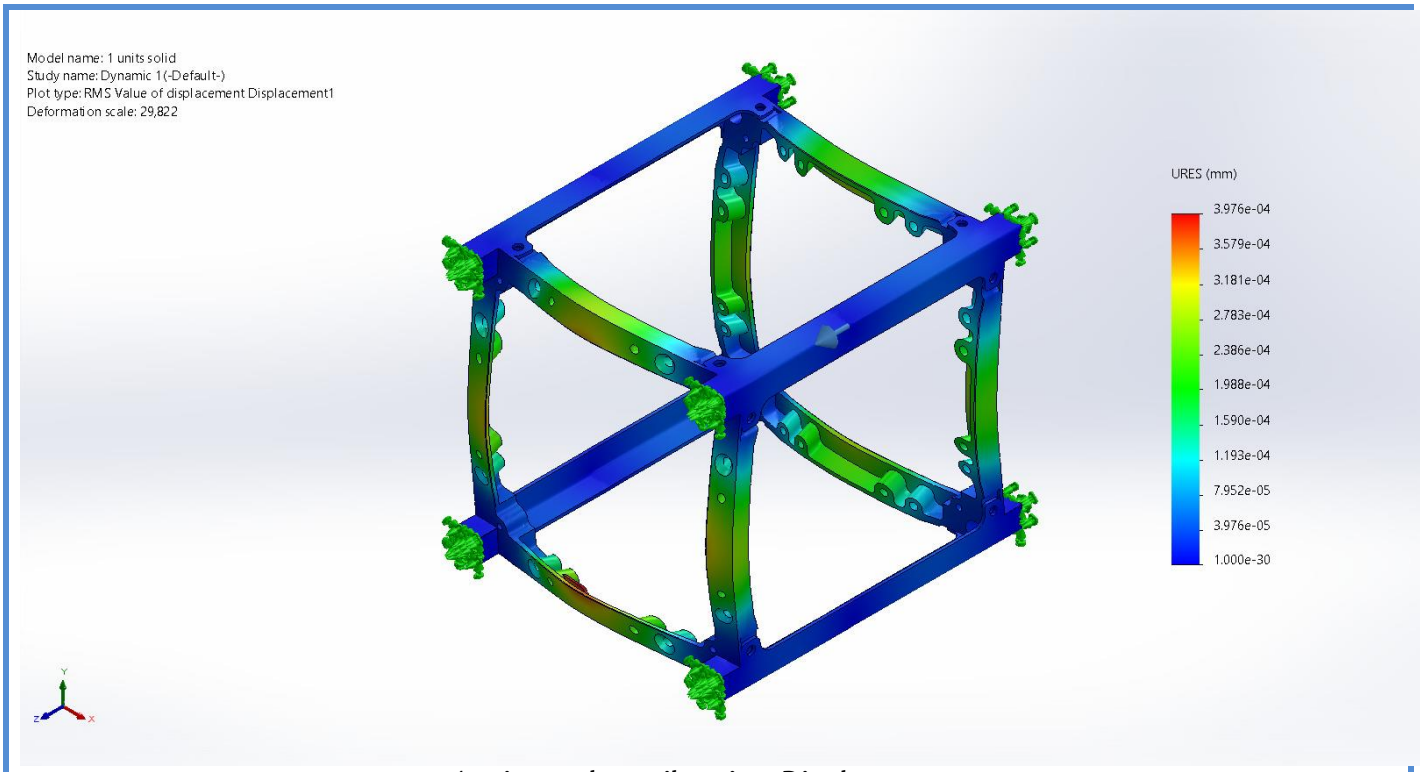
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	4.196e+02N/m^2 Node: 188893	1.792e+06N/m^2 Node: 48297



1unit-random vibration-Stress

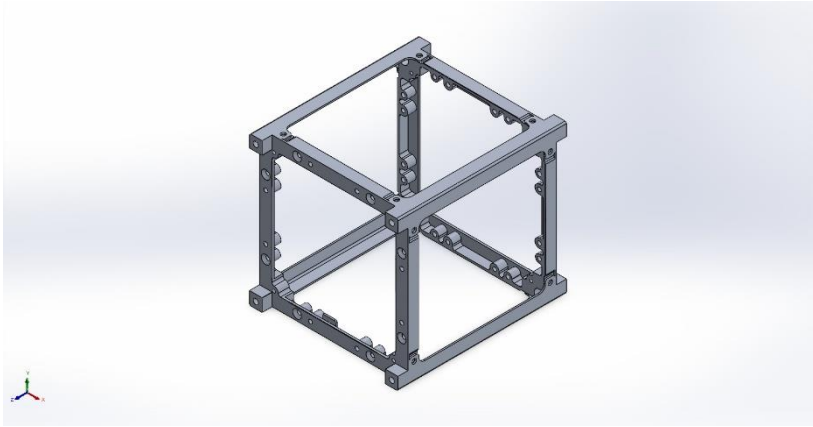
Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 131	3.976e-04mm Node: 142249



1unit-random vibration-Displacement

Mass Participation (Normalized)

Mode Number	Frequency(Hertz)	X direction	Y direction	Z direction
1	2,458.1	7.8015e-05	0.00034959	7.8394e-07
2	2,461.6	0.0020548	0.041623	3.9979e-07
3	2,461.7	0.041112	0.0017259	2.7334e-08
4	2,463	0.0007928	0.00060083	1.1754e-09
5	3,231.5	2.5837e-06	9.8543e-05	0.00046215
6	3,264.4	8.6647e-08	1.0671e-06	4.0404e-05
7	3,322.8	9.9393e-06	0.0027969	0.00014271
8	3,334.2	4.2587e-05	0.02796	7.7071e-05
9	3,338	0.035725	4.126e-05	1.128e-07
10	3,390.9	1.1693e-09	2.2617e-06	2.6981e-07
11	3,557.9	3.0653e-05	0.043754	0.0037083
12	3,598.5	4.0121e-10	1.3392e-06	1.5941e-07
13	3,616.4	0.00032108	0.14377	0.00032719
14	3,625.7	0.18381	0.00033125	6.2534e-08
15	3,809.7	1.5189e-06	0.0013116	0.35025
		Sum X = 0.26399	Sum Y = 0.26436	Sum Z = 0.35501



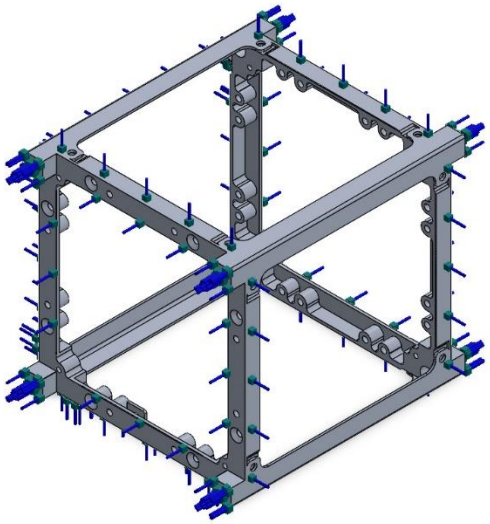
1Unit CubeSat

Simulation of of 1Unit CubeSat Aluminum

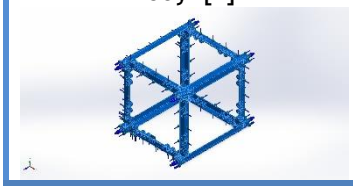
Designer: KSF
Study name: Thermal
Analysis type: Thermal(Steady state)

Table of Contents

Model Information



Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties
Body1[1] 	Solid Body	**Mass:0.0938515 kg** **Volume:3.47598e-05 m^3** **Density:2,700 kg/m^3** **Weight:0.919744 N**

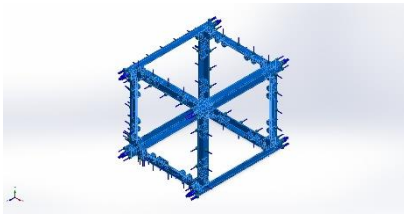
Study Properties

Study name	Thermal 2
Analysis type	Thermal(Steady state)
Mesh type	Solid Mesh
Solver type	FFEPlus
Solution type	Steady state
Contact resistance defined?	No

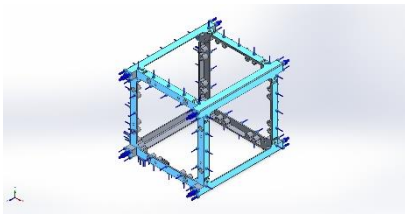
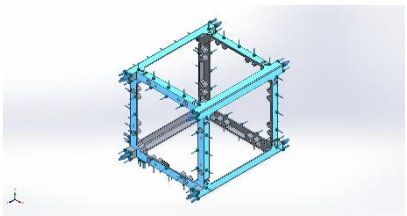
Units

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

Material Properties

Model Reference	Properties	Components
	**Name:** 6061-T6 (SS) **Model type:** Linear Elastic Isotropic **Default failure criterion:** Max von Mises Stress **Thermal conductivity:** 166.9 W/(m.K) **Specific heat:** 896 J/(kg.K) **Mass density:** 2,700 kg/m^3	SolidBody 1(Body1[1])(1 units solid)
Curve Data:N/A		

Thermal Loads

Load name	Load Image	Load Details
Radiation-2		**Entities:** 14 face(s) **Radiation Type:** Surface to ambient **Ambient Temperature:** 3 Kelvin **Emissivity:** 0.8 **View Factor:** 0.5
Temperature-1		**Entities:** 14 face(s) **Temperature:** 80 Celsius

Mesh information

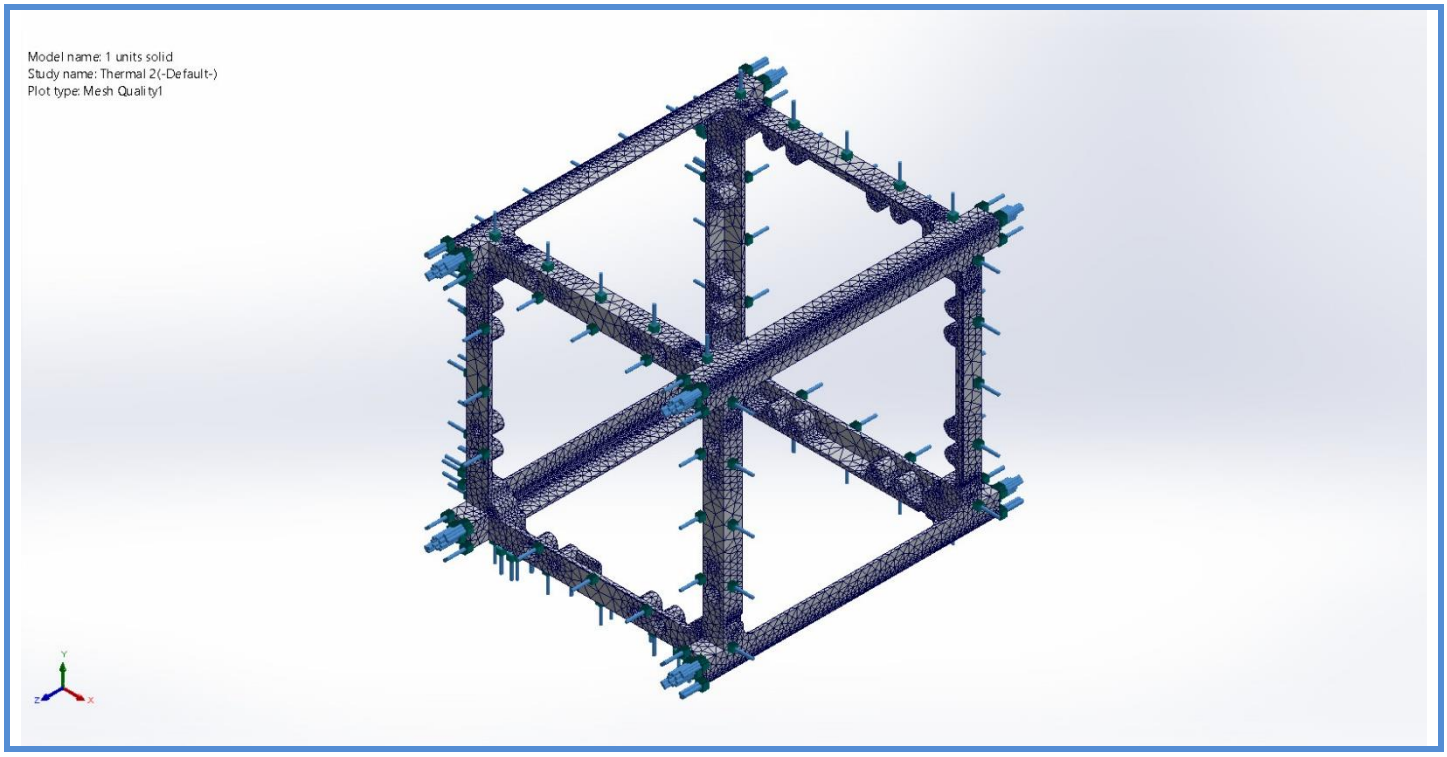
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	8.30303 mm
Minimum element size	0.415152 mm
Mesh Quality	High

Mesh information - Details

Total Nodes	223944
Total Elements	131509
Maximum Aspect Ratio	30.744
% of elements with Aspect Ratio < 3	94.6
Percentage of elements with Aspect Ratio > 10	0.437
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:17
Computer name:	

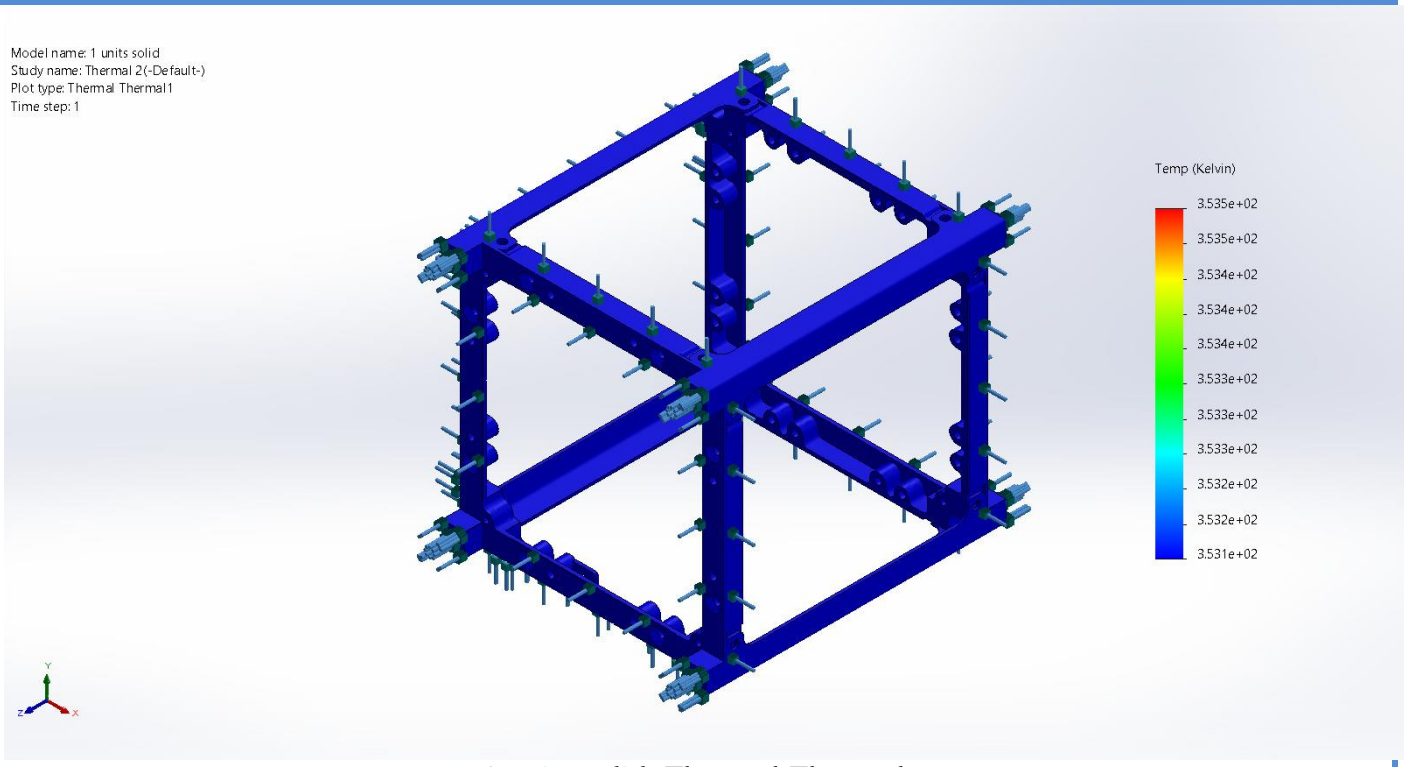
Mesh Quality Plots

Name	Type	Min	Max
Quality1	Mesh	-	-

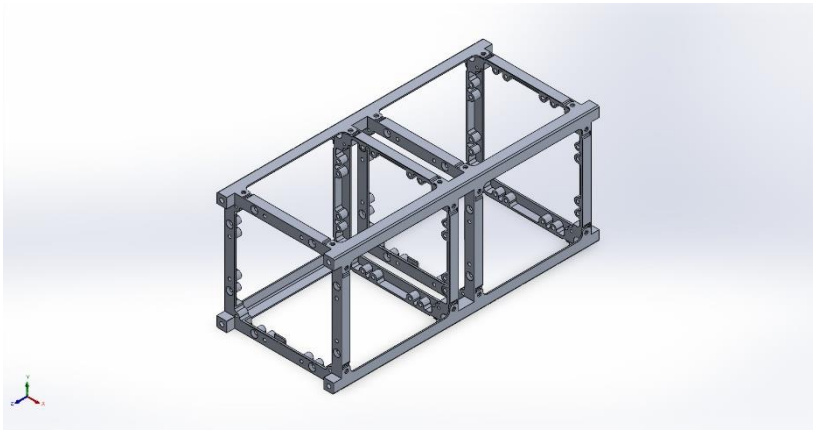


Study Results

Name	Type	Min	Max
Thermal1	TEMP: Temperature	3.531e+02Kelvin Node: 1	3.531e+02Kelvin Node: 1



1 units solid- Thermal-Thermal



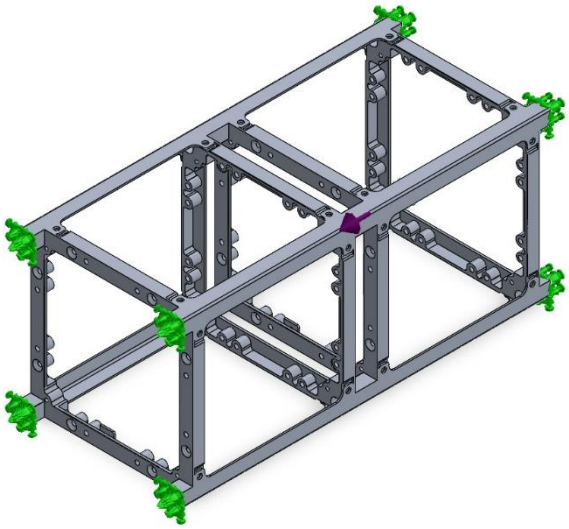
2 Units CubeSat

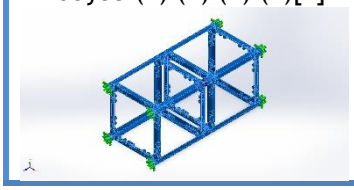
Simulation of 2 Units CubeSat Aluminum

Designer: KSF
Study name: Dynamic
Analysis type: Linear dynamic analysis (Random Vibration)

Table of Contents

Model Information



Solid Bodies		
Document Name and Reference	**Treated As**	**Volumetric Properties**
Body35 (2) (2) (1) (1)[1] 	Solid Body	**Mass:0.187703 kg** **Volume:6.95196e-05 m^3** **Density:2,700 kg/m^3** **Weight:1.83949 N**

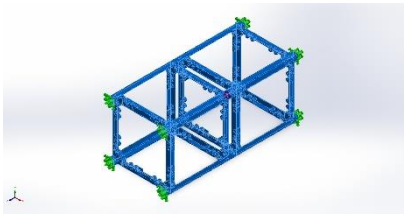
Study Properties

Study name	Dynamic 1
Analysis type	Linear dynamic analysis (Random Vibration)
Mesh type	Solid Mesh
Number of frequencies	15
Decouple the mixed free body modes	Off
Solver type	FFEPlus
Soft Spring:	Off
Incompatible bonding options	Automatic
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Lower frequency limit	20 Hz
Upper frequency limit	3,000 Hz
Number of output frequencies	10
Correlation	Fully correlated

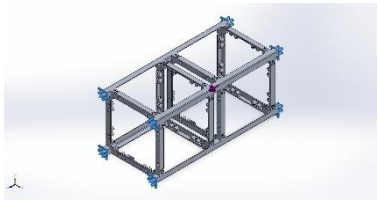
Units

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

Material Properties

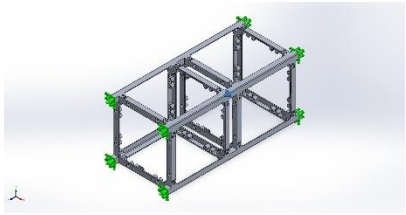
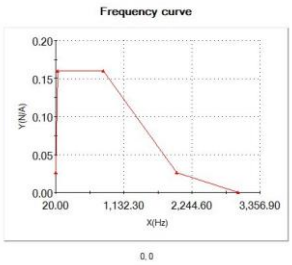
Model Reference	Properties	Components
	**Name:** 6061-T6 (SS) **Model type:** Linear Elastic Isotropic **Default failure criterion:** Unknown **Yield strength:** 2.75e+08 N/m^2 **Tensile strength:** 3.1e+08 N/m^2 **Elastic modulus:** 6.9e+10 N/m^2 **Poisson's ratio:** 0.33 **Mass density:** 2,700 kg/m^3 **Shear modulus:** 2.6e+10 N/m^2 **Thermal expansion coefficient:** 2.4e-05 /Kelvin	SolidBody 1(Body35 (2) (2) (1) (1)[1])(2 UNITS (2).step)
Curve Data:N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 8 face(s) **Type:** Fixed Geometry

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	1.42004e-13	1.55066e-13	3.22354e-12	3.23039e-12
Reaction Moment(N.m)	0	0	0	0

Load name	Load Image	Load Details	Function Curve
Base Excitation-1		**Type:** Acceleration **Translation:** ---, ---, 1 **Units:** in **Phase Angle:** 0 **Units:** deg	 Frequency curve

Mesh information

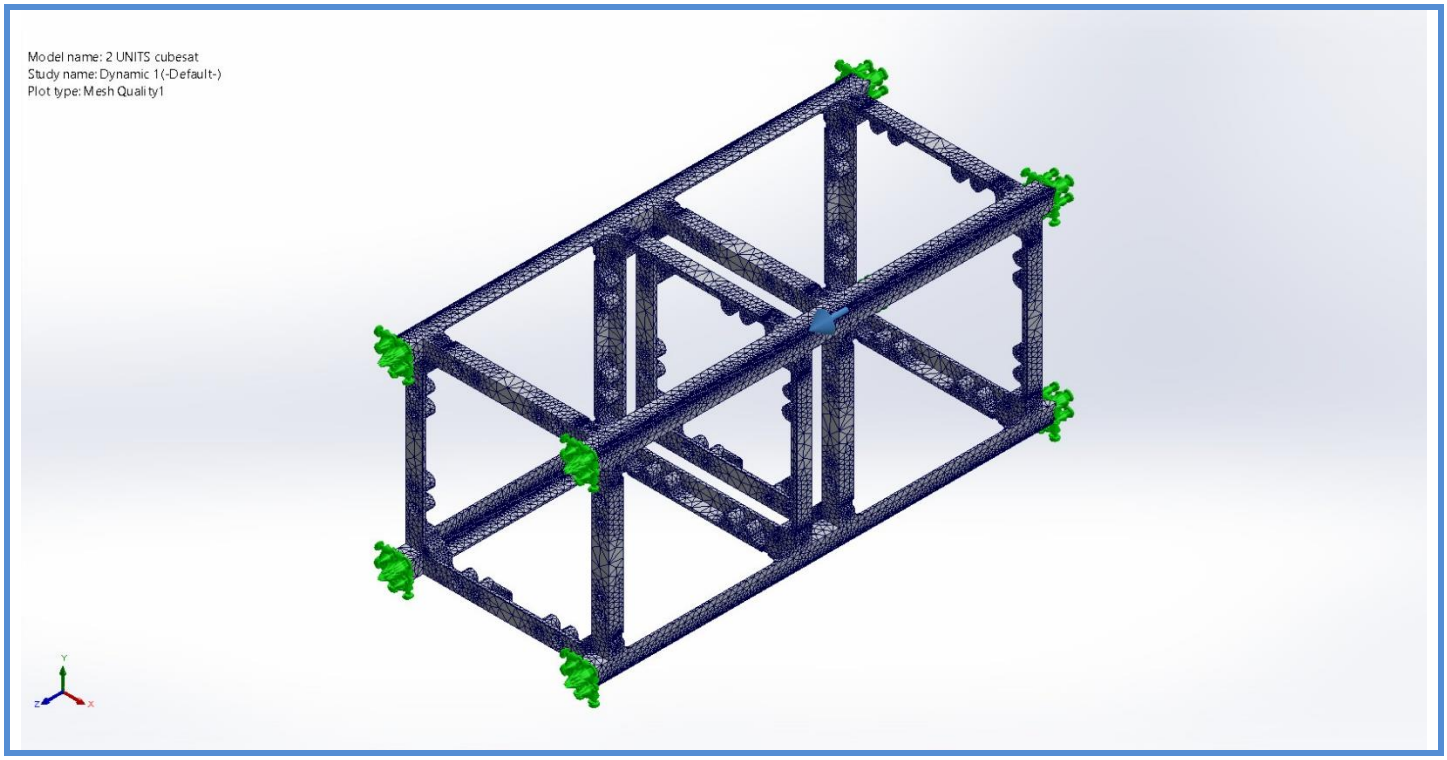
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	11.7076 mm
Minimum element size	0.585379 mm
Mesh Quality	High

Mesh information - Details

Total Nodes	423549
Total Elements	247908
Maximum Aspect Ratio	36.722
% of elements with Aspect Ratio < 3	95.2
Percentage of elements with Aspect Ratio > 10	0.41
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:28
Computer name:	

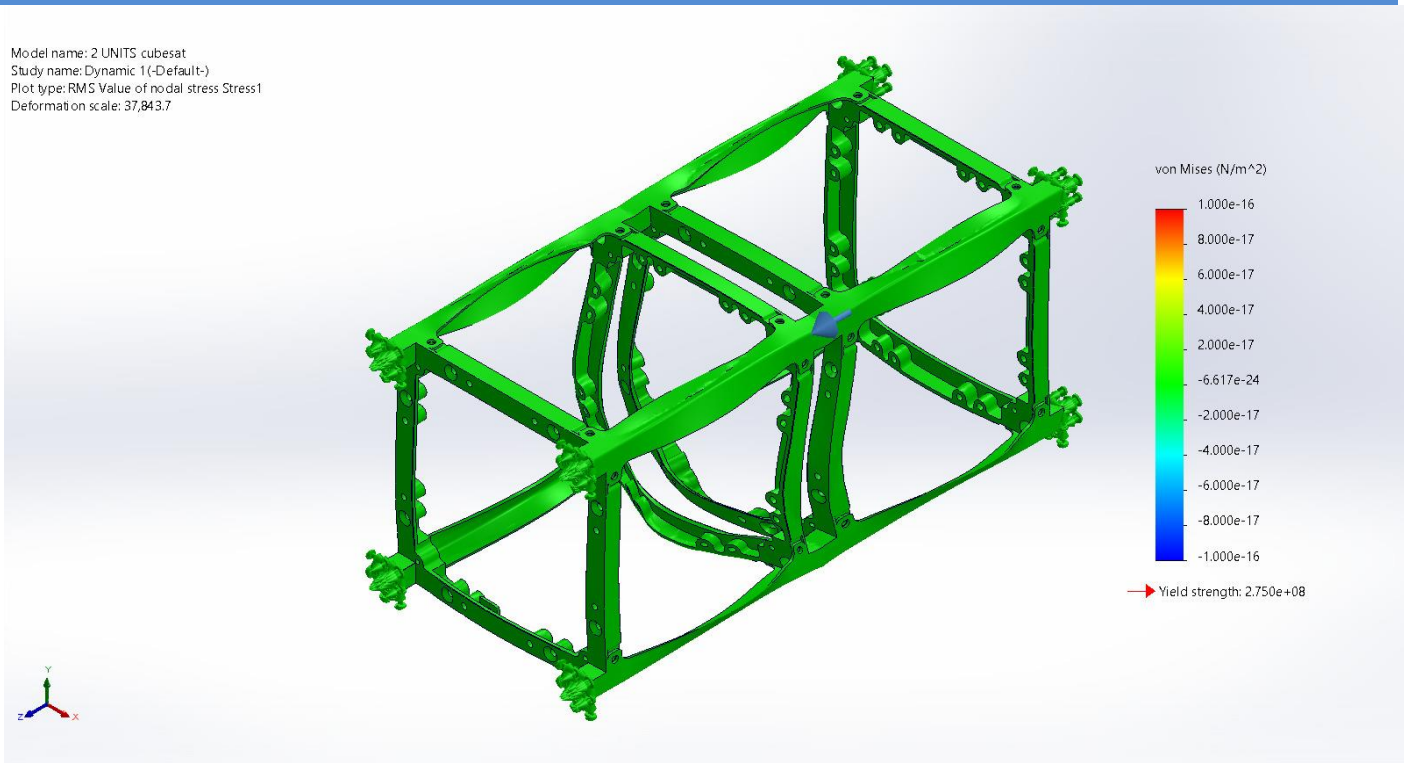
Mesh Quality Plots

Name	Type	Min	Max
Quality1	Mesh	-	-



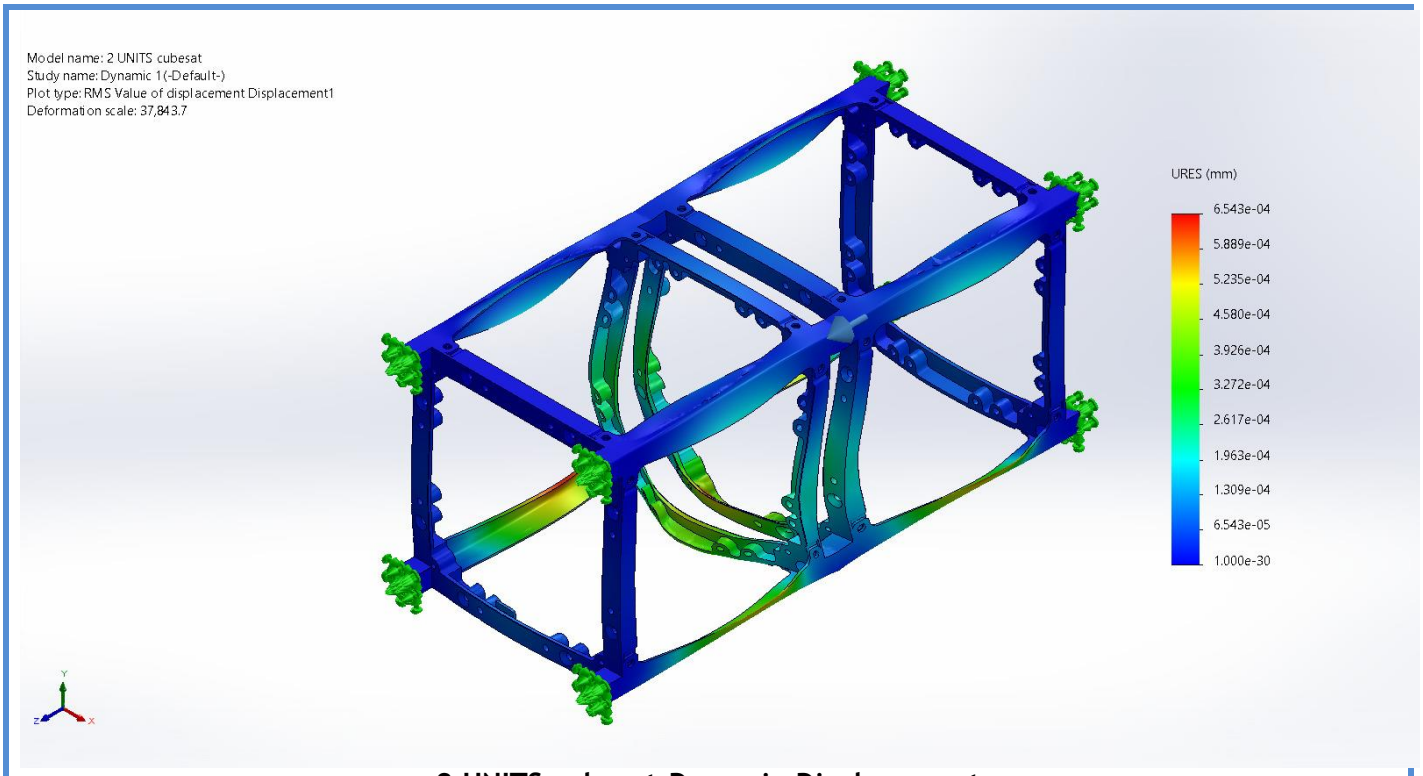
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	0.000e+00N/m^2 Node: 1	0.000e+00N/m^2 Node: 1



2 UNITS cubesat-Dynamic-Stress

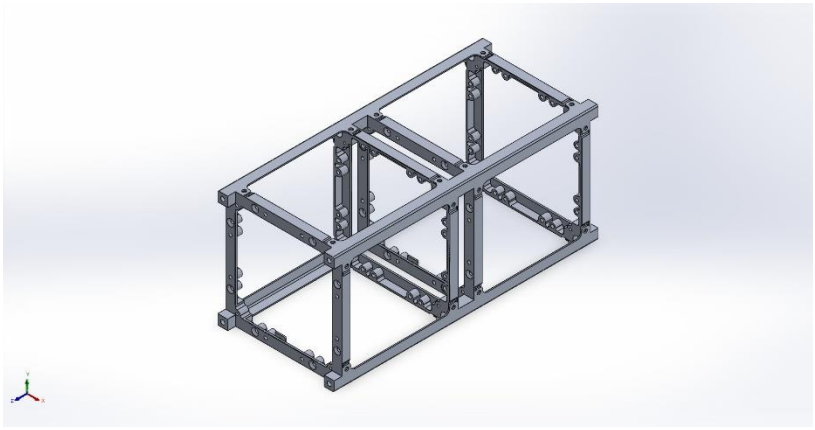
Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 363	6.543e-04mm Node: 5553



2 UNITS cubesat-Dynamic-Displacement

Mass Participation (Normalized)

Mode Number	Frequency(Hertz)	X direction	Y direction	Z direction
1	492.58	0.018487	0.5165	5.2141e-11
2	492.6	0.51649	0.018488	8.4038e-11
3	745.16	8.7797e-07	1.6796e-08	7.1713e-11
4	1,039.5	1.7752e-07	8.4007e-09	5.0926e-11
5	1,774.5	8.5909e-11	2.2285e-07	8.4477e-07
6	2,372.6	7.2071e-09	1.7357e-07	1.5014e-07
7	2,373.2	4.8503e-12	2.7436e-08	1.815e-07
8	2,379.6	3.6835e-08	1.1507e-08	1.5037e-08
9	2,418.6	3.3316e-09	7.0025e-07	2.4698e-06
10	2,474.4	2.4626e-07	2.4113e-06	3.3348e-07
11	2,489.4	0.0035394	0.004725	5.6659e-07
12	2,489.7	0.0047119	0.0035792	1.1063e-06
13	2,527.4	7.428e-08	9.2542e-08	1.6426e-09
14	2,778.7	9.9167e-10	8.8743e-09	0.00036456
15	2,799.8	8.2944e-10	1.7058e-06	0.094166
		Sum X = 0.54323	Sum Y = 0.5433	Sum Z = 0.094536



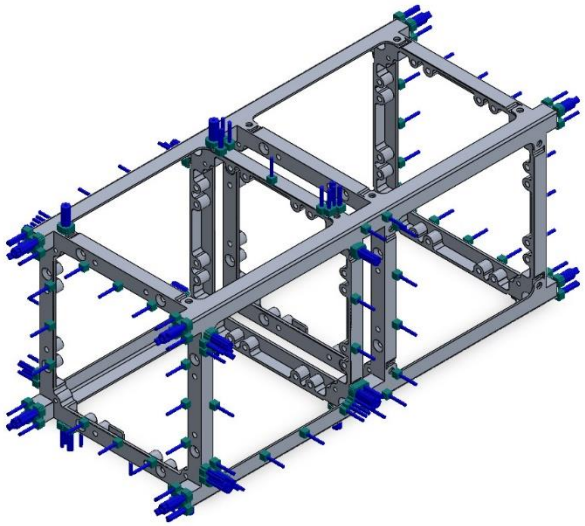
2 Units CubeSat

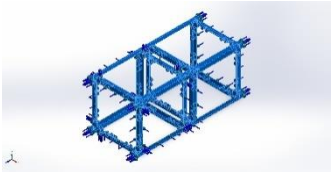
Simulation of 2 Units CubeSat Aluminum

Designer: KSF
Study name: Thermal
Analysis type: Thermal(Steady state)

Table of Contents

Model Information



Solid Bodies		
Document Name and Reference	**Treated As**	**Volumetric Properties**
Body35 (2) (2) (1) (1)[1] 	Solid Body	**Mass:0.187703 kg** **Volume:6.95196e-05 m^3** **Density:2,700 kg/m^3** **Weight:1.83949 N**

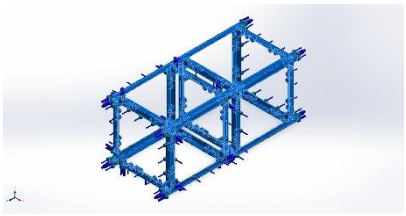
Study Properties

Study name	Thermal 1
Analysis type	Thermal(Steady state)
Mesh type	Solid Mesh
Solver type	FFEPlus
Solution type	Steady state
Contact resistance defined?	No

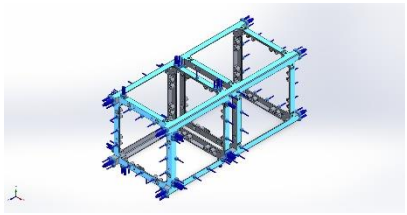
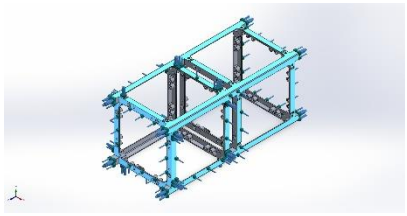
Units

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

Material Properties

Model Reference	Properties	Components
	**Name:** 6061-T6 (SS) **Model type:** Linear Elastic Isotropic **Default failure criterion:** Max von Mises Stress **Thermal conductivity:** 166.9 W/(m.K) **Specific heat:** 896 J/(kg.K) **Mass density:** 2,700 kg/m^3	SolidBody 1(Body35 (2) (2) (1) (1)[1])(2 UNITS (1).step)
Curve Data:N/A		

Thermal Loads

Load name	Load Image	Load Details
Radiation-1		**Entities:** 14 face(s) **Radiation Type:** Surface to ambient **Ambient Temperature:** 3 Kelvin **Emissivity:** 0.8 **View Factor:** 0.5
Temperature-1		**Entities:** 14 face(s) **Temperature:** 80 Celsius

Mesh information

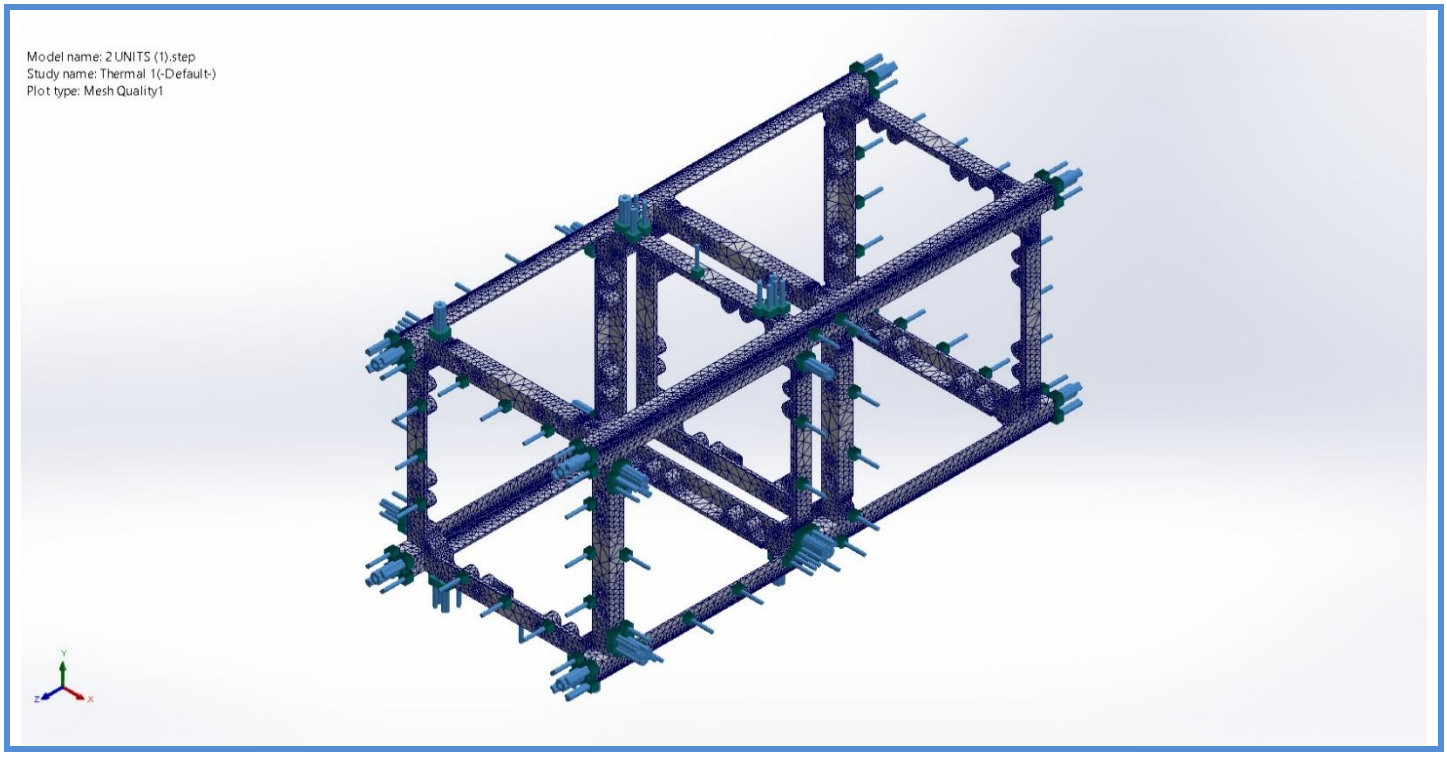
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	11.7076 mm
Minimum element size	0.585379 mm
Mesh Quality	High

Mesh information - Details

Total Nodes	423549
Total Elements	247908
Maximum Aspect Ratio	36.722
% of elements with Aspect Ratio < 3	95.2
Percentage of elements with Aspect Ratio > 10	0.41
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:31
Computer name:	

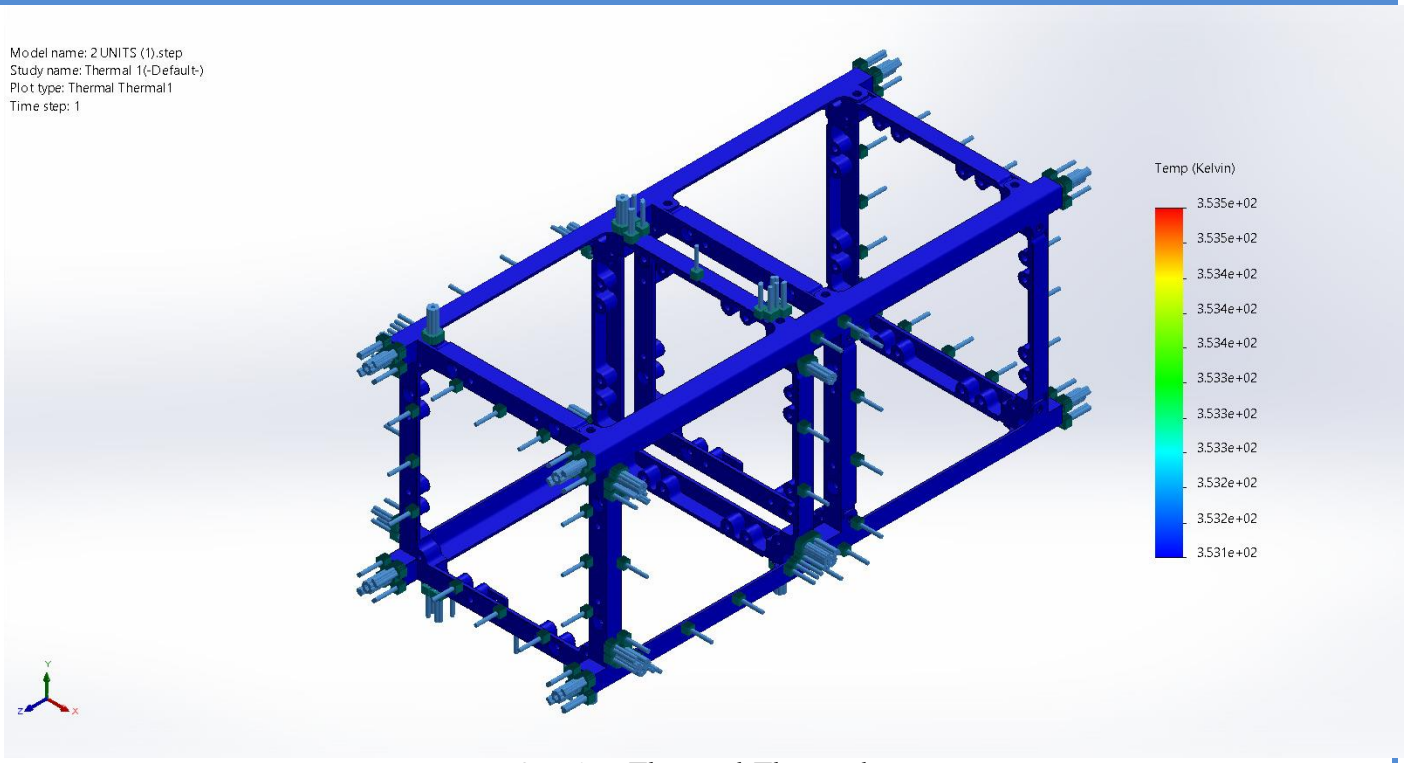
Mesh Quality Plots

Name	Type	Min	Max
Quality1	Mesh	-	-

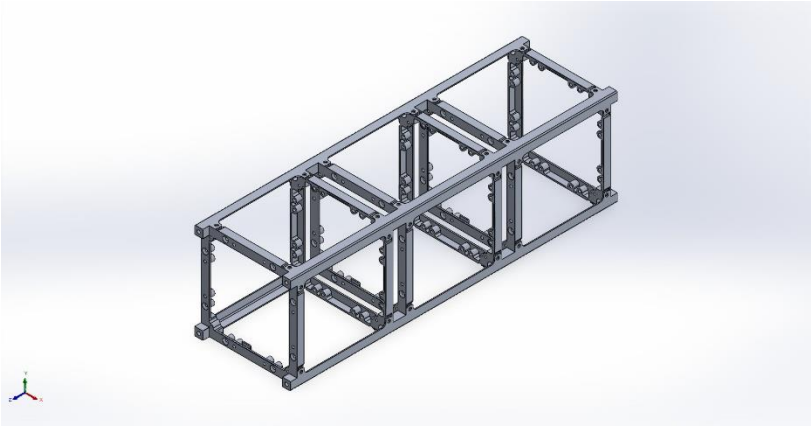


Study Results

Name	Type	Min	Max
Thermal1	TEMP: Temperature	3.531e+02Kelvin Node: 1	3.531e+02Kelvin Node: 1



2 units- Thermal-Thermal



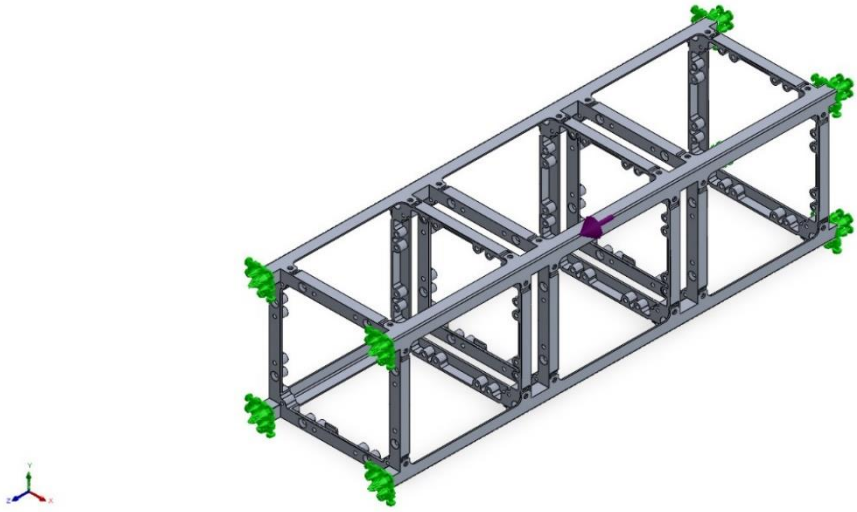
3 Units CubeSat

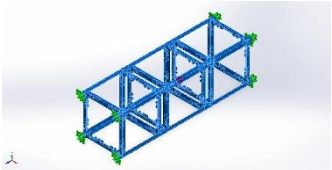
Simulation of 3 Units CubeSat Aluminum

Designer: KSF
Study name: Dynamic
Analysis type: Linear dynamic analysis (Random Vibration)

Table of Contents

Model Information



Solid Bodies		
Document Name and Reference	**Treated As**	**Volumetric Properties**
Body35 (2) (2) (1) (1) (3)[1] 	Solid Body	**Mass:0.281554 kg** **Volume:0.000104279 m^3** **Density:2,700 kg/m^3** **Weight:2.75923 N**

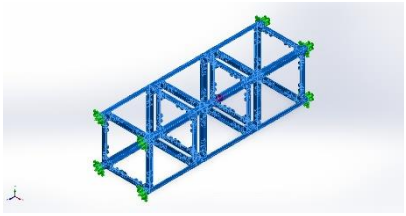
Study Properties

Study name	Dynamic 1
Analysis type	Linear dynamic analysis (Random Vibration)
Mesh type	Solid Mesh
Number of frequencies	15
Decouple the mixed free body modes	Off
Solver type	FFEPlus
Soft Spring:	Off
Incompatible bonding options	Automatic
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Lower frequency limit	20 Hz
Upper frequency limit	3,000 Hz
Number of output frequencies	10
Correlation	Fully correlated

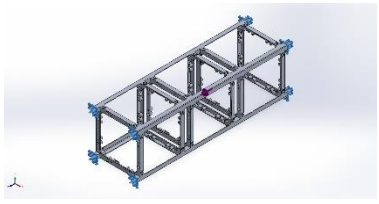
Units

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

Material Properties

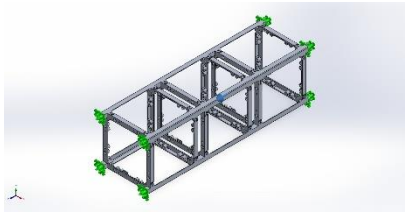
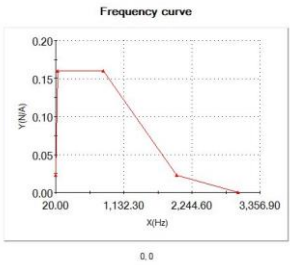
Model Reference	Properties	Components
	**Name:** 6061-T6 (SS) **Model type:** Linear Elastic Isotropic **Default failure criterion:** Unknown **Yield strength:** 2.75e+08 N/m^2 **Tensile strength:** 3.1e+08 N/m^2 **Elastic modulus:** 6.9e+10 N/m^2 **Poisson's ratio:** 0.33 **Mass density:** 2,700 kg/m^3 **Shear modulus:** 2.6e+10 N/m^2 **Thermal expansion coefficient:** 2.4e-05 /Kelvin	SolidBody 1(Body35 (2) (2) (1) (1) (3)[1])(3 units)
Curve Data:N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 8 face(s) **Type:** Fixed Geometry

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	7.02752e-18	7.57904e-18	1.1174e-16	1.12217e-16
Reaction Moment(N.m)	0	0	0	0

Load name	Load Image	Load Details	Function Curve
Base Excitation-1		**Type:** Acceleration **Translation:** ---, ---, 1 **Units:** in **Phase Angle:** 0 **Units:** deg	 Frequency curve

Mesh information

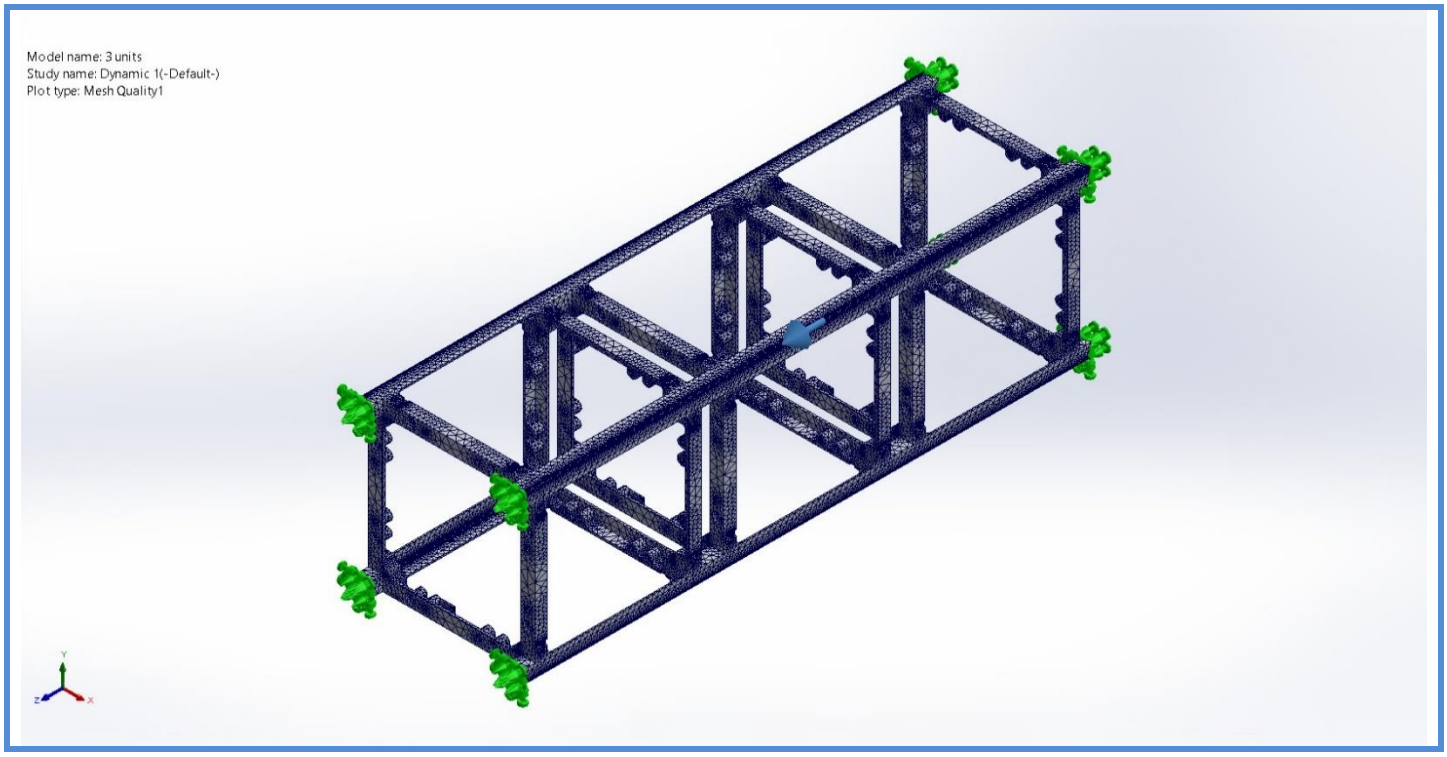
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	14.3246 mm
Minimum element size	0.716231 mm
Mesh Quality	High

Mesh information - Details

Total Nodes	623244
Total Elements	364470
Maximum Aspect Ratio	32.004
% of elements with Aspect Ratio < 3	95
Percentage of elements with Aspect Ratio > 10	0.449
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:48
Computer name:	

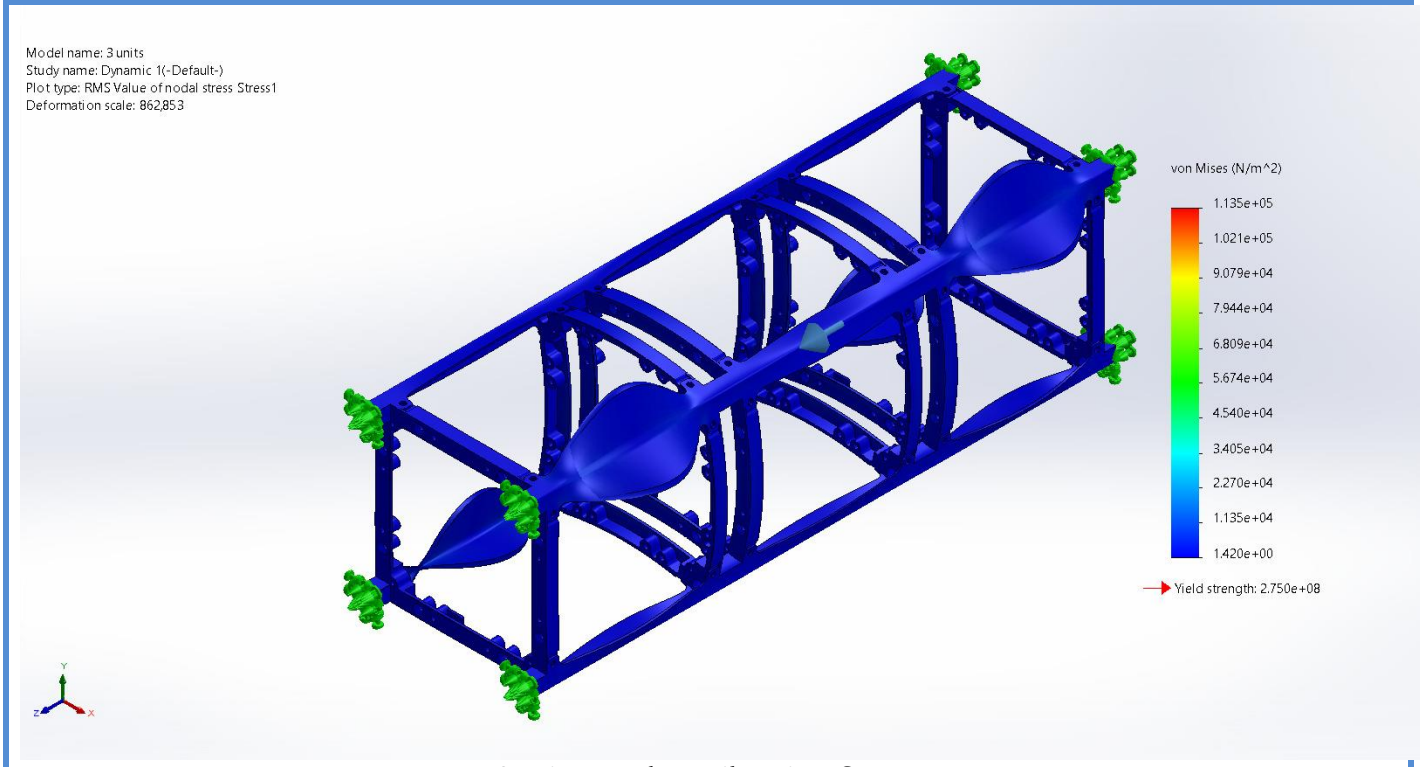
Mesh Quality Plots

Name	Type	Min	Max
Quality1	Mesh	-	-



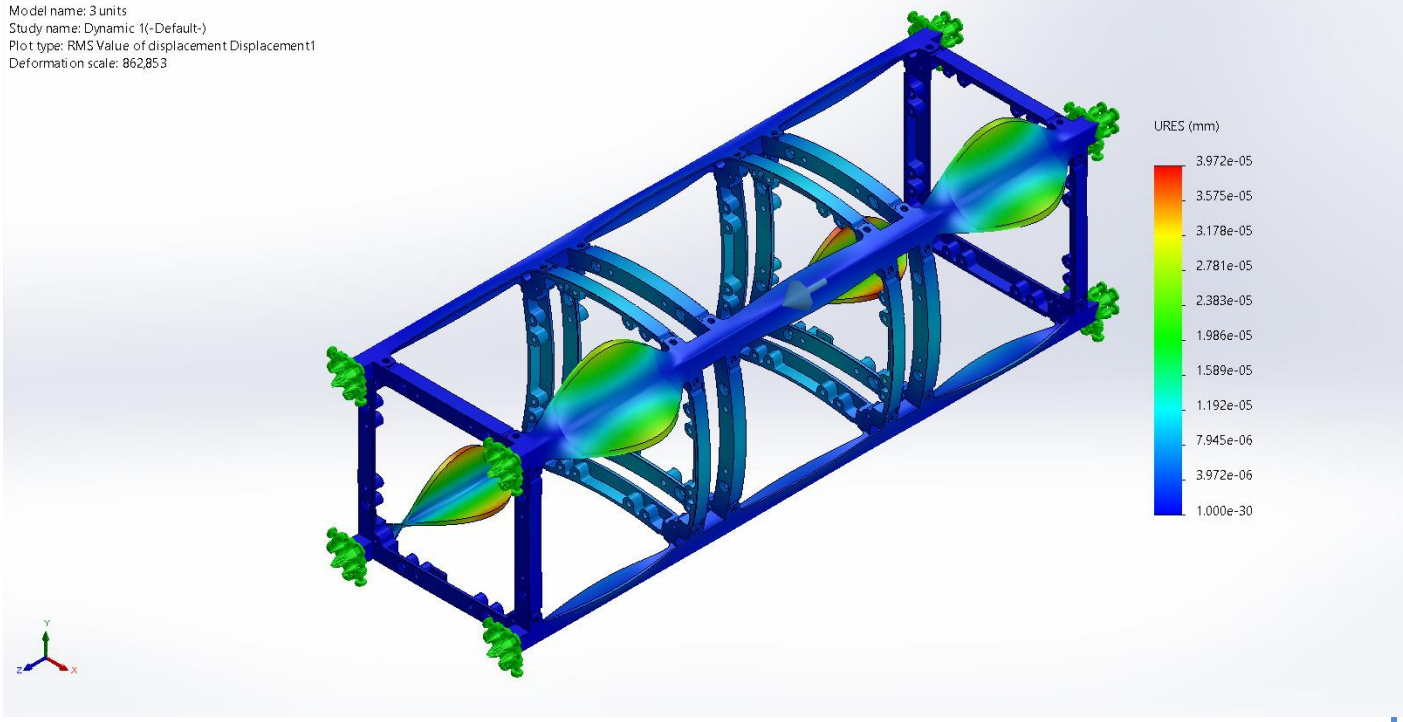
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	1.420e+00N/m^2 Node: 544736	1.135e+05N/m^2 Node: 114318



3units-random vibration-Stress

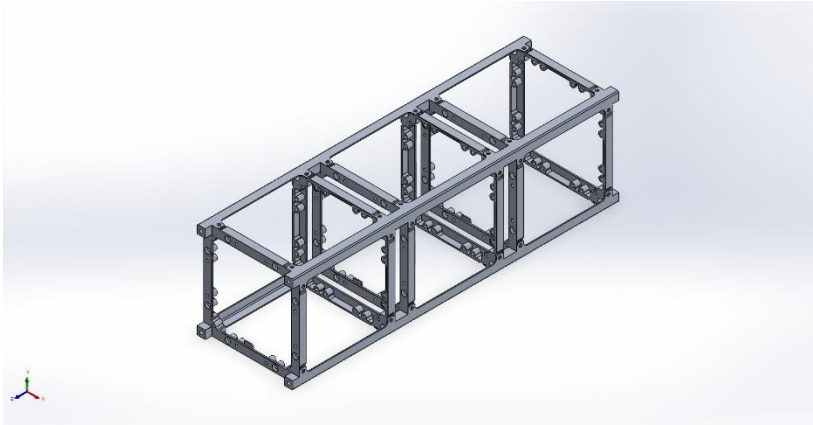
Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 391	3.972e-05mm Node: 53974



3units-random vibration -Displacement

Mass Participation (Normalized)

Mode Number	Frequency(Hertz)	X direction	Y direction	Z direction
1	314.61	0.0021631	0.68148	2.1783e-11
2	314.62	0.68148	0.0021634	3.4252e-15
3	458.41	1.3813e-06	2.6872e-08	4.5858e-11
4	597.3	2.0614e-10	3.6011e-09	9.1619e-11
5	597.32	1.8655e-09	2.0607e-13	2.0219e-10
6	905.32	1.0367e-09	2.3909e-11	4.736e-11
7	998.58	3.2393e-08	1.5703e-09	6.5721e-12
8	1,075.2	2.2061e-09	5.9862e-10	9.6189e-11
9	1,771	8.7884e-13	2.7715e-08	1.6199e-06
10	1,778.2	5.354e-10	1.7379e-07	1.141e-09
11	2,302.4	1.3026e-06	0.01035	6.5366e-10
12	2,303.2	0.010321	1.1786e-06	2.7621e-08
13	2,326	8.4242e-07	1.9193e-11	2.9191e-09
14	2,396.2	9.4856e-09	8.1352e-07	3.5124e-08
15	2,444.7	3.8882e-12	5.8119e-08	2.1139e-05
		Sum X = 0.69397	Sum Y = 0.694	Sum Z = 2.2827e-05



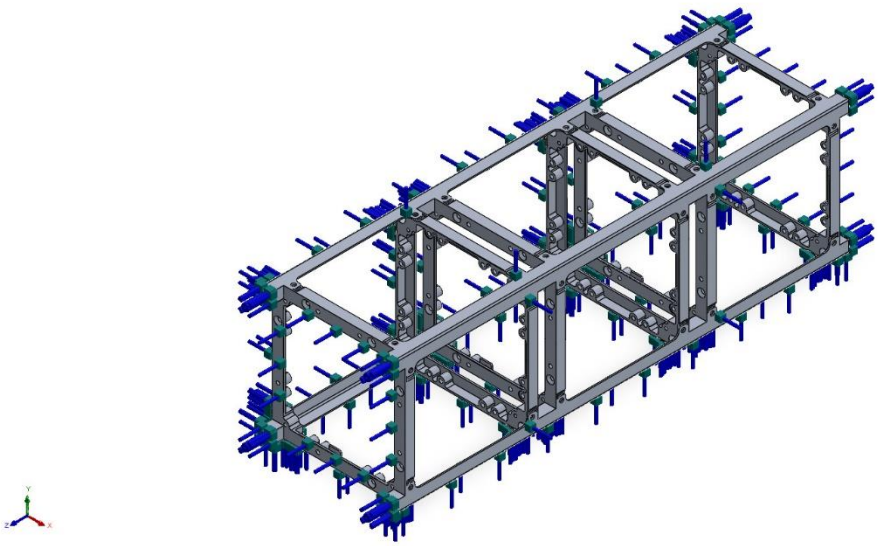
3 Units CubeSat

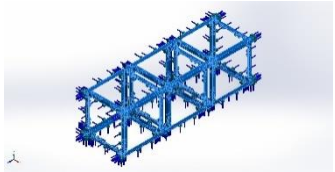
Simulation of 3 units CubeSat Aluminum

Designer: KSF
Study name: Thermal
Analysis type: Thermal(Steady state)

Table of Contents

Model Information



Solid Bodies		
Document Name and Reference	**Treated As**	**Volumetric Properties**
Body35 (2) (2) (1) (1) (3)[1] 	Solid Body	**Mass:0.281554 kg** **Volume:0.000104279 m^3** **Density:2,700 kg/m^3** **Weight:2.75923 N**

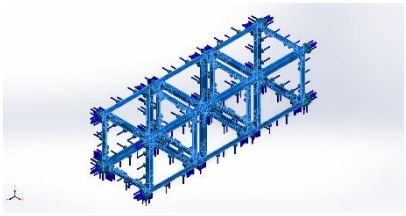
Study Properties

Study name	Thermal 1
Analysis type	Thermal(Steady state)
Mesh type	Solid Mesh
Solver type	FFEPlus
Solution type	Steady state
Contact resistance defined?	No

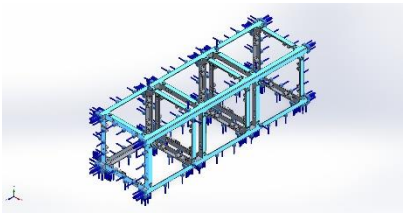
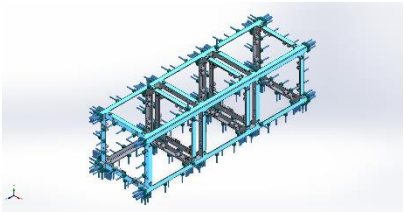
Units

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

Material Properties

Model Reference	Properties	Components
	**Name:** 6061-T6 (SS) **Model type:** Linear Elastic Isotropic **Default failure criterion:** Unknown **Thermal conductivity:** 166.9 W/(m.K) **Specific heat:** 896 J/(kg.K) **Mass density:** 2,700 kg/m^3	SolidBody 1(Body35 (2) (2) (1) (1) (3)[1])(3 units (1))
Curve Data:N/A		

Thermal Loads

Load name	Load Image	Load Details
Radiation-1		**Entities:** 14 face(s) **Radiation Type:** Surface to ambient **Ambient Temperature:** 3 Kelvin **Emissivity:** 0.8 **View Factor:** 0.5
Temperature-1		**Entities:** 14 face(s) **Temperature:** 80 Celsius

Mesh information

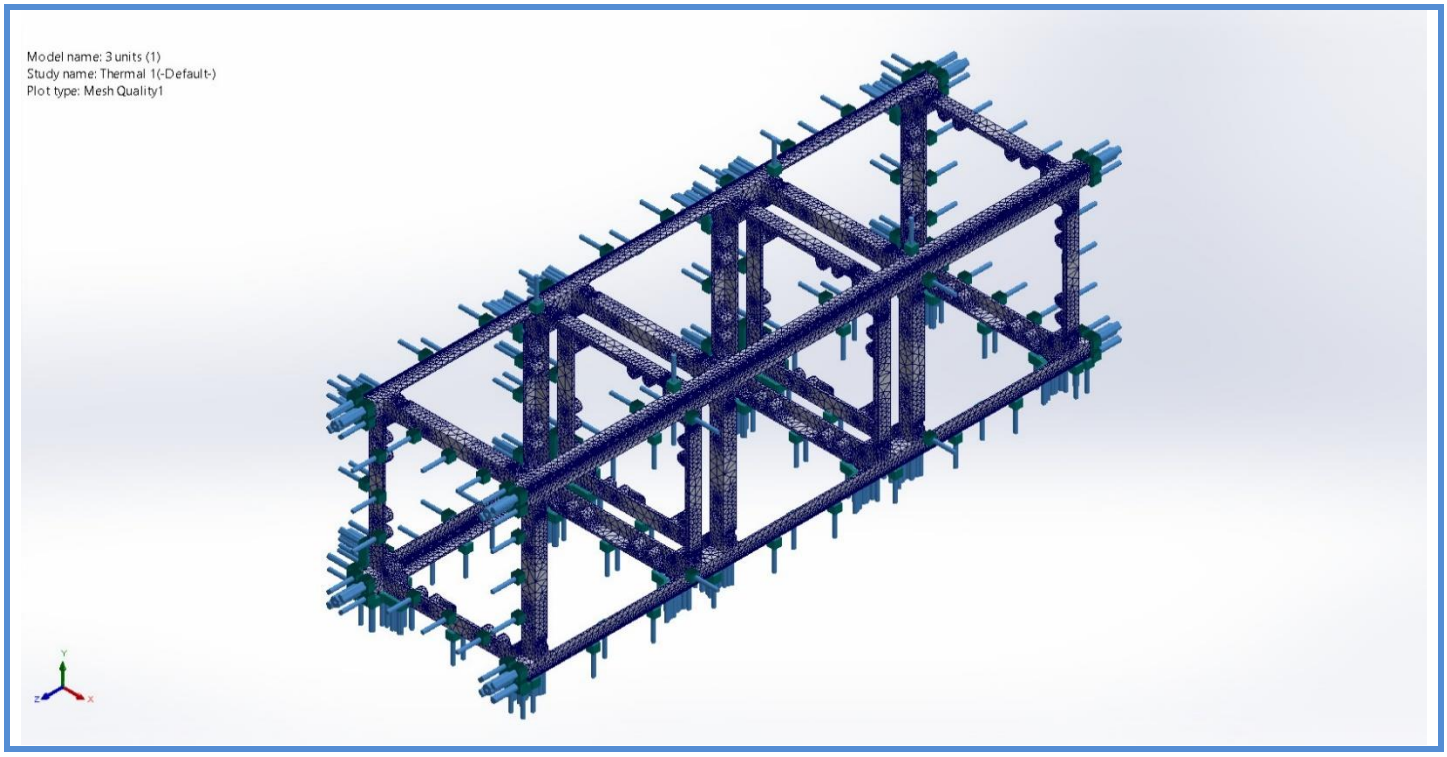
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	14.3246 mm
Minimum element size	0.716231 mm
Mesh Quality	High

Mesh information - Details

Total Nodes	623244
Total Elements	364470
Maximum Aspect Ratio	32.004
% of elements with Aspect Ratio < 3	95
Percentage of elements with Aspect Ratio > 10	0.449
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:45
Computer name:	

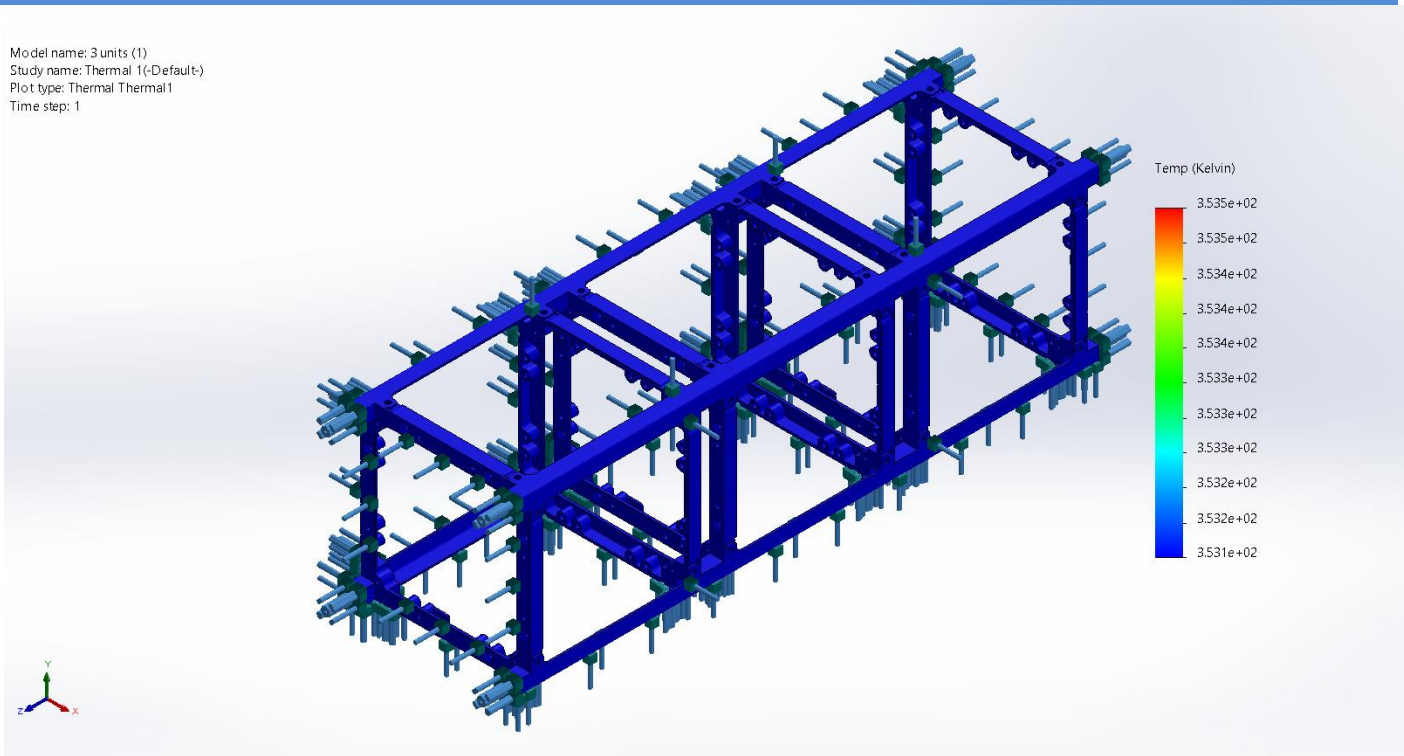
Mesh Quality Plots

Name	Type	Min	Max
Quality1	Mesh	-	-

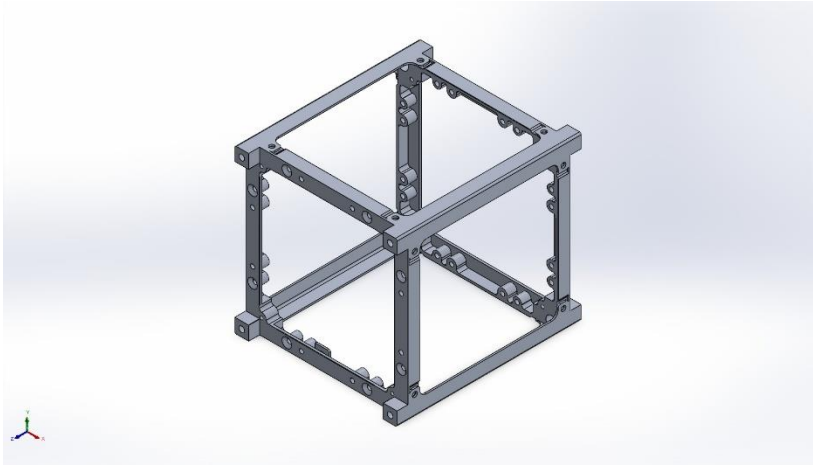


Study Results

Name	Type	Min	Max
Thermal1	TEMP: Temperature	3.531e+02Kelvin Node: 1	3.531e+02Kelvin Node: 1



3 units- Thermal-Thermal



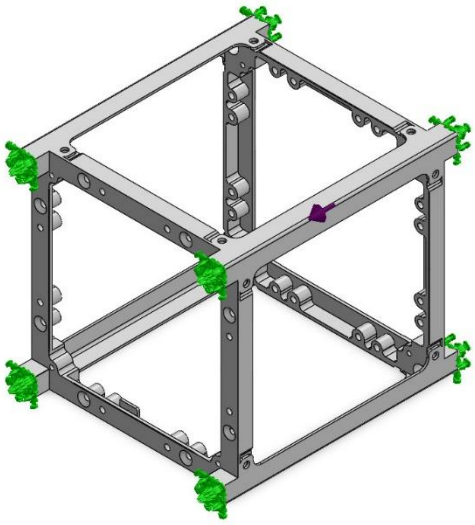
1Unit CubeSat

Simulation of 1Unit CubeSat PA11

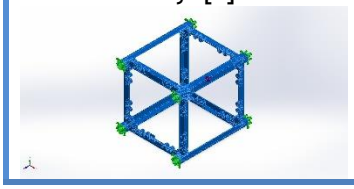
Designer: KSF Space
Study name: Dynamic
Analysis type: Linear dynamic analysis (Random Vibration)

Table of Contents

Model Information



Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties
Body1[1] 	Solid Body	**Mass:0.0382358 kg** **Volume:3.47598e-05 m^3** **Density:1,100 kg/m^3** **Weight:0.374711 N**

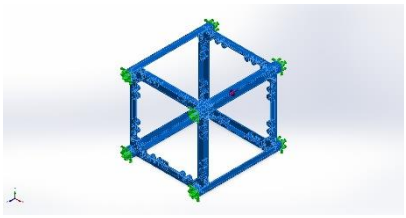
Study Properties

Study name	Dynamic 1
Analysis type	Linear dynamic analysis (Random Vibration)
Mesh type	Solid Mesh
Number of frequencies	15
Decouple the mixed free body modes	Off
Solver type	FFEPlus
Soft Spring:	Off
Incompatible bonding options	Automatic
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Lower frequency limit	20 Hz
Upper frequency limit	3,000 Hz
Number of output frequencies	10
Correlation	Fully correlated

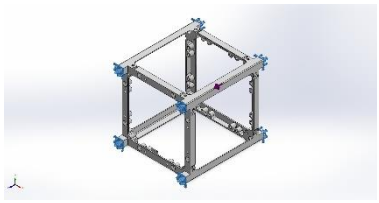
Units

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

Material Properties

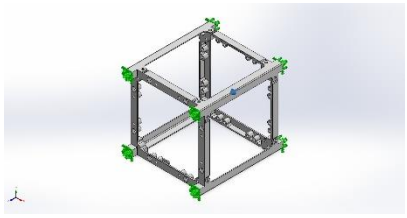
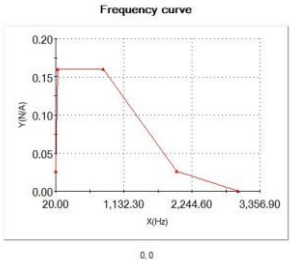
Model Reference	Properties		Components
	**Name:** **Model type:** **Default failure criterion:** **Yield strength:** **Tensile strength:** **Compressive strength:** **Elastic modulus:** **Poisson's ratio:** **Mass density:** **Shear modulus:** **Thermal expansion coefficient:** **Material damping ratio:**	PA11 Linear Elastic Isotropic Max von Mises Stress 9.15e+07 N/m^2 1.22e+08 N/m^2 1.027e+08 N/m^2 6.8e+09 N/m^2 0.4 1,100 kg/m^3 2.42857e+09 N/m^2 8.5e-05 /Kelvin 0.03	SolidBody 1(Body1[1])(1 units solid)
Curve Data:N/A			

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-2		**Entities:** 8 face(s) **Type:** Fixed Geometry

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	1.96152e-15	1.86504e-15	2.02125e-14	2.03929e-14
Reaction Moment(N.m)	0	0	0	0

Load name	Load Image	Load Details	Function Curve
Base Excitation-1		**Type:** Acceleration **Translation:** ---, ---, 1 **Units:** in **Phase Angle:** 0 **Units:** deg	 Frequency curve

Mesh information

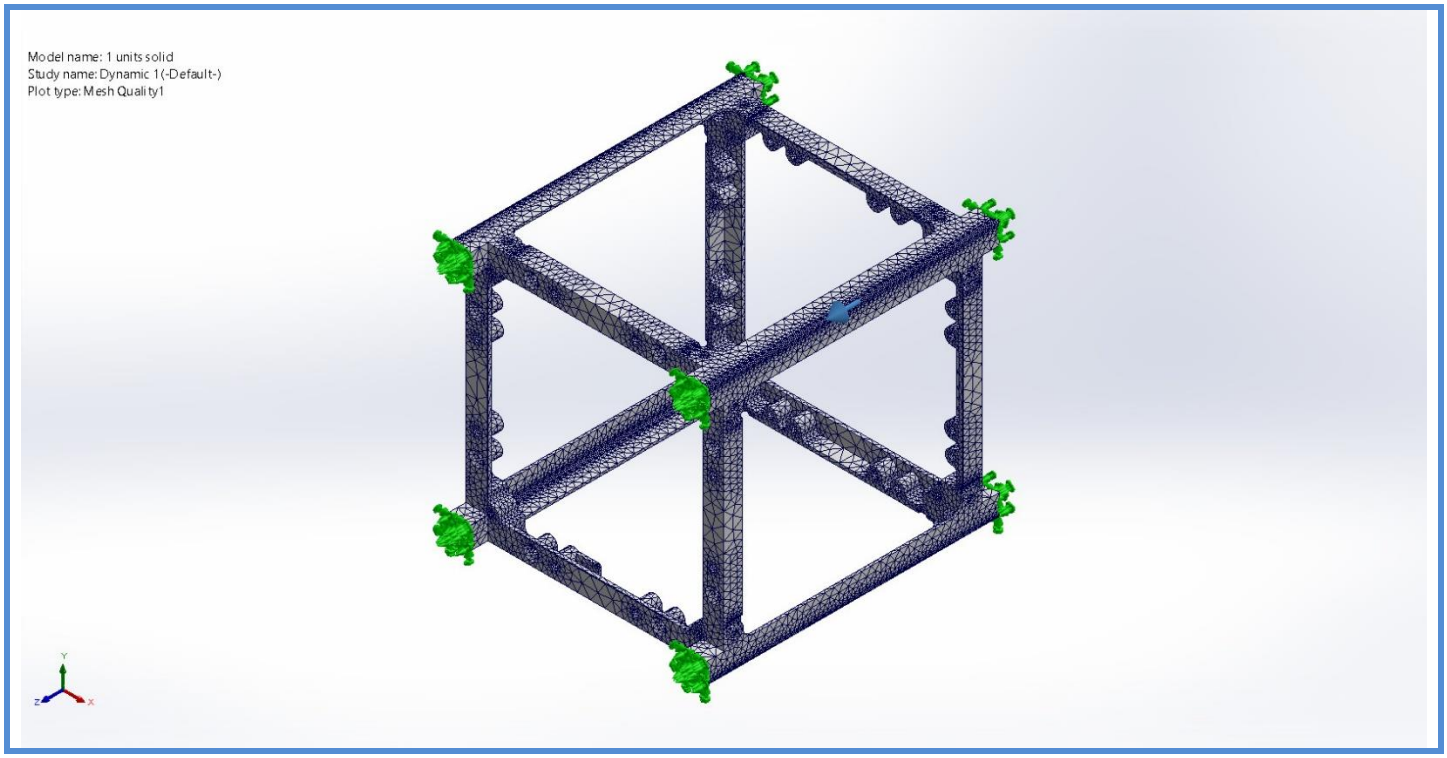
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	8.30303 mm
Minimum element size	0.415152 mm
Mesh Quality	High

Mesh information - Details

Total Nodes	223944
Total Elements	131509
Maximum Aspect Ratio	30.744
% of elements with Aspect Ratio < 3	94.6
Percentage of elements with Aspect Ratio > 10	0.437
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:17
Computer name:	

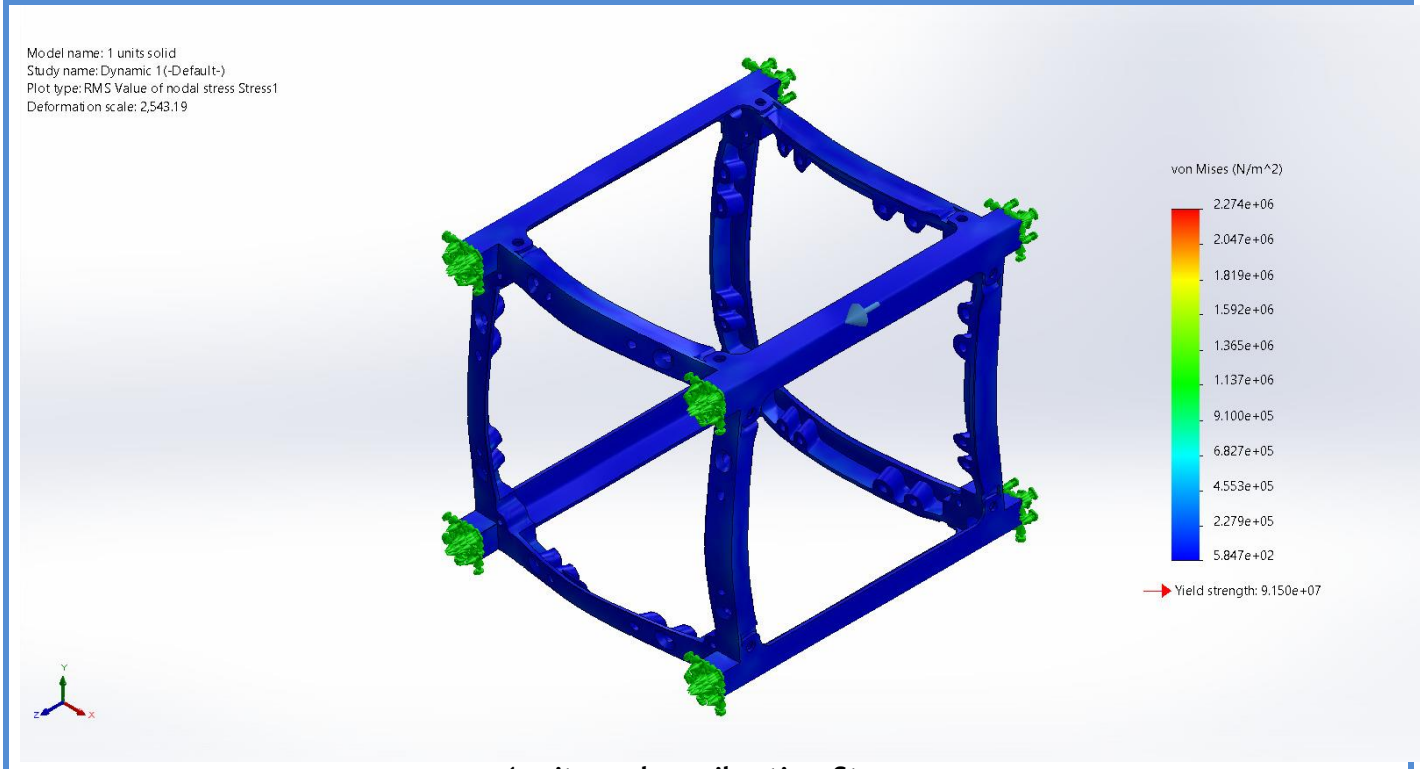
Mesh Quality Plots

Name	Type	Min	Max
Quality1	Mesh	-	-



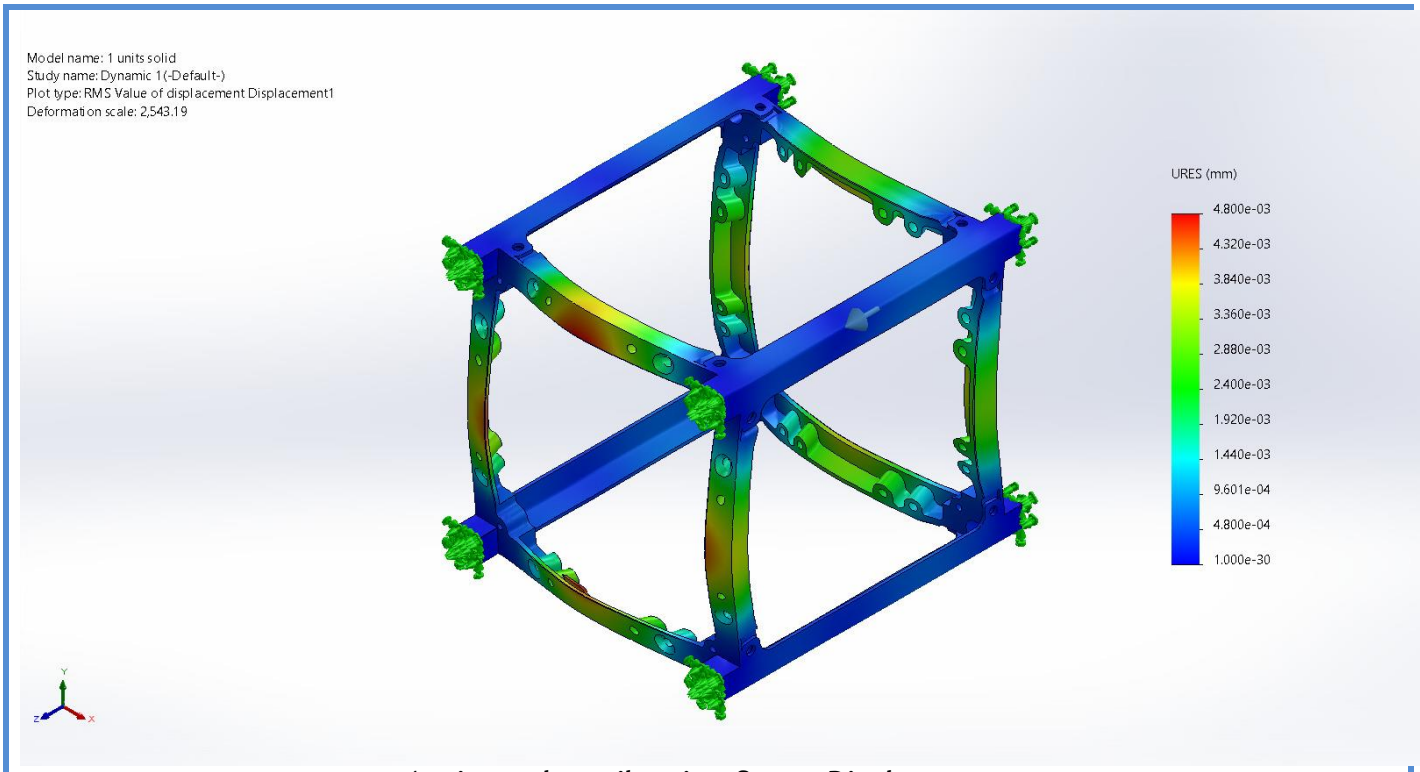
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	5.847e+02N/m^2 Node: 168994	2.274e+06N/m^2 Node: 48297



1unit-random vibration-Stress

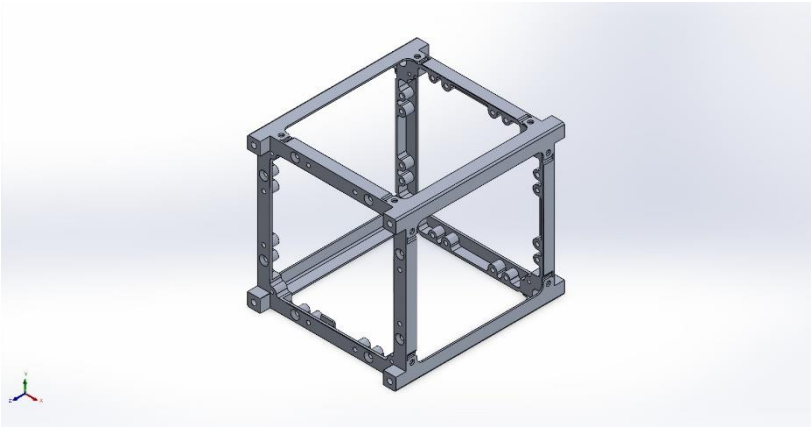
Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 131	4.800e-03mm Node: 16826



1unit-random vibration-Stress-Displacement

Mass Participation (Normalized)

Mode Number	Frequency(Hertz)	X direction	Y direction	Z direction
1	1,187.3	0.00024773	0.00051549	6.1553e-07
2	1,188.6	0.00035265	0.038668	2.8946e-07
3	1,188.6	0.039787	0.001016	5.004e-09
4	1,189	0.002125	0.0025719	9.8664e-09
5	1,583.3	2.1827e-06	0.00016441	0.00040909
6	1,598.9	7.4511e-09	6.4822e-06	3.2364e-05
7	1,637.6	1.3213e-05	0.0046175	0.00018025
8	1,642.4	2.2628e-05	0.024955	6.0442e-05
9	1,644.1	0.034886	2.5647e-05	1.2653e-07
10	1,669.1	6.191e-12	2.6451e-06	2.3877e-07
11	1,748.4	2.9095e-05	0.046271	0.0034436
12	1,768.5	9.5905e-07	1.1673e-05	6.5328e-08
13	1,776.7	0.00047263	0.14406	0.00026467
14	1,781.1	0.18626	0.00045758	8.3247e-08
15	1,877.1	1.6395e-06	0.0012351	0.34752
		Sum X = 0.2642	Sum Y = 0.26458	Sum Z = 0.35191



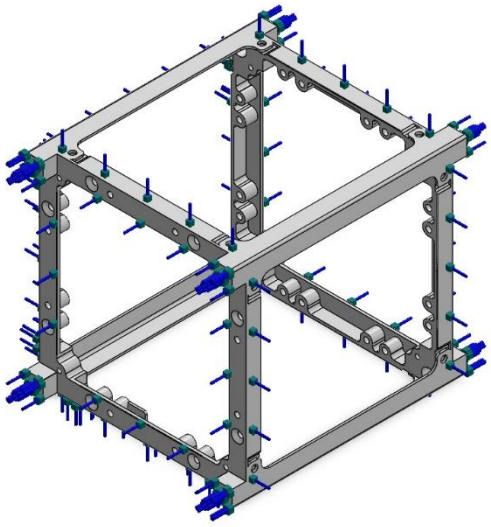
1Unit CubeSat

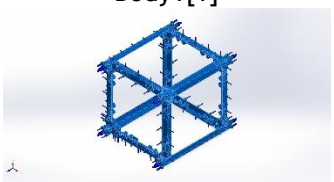
Simulation of of 1Unit CubeSat PA11

Designer: KSF
Study name: Thermal
Analysis type: Thermal(Steady state)

Table of Contents

Model Information



Solid Bodies		
Document Name and Reference	**Treated As**	**Volumetric Properties**
Body1[1] 	Solid Body	**Mass:0.0382358 kg** **Volume:3.47598e-05 m^3** **Density:1,100 kg/m^3** **Weight:0.374711 N**

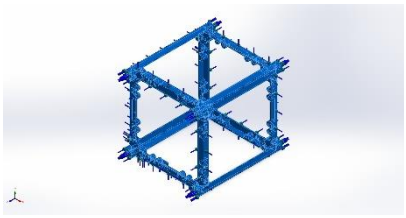
Study Properties

Study name	Thermal 3
Analysis type	Thermal(Steady state)
Mesh type	Solid Mesh
Solver type	FFEPlus
Solution type	Steady state
Contact resistance defined?	No

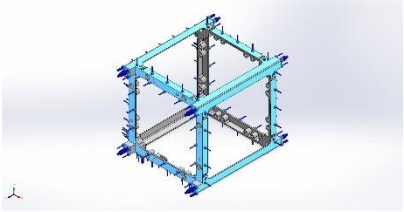
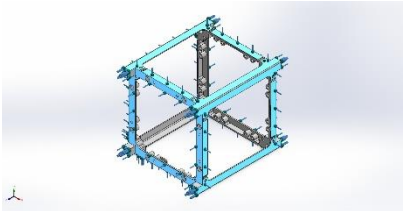
Units

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

Material Properties

Model Reference	Properties	Components
	**Name:** PA11 **Model type:** Linear Elastic Isotropic **Default failure criterion:** Max von Mises Stress **Thermal conductivity:** 0.23 W/(m.K) **Specific heat:** 2,400 J/(kg.K) **Mass density:** 1,100 kg/m^3	SolidBody 1(Body1[1])(1 units solid)
Curve Data:N/A		

Thermal Loads

Load name	Load Image	Load Details
Radiation-1		**Entities:** 14 face(s) **Radiation Type:** Surface to ambient **Ambient Temperature:** 3 Kelvin **Emissivity:** 0.8 **View Factor:** 0.5
Temperature-1		**Entities:** 14 face(s) **Temperature:** 80 Celsius

Mesh information

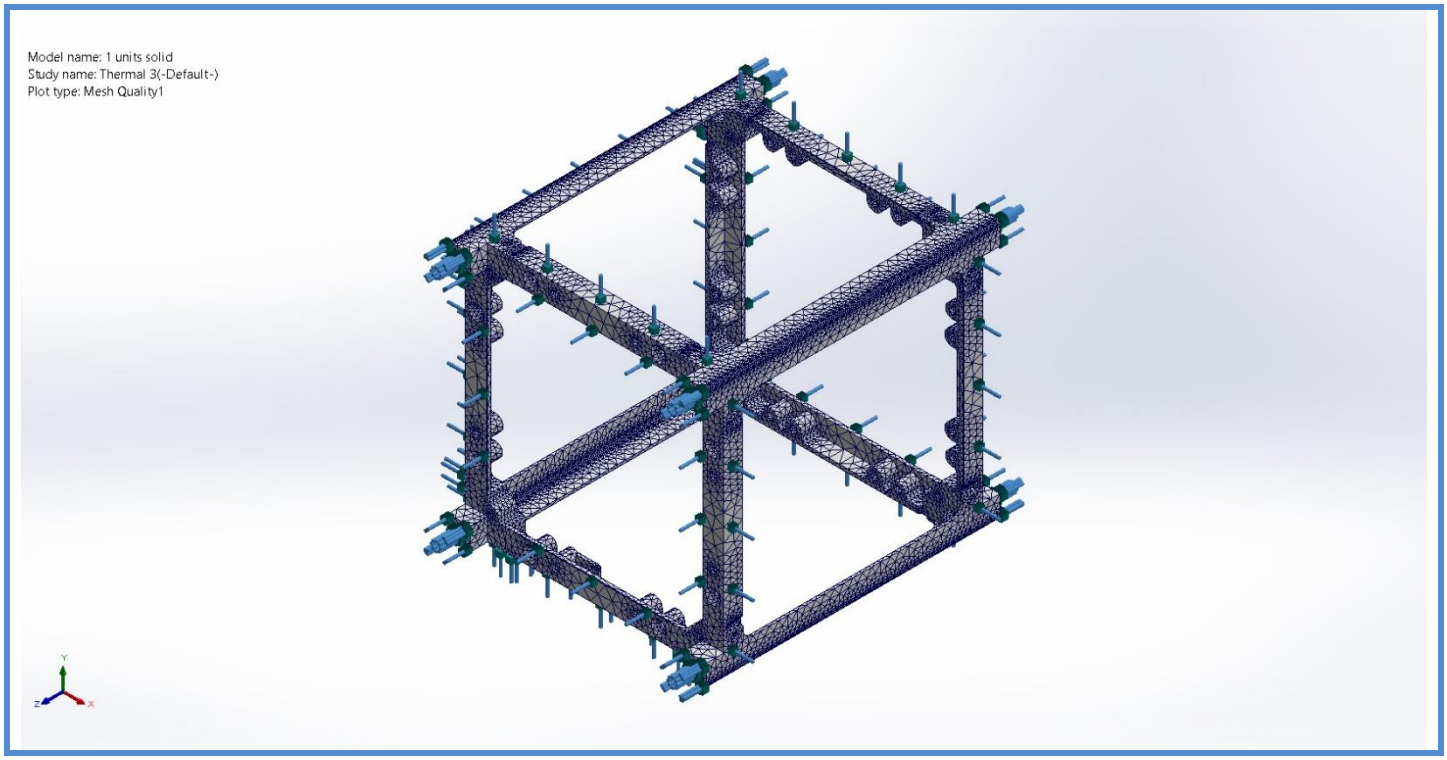
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	8.30303 mm
Minimum element size	0.415152 mm
Mesh Quality	High

Mesh information - Details

Total Nodes	223944
Total Elements	131509
Maximum Aspect Ratio	30.744
% of elements with Aspect Ratio < 3	94.6
Percentage of elements with Aspect Ratio > 10	0.437
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:17
Computer name:	

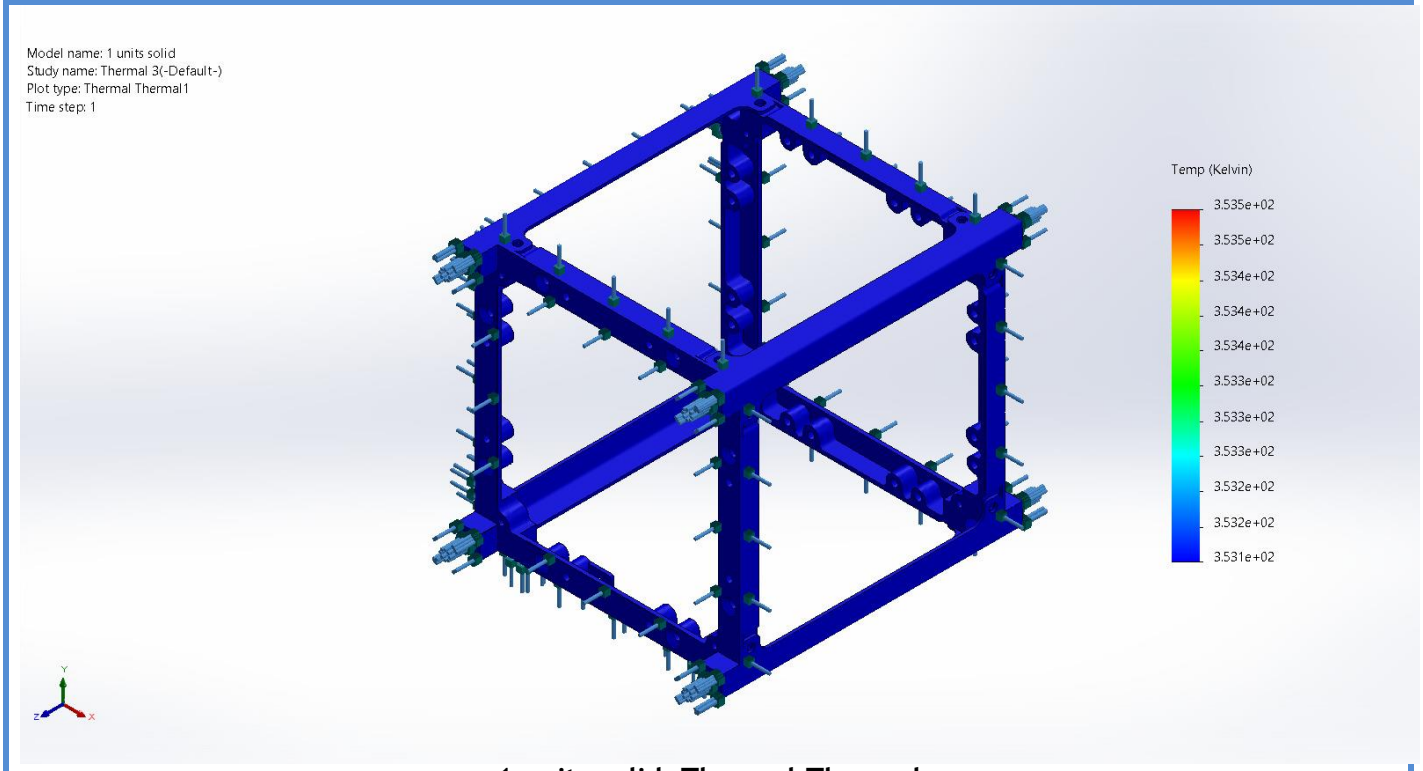
Mesh Quality Plots

Name	Type	Min	Max
Quality1	Mesh	-	-

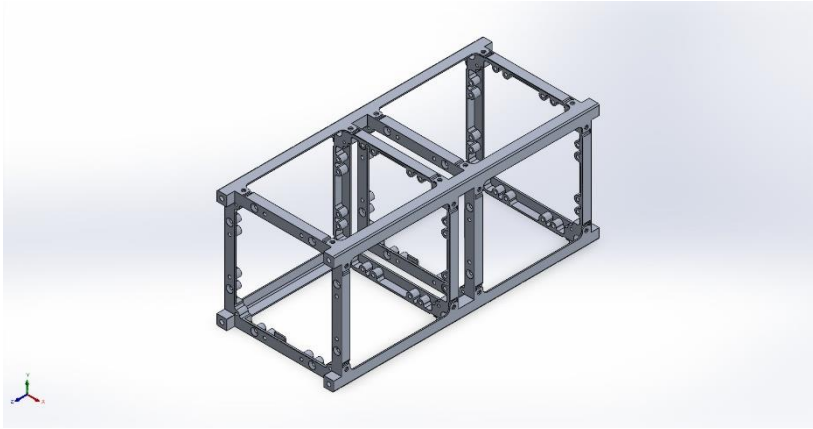


Study Results

Name	Type	Min	Max
Thermal1	TEMP: Temperature	3.531e+02Kelvin Node: 1	3.531e+02Kelvin Node: 1



1 units solid- Thermal-Thermal



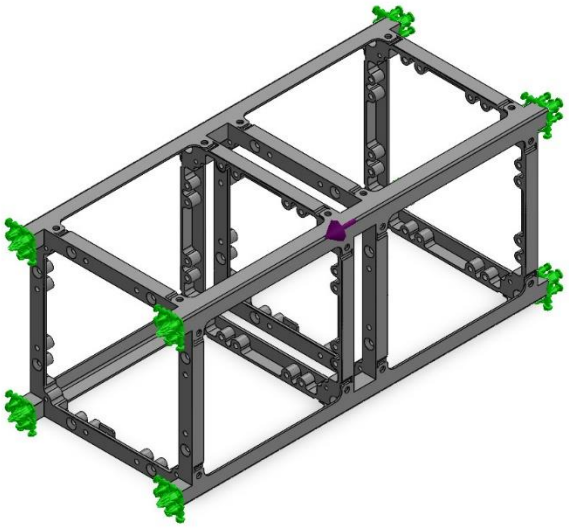
2 Units CubeSat

Simulation of 2 Units CubeSat PA11

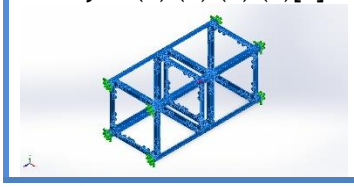
Designer: KSF
Study name: Dynamic
Analysis type: Linear dynamic analysis (Random Vibration)

Table of Contents

Model Information



Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties
Body35 (2) (2) (1) (1)[1] 	Solid Body	**Mass:0.0764716 kg** **Volume:6.95196e-05 m^3** **Density:1,100 kg/m^3** **Weight:0.749421 N**

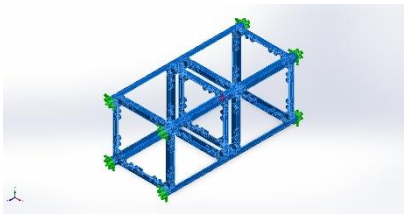
Study Properties

Study name	Dynamic 1
Analysis type	Linear dynamic analysis (Random Vibration)
Mesh type	Solid Mesh
Number of frequencies	15
Decouple the mixed free body modes	Off
Solver type	FFEPlus
Soft Spring:	Off
Incompatible bonding options	Automatic
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Lower frequency limit	20 Hz
Upper frequency limit	3,000 Hz
Number of output frequencies	10
Correlation	Fully correlated

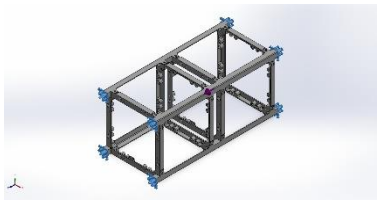
Units

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

Material Properties

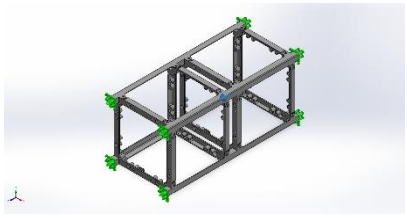
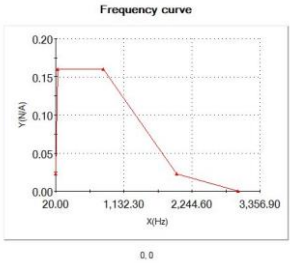
Model Reference	Properties		Components
	**Name:** **Model type:** **Default failure criterion:** **Yield strength:** **Tensile strength:** **Compressive strength:** **Elastic modulus:** **Poisson's ratio:** **Mass density:** **Shear modulus:** **Thermal expansion coefficient:** **Material damping ratio:**	PA11 Linear Elastic Isotropic Unknown 9.15e+07 N/m^2 1.22e+08 N/m^2 1.027e+08 N/m^2 6.8e+09 N/m^2 0.4 1,100 kg/m^3 2.42857e+09 N/m^2 8.5e-05 /Kelvin 0.03	SolidBody 1(Body35 (2) (2) (1) (1)[1])(2 UNITS)
Curve Data:N/A			

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 8 face(s) **Type:** Fixed Geometry

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	4.51832e-17	5.65196e-17	5.80882e-16	5.85372e-16
Reaction Moment(N.m)	0	0	0	0

Load name	Load Image	Load Details	Function Curve
Base Excitation-1		**Type:** Acceleration **Translation:** ---, ---, 1 **Units:** in **Phase Angle:** 0 **Units:** deg	 Frequency curve

Mesh information

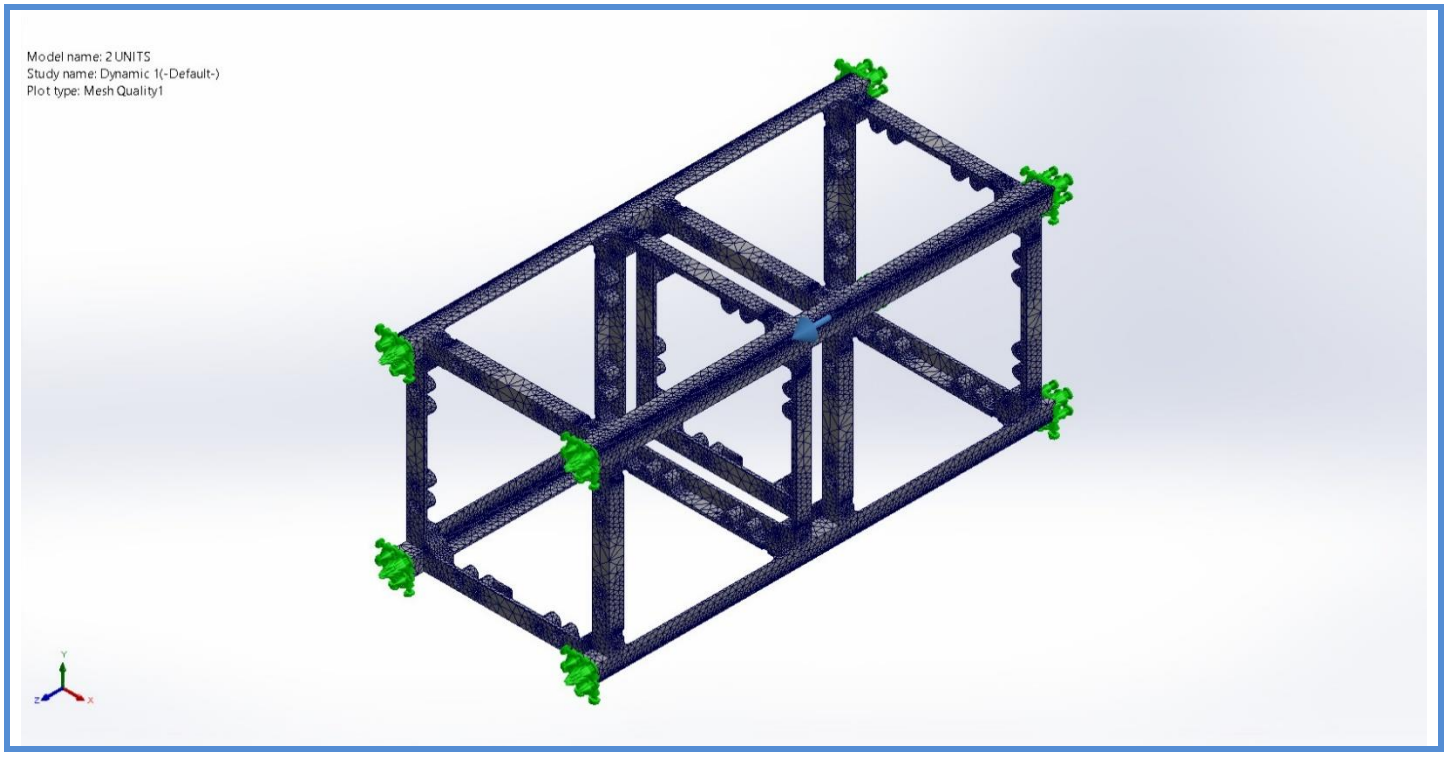
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	11.7076 mm
Minimum element size	0.585379 mm
Mesh Quality	High

Mesh information - Details

Total Nodes	423549
Total Elements	247908
Maximum Aspect Ratio	36.722
% of elements with Aspect Ratio < 3	95.2
Percentage of elements with Aspect Ratio > 10	0.41
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:29
Computer name:	

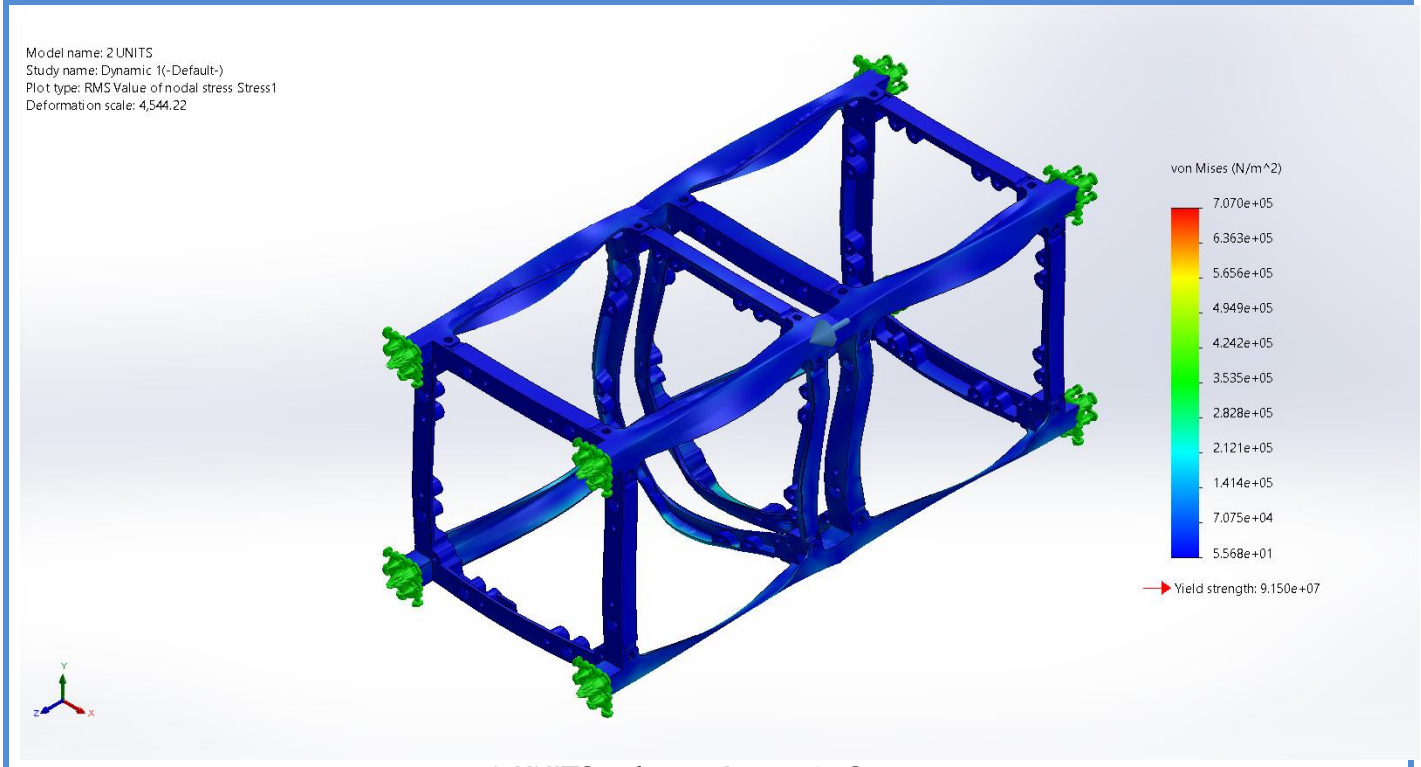
Mesh Quality Plots

Name	Type	Min	Max
Quality1	Mesh	-	-



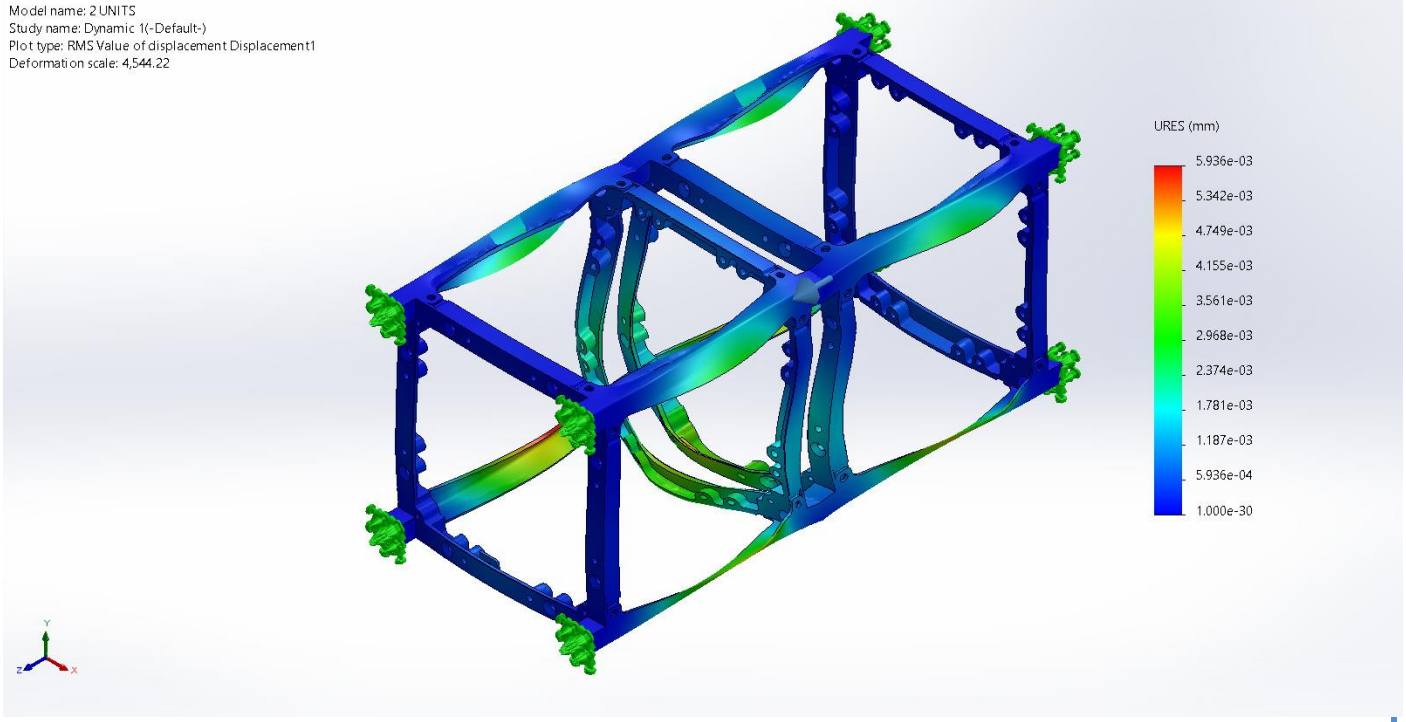
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	5.568e+01N/m^2 Node: 408834	7.070e+05N/m^2 Node: 381216



2 UNITS cubesat-Dynamic-Stress

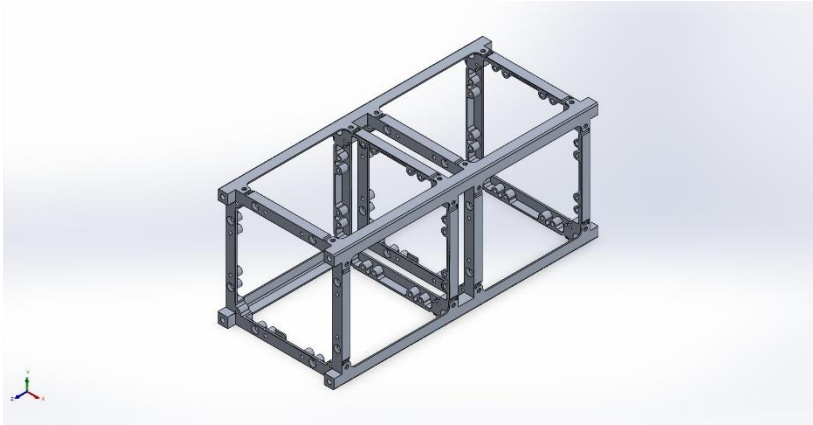
Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 363	5.936e-03mm Node: 5553



2 UNITS cubesat-Dynamic- Displacement

Mass Participation (Normalized)

Mode Number	Frequency(Hertz)	X direction	Y direction	Z direction
1	242.52	0.032879	0.50188	4.0113e-11
2	242.53	0.50187	0.032879	4.8937e-11
3	366.87	8.6978e-07	2.0676e-08	4.3929e-11
4	512.47	1.7487e-07	7.9785e-09	7.9621e-11
5	872.65	4.9748e-11	2.2691e-07	8.5741e-07
6	1,149.3	5.0694e-09	1.3916e-07	9.6906e-08
7	1,149.5	3.0246e-12	2.6893e-08	1.3213e-07
8	1,151.2	4.3369e-08	1.6038e-08	8.9878e-09
9	1,170.3	6.5052e-09	7.131e-07	1.6065e-06
10	1,195.1	6.2372e-07	1.7144e-06	2.2573e-07
11	1,201.9	0.0035076	0.0045126	3.5381e-07
12	1,202	0.0044968	0.0035361	6.3312e-07
13	1,219.7	6.2436e-08	1.5885e-07	1.3142e-09
14	1,367.7	1.8053e-09	1.0949e-08	0.00044997
15	1,376.2	5.2725e-10	1.2752e-06	0.05374
		Sum X = 0.54275	Sum Y = 0.54281	Sum Z = 0.054194



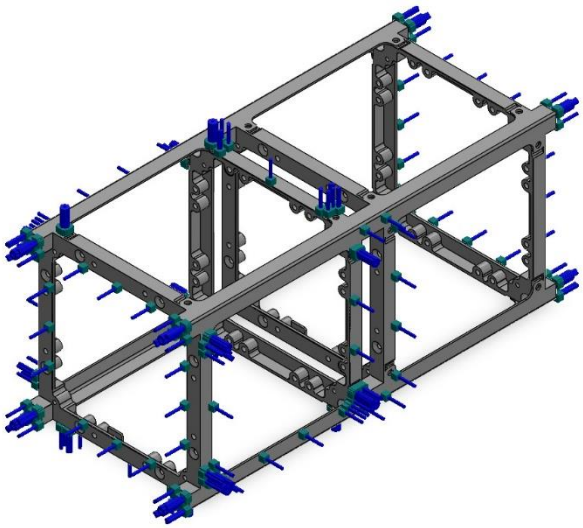
2 Units CubeSat

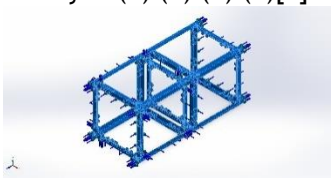
Simulation of 2 Units CubeSat PA11

Designer: KSF
Study name: Thermal
Analysis type: Thermal(Steady state)

Table of Contents

Model Information



Solid Bodies		
Document Name and Reference	**Treated As**	**Volumetric Properties**
Body35 (2) (2) (1) (1)[1] 	Solid Body	**Mass:0.0764716 kg** **Volume:6.95196e-05 m^3** **Density:1,100 kg/m^3** **Weight:0.749421 N**

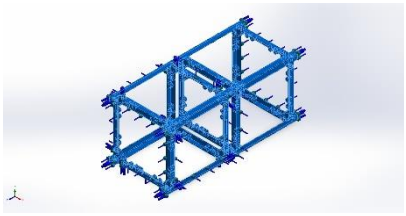
Study Properties

Study name	Thermal 1
Analysis type	Thermal(Steady state)
Mesh type	Solid Mesh
Solver type	FFEPlus
Solution type	Steady state
Contact resistance defined?	No

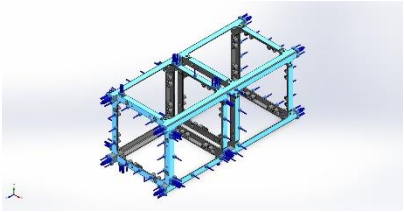
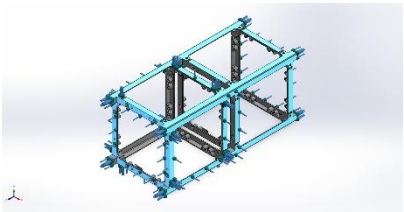
Units

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

Material Properties

Model Reference	Properties	Components
	**Name:** PA11 **Model type:** Linear Elastic Isotropic **Default failure criterion:** Unknown **Thermal conductivity:** 0.23 W/(m.K) **Specific heat:** 2,400 J/(kg.K) **Mass density:** 1,100 kg/m^3	SolidBody 1(Body35 (2) (2) (1) (1)[1])(2 UNITS)
Curve Data:N/A		

Thermal Loads

Load name	Load Image	Load Details
Radiation-1		**Entities:** 14 face(s) **Radiation Type:** Surface to ambient **Ambient Temperature:** 3 Kelvin **Emissivity:** 0.8 **View Factor:** 0.5
Temperature-1		**Entities:** 14 face(s) **Temperature:** 80 Celsius

Mesh information

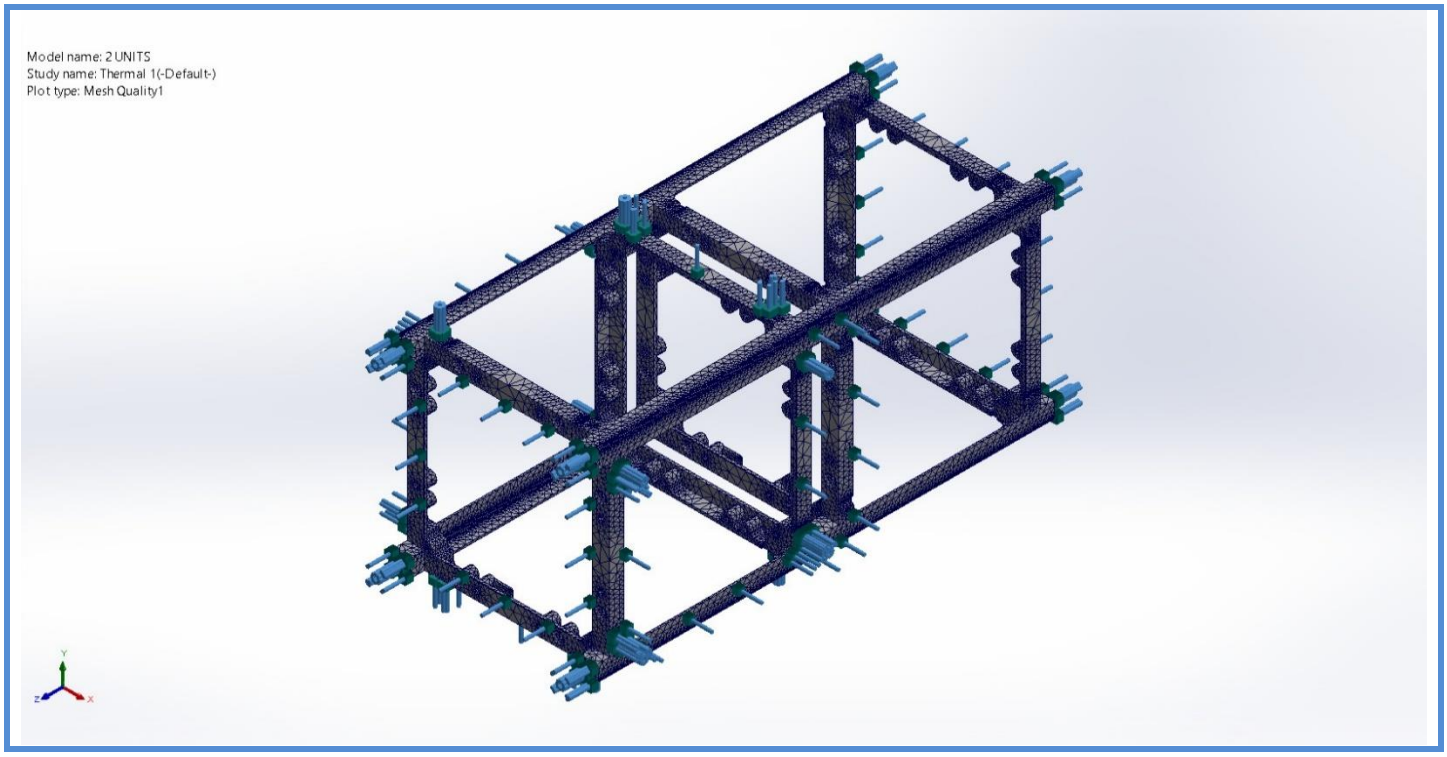
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	11.7076 mm
Minimum element size	0.585379 mm
Mesh Quality	High

Mesh information - Details

Total Nodes	423549
Total Elements	247908
Maximum Aspect Ratio	36.722
% of elements with Aspect Ratio < 3	95.2
Percentage of elements with Aspect Ratio > 10	0.41
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:28
Computer name:	

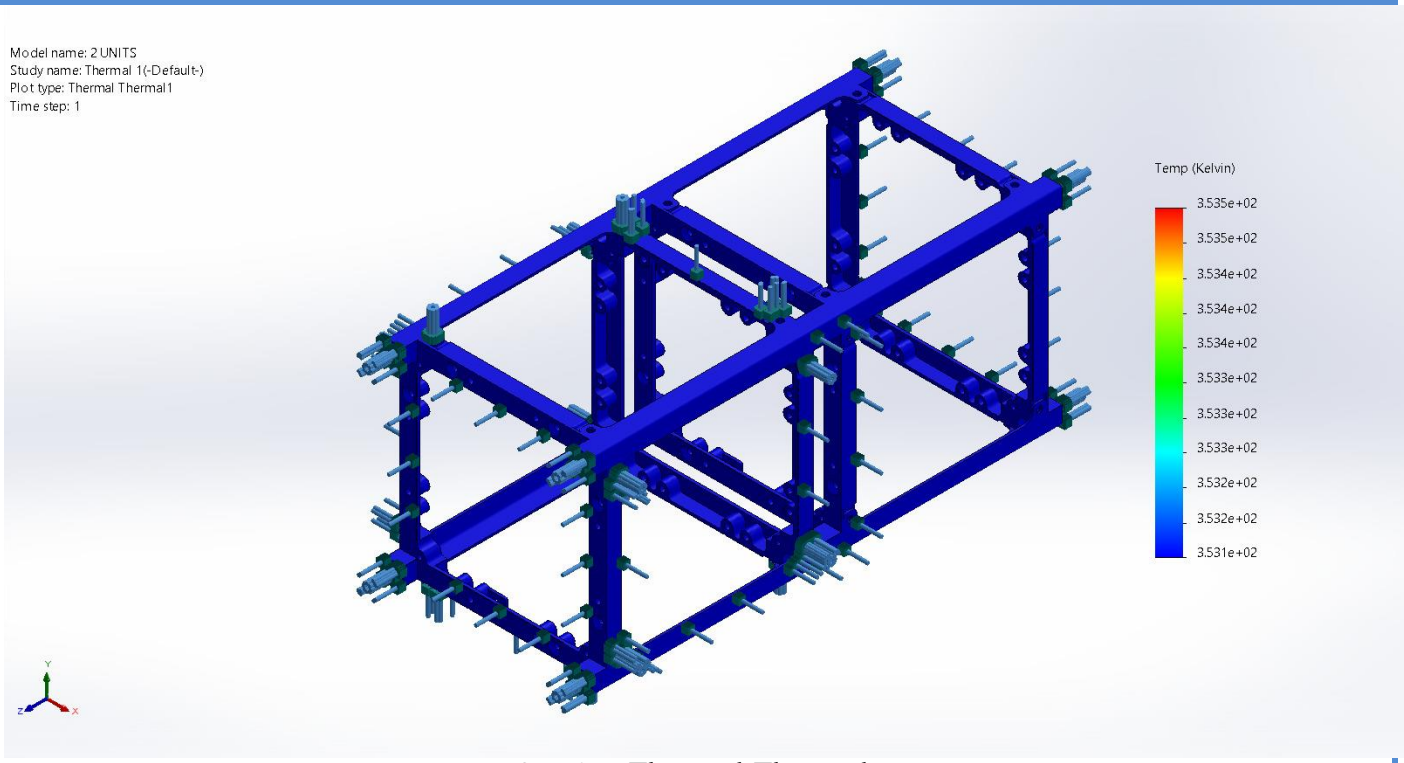
Mesh Quality Plots

Name	Type	Min	Max
Quality1	Mesh	-	-

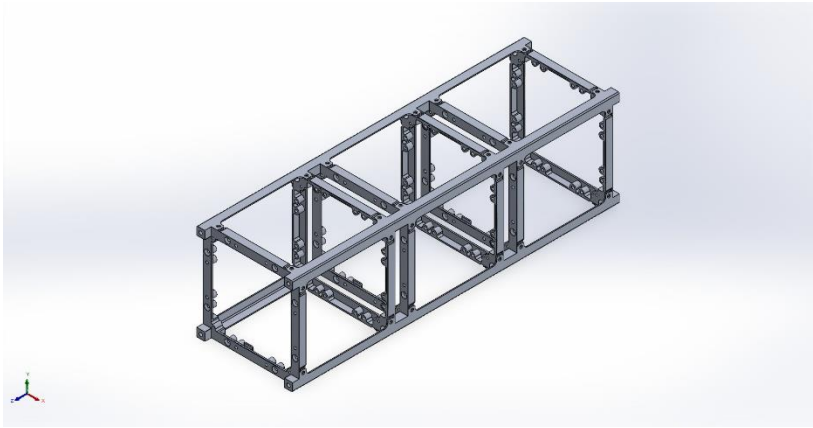


Study Results

Name	Type	Min	Max
Thermal1	TEMP: Temperature	3.531e+02Kelvin Node: 1	3.531e+02Kelvin Node: 1



2 units- Thermal-Thermal



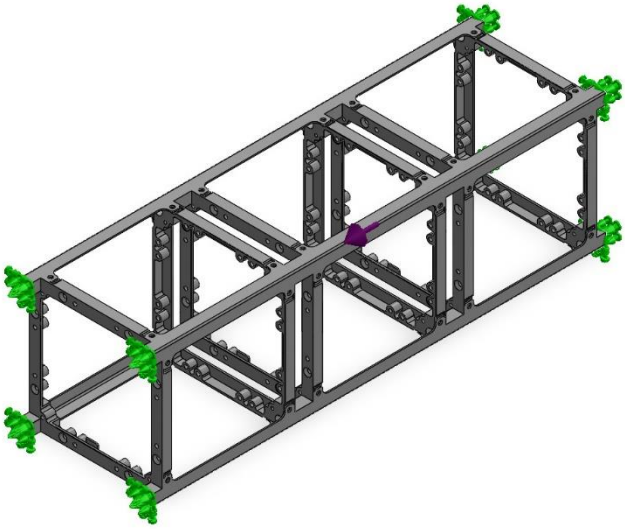
3 Units CubeSat

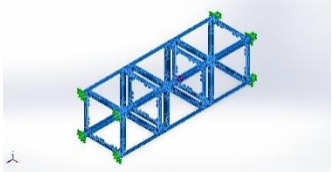
Simulation of 3 Units CubeSat PA11

Designer: KSF
Study name: Dynamic
Analysis type: Linear dynamic analysis (Random Vibration)

Table of Contents

Model Information



Solid Bodies		
Document Name and Reference	**Treated As**	**Volumetric Properties**
Body35 (2) (2) (1) (1) (3)[1] 	Solid Body	**Mass:0.114707 kg** **Volume:0.000104279 m^3** **Density:1,100 kg/m^3** **Weight:1.12413 N**

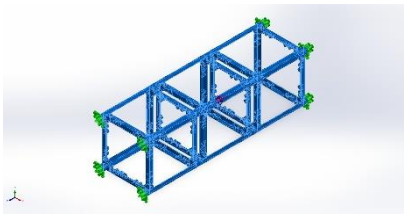
Study Properties

Study name	Dynamic 1
Analysis type	Linear dynamic analysis (Random Vibration)
Mesh type	Solid Mesh
Number of frequencies	15
Decouple the mixed free body modes	Off
Solver type	FFEPlus
Soft Spring:	Off
Incompatible bonding options	Automatic
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Lower frequency limit	20 Hz
Upper frequency limit	3,000 Hz
Number of output frequencies	10
Correlation	Fully correlated

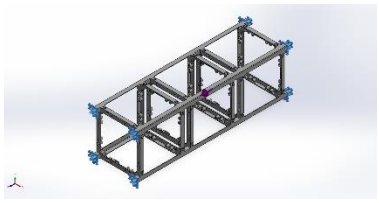
Units

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

Material Properties

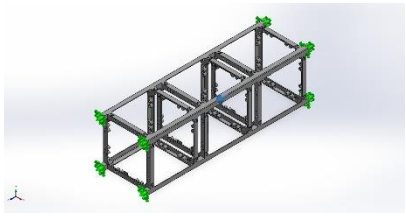
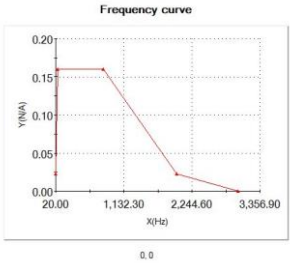
Model Reference	Properties		Components
	**Name:** **Model type:** **Default failure criterion:** **Yield strength:** **Tensile strength:** **Compressive strength:** **Elastic modulus:** **Poisson's ratio:** **Mass density:** **Shear modulus:** **Thermal expansion coefficient:** **Material damping ratio:**	PA11 Linear Elastic Isotropic Unknown 9.15e+07 N/m^2 1.22e+08 N/m^2 1.027e+08 N/m^2 6.8e+09 N/m^2 0.4 1,100 kg/m^3 2.42857e+09 N/m^2 8.5e-05 /Kelvin 0.03	SolidBody 1(Body35 (2) (2) (1) (1) (3)[1])(3 units (1).step)
Curve Data:N/A			

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 8 face(s) **Type:** Fixed Geometry

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	6.22555e-21	6.8594e-21	5.73366e-20	5.80801e-20
Reaction Moment(N.m)	0	0	0	0

Load name	Load Image	Load Details	Function Curve
Base Excitation-1		**Type:** Acceleration **Translation:** ---, ---, 1 **Units:** in **Phase Angle:** 0 **Units:** deg	 Frequency curve

Mesh information

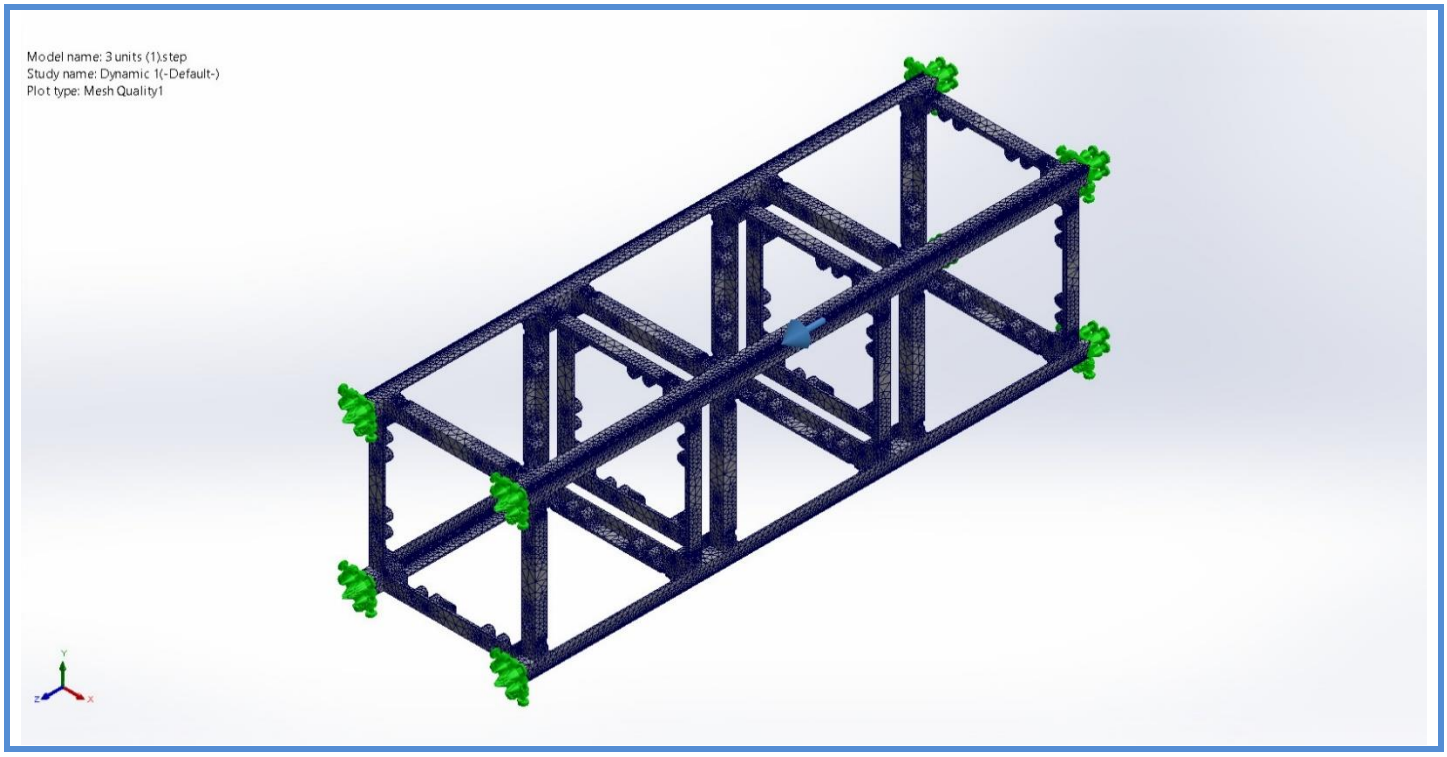
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	14.3246 mm
Minimum element size	0.716231 mm
Mesh Quality	High

Mesh information - Details

Total Nodes	623244
Total Elements	364470
Maximum Aspect Ratio	32.004
% of elements with Aspect Ratio < 3	95
Percentage of elements with Aspect Ratio > 10	0.449
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:39
Computer name:	

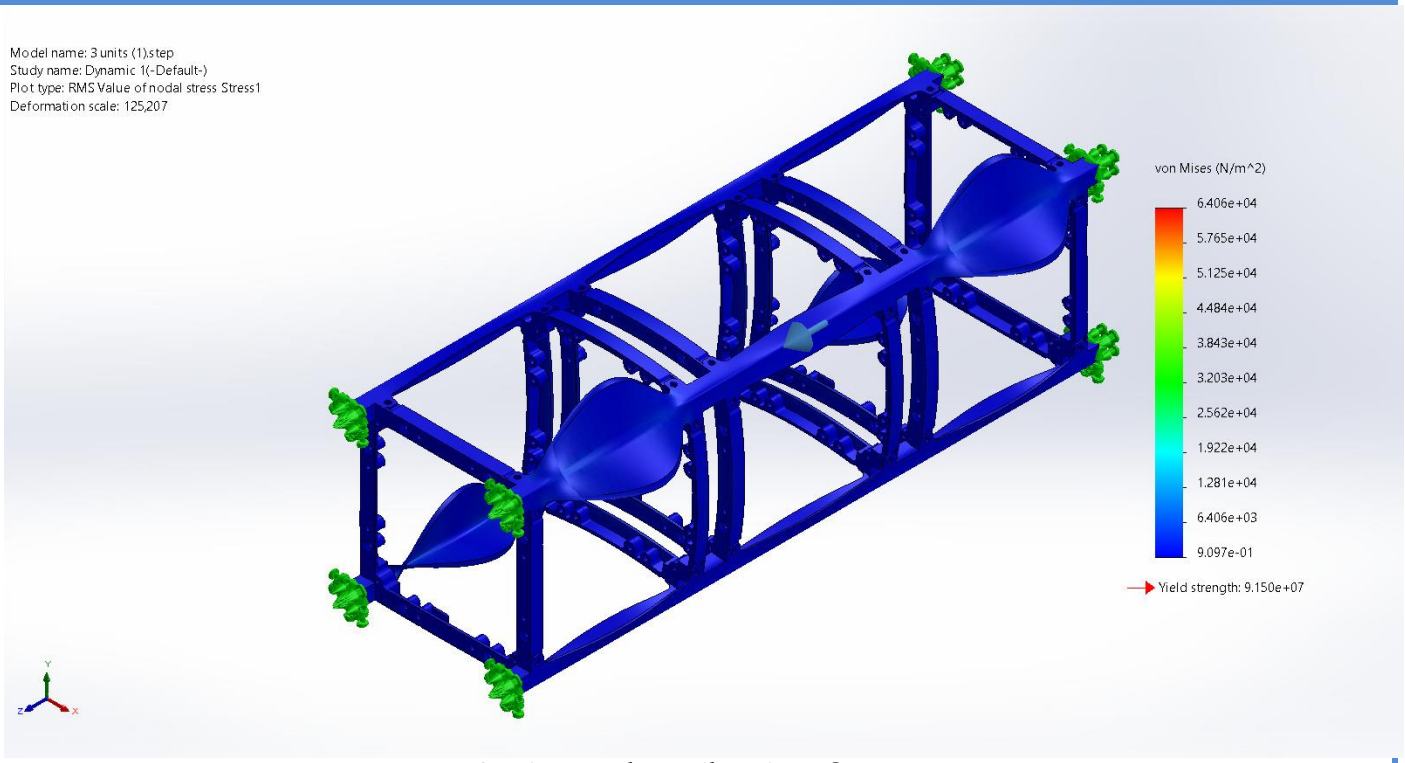
Mesh Quality Plots

Name	Type	Min	Max
Quality1	Mesh	-	-



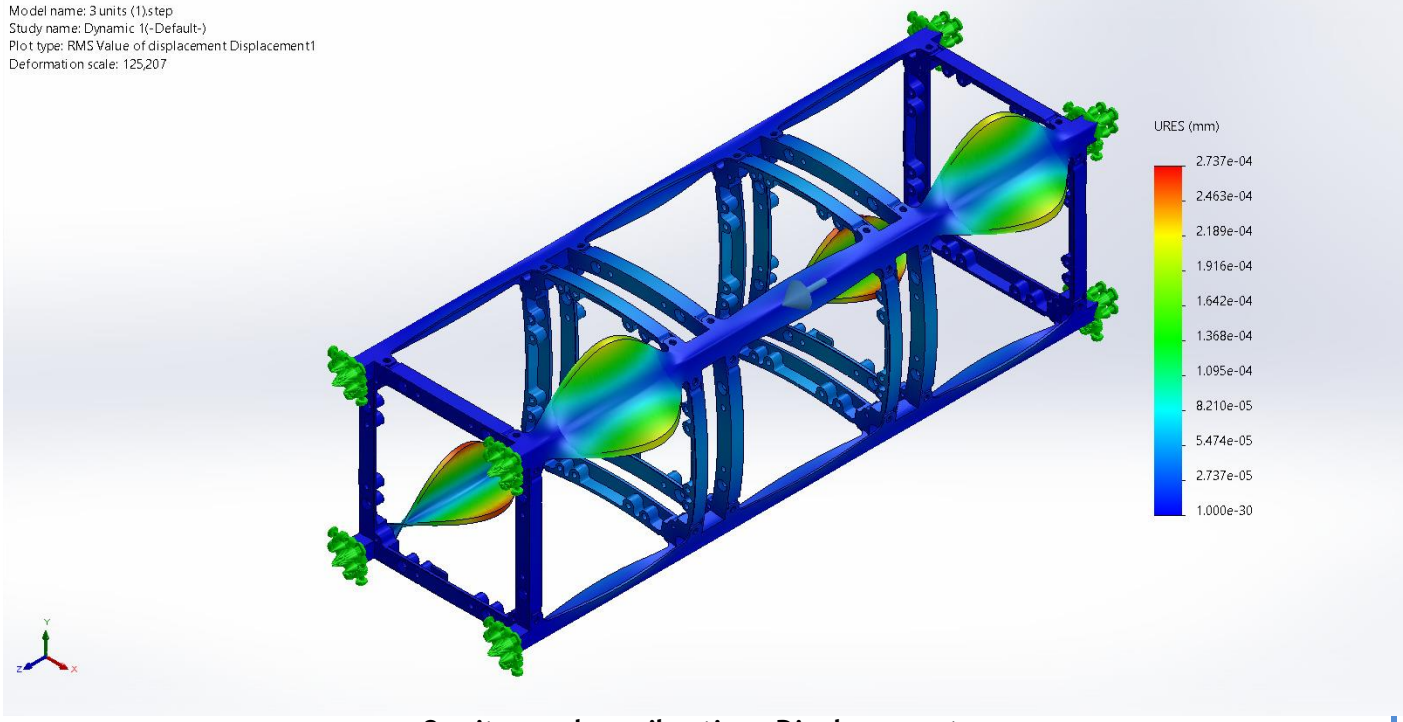
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	9.097e-01N/m^2 Node: 612051	6.406e+04N/m^2 Node: 114318



3units-random vibration -Stress

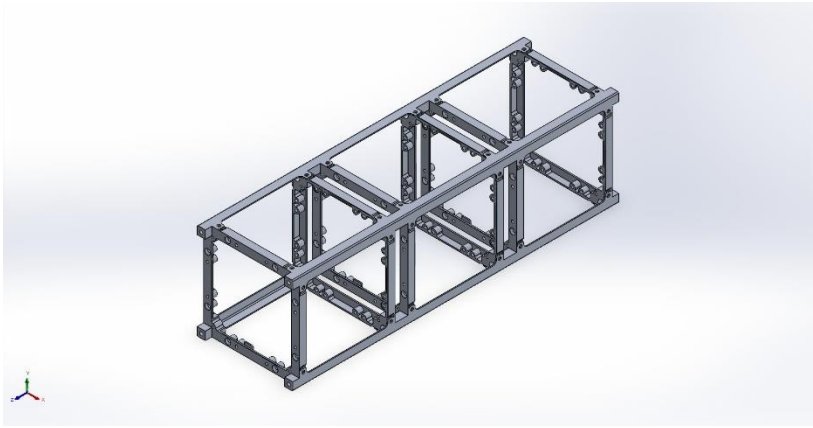
Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 391	2.737e-04mm Node: 53974



3units-random vibration -Displacement

Mass Participation (Normalized)

Mode Number	Frequency(Hertz)	X direction	Y direction	Z direction
1	154.89	0.018486	0.66499	2.613e-11
2	154.89	0.66499	0.018485	9.775e-13
3	225.57	1.3843e-06	2.2059e-08	3.4758e-11
4	293.97	2.7078e-10	3.67e-09	1.0328e-10
5	293.98	1.411e-09	4.8556e-12	2.2595e-10
6	445.51	9.7807e-10	1.5098e-11	5.0967e-11
7	492.28	3.2309e-08	1.5428e-09	4.7878e-12
8	530.08	2.1603e-09	5.5351e-10	9.5519e-11
9	870.93	8.0023e-12	2.7418e-08	1.6239e-06
10	874.51	5.4612e-10	1.8045e-07	9.3761e-10
11	1,118.1	8.2767e-06	0.0098369	1.16e-10
12	1,118.4	0.0098072	8.7894e-06	3.1485e-08
13	1,126.8	1.2941e-06	2.5146e-08	1.774e-09
14	1,160.4	2.9961e-08	6.5577e-07	1.7776e-08
15	1,181.8	5.539e-10	2.4126e-08	7.6216e-06
		Sum X = 0.6933	Sum Y = 0.69333	Sum Z = 9.2981e-06



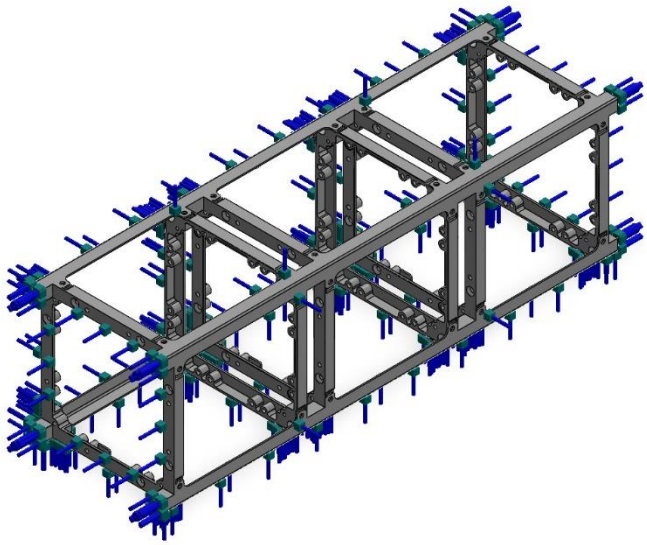
3 Units CubeSat

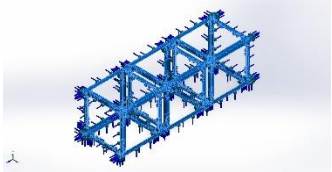
Simulation of 3 units CubeSat PA11

Designer: KSF
Study name: Thermal
Analysis type: Thermal(Steady state)

Table of Contents

Model Information



Solid Bodies		
Document Name and Reference	**Treated As**	**Volumetric Properties**
Body35 (2) (2) (1) (1) (3)[1] 	Solid Body	**Mass:0.114707 kg** **Volume:0.000104279 m^3** **Density:1,100 kg/m^3** **Weight:1.12413 N**

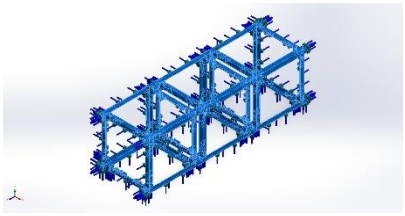
Study Properties

Study name	Thermal 1
Analysis type	Thermal(Steady state)
Mesh type	Solid Mesh
Solver type	FFEPlus
Solution type	Steady state
Contact resistance defined?	No

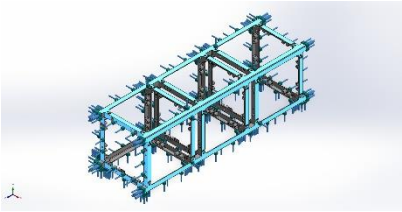
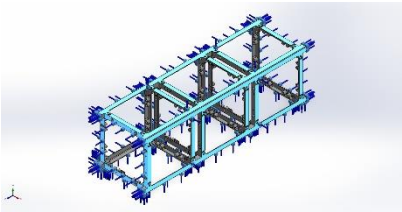
Units

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

Material Properties

Model Reference	Properties	Components
	**Name:** PA11 **Model type:** Linear Elastic Isotropic **Default failure criterion:** Unknown **Thermal conductivity:** 0.23 W/(m.K) **Specific heat:** 2,400 J/(kg.K) **Mass density:** 1,100 kg/m^3	SolidBody 1(Body35 (2) (2) (1) (1) (3)[1])(3 units (1).step)
Curve Data:N/A		

Thermal Loads

Load name	Load Image	Load Details
Temperature-1		**Entities:** 14 face(s) **Temperature:** 80 Celsius
Radiation-1		**Entities:** 14 face(s) **Radiation Type:** Surface to ambient **Ambient Temperature:** 3 Kelvin **Emissivity:** 0.8 **View Factor:** 0.5

Mesh information

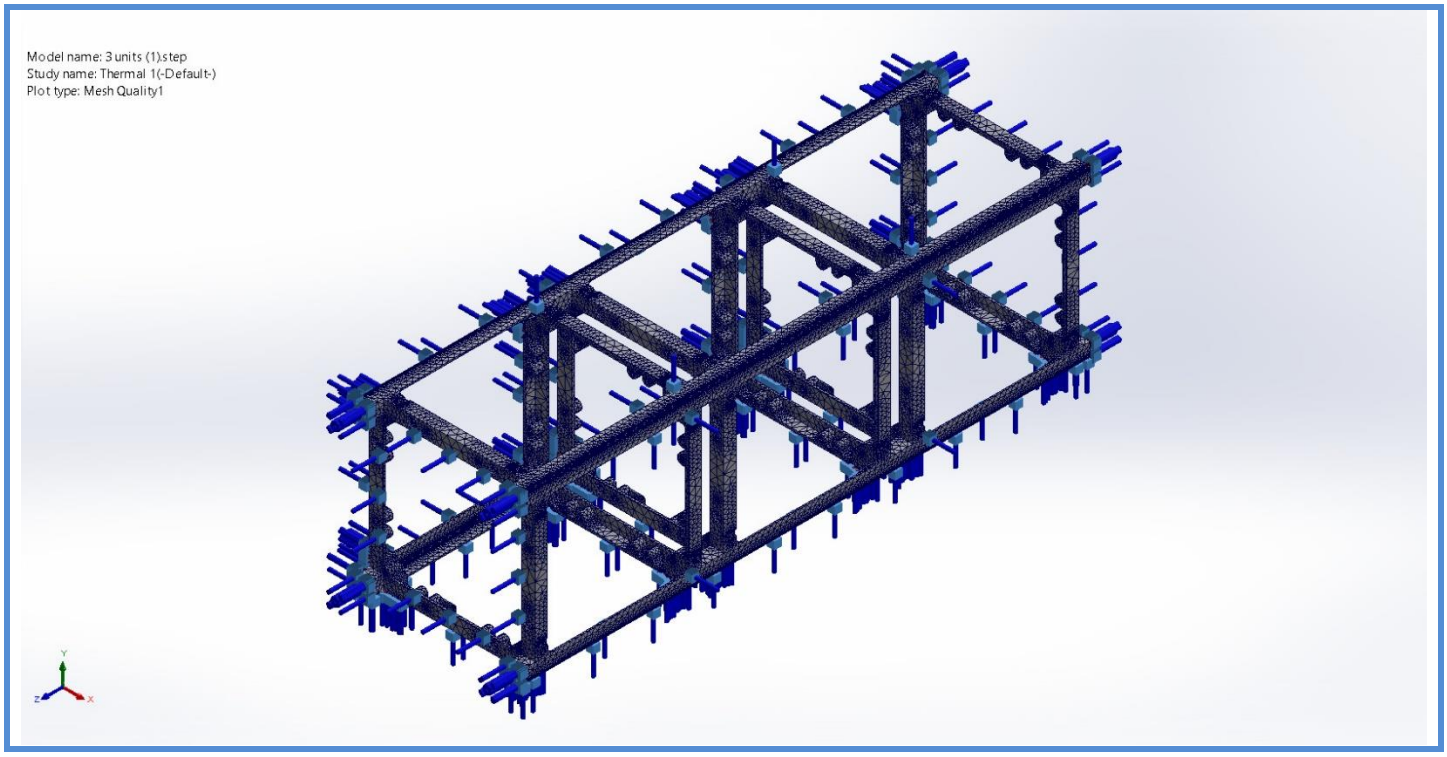
Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	14.3246 mm
Minimum element size	0.716231 mm
Mesh Quality	High

Mesh information - Details

Total Nodes	623244
Total Elements	364470
Maximum Aspect Ratio	32.004
% of elements with Aspect Ratio < 3	95
Percentage of elements with Aspect Ratio > 10	0.449
Percentage of distorted elements	0
Time to complete mesh(hh;mm;ss):	00:00:40
Computer name:	

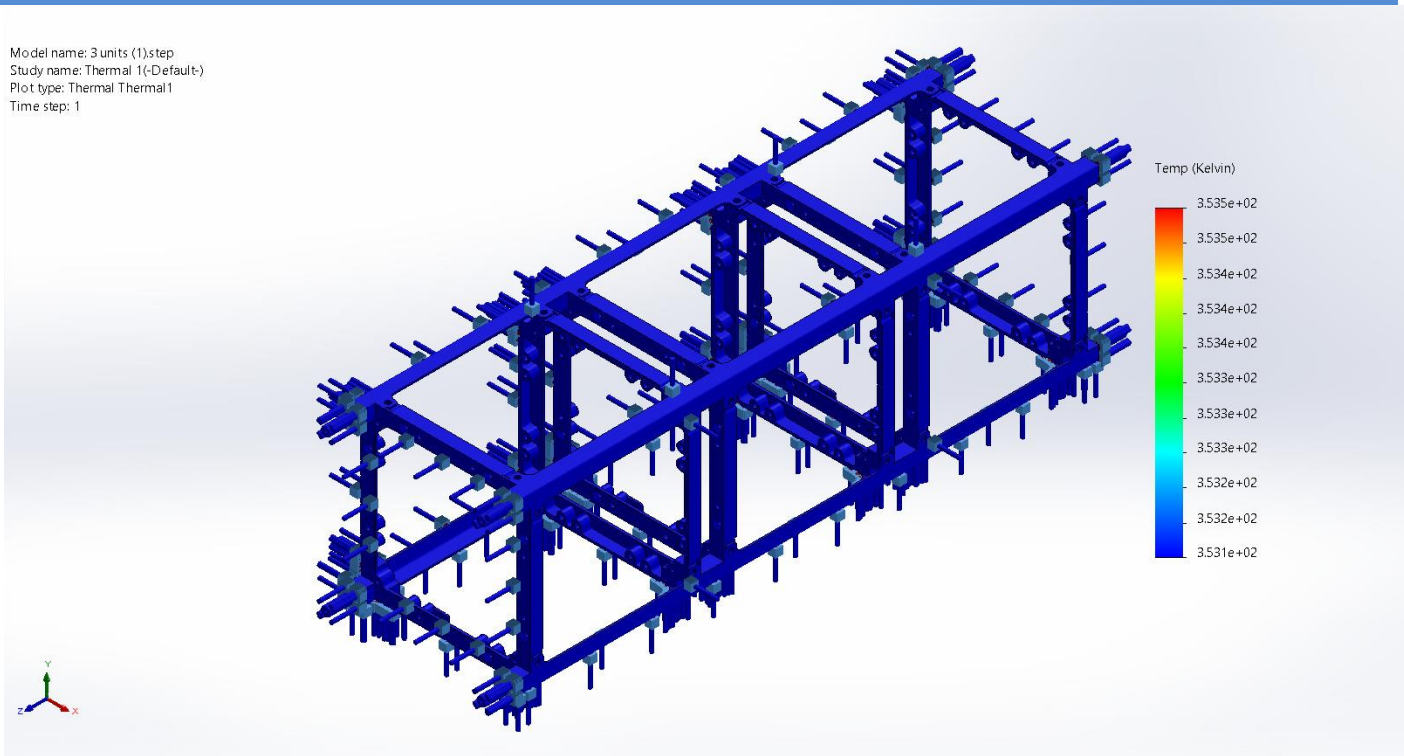
Mesh Quality Plots

Name	Type	Min	Max
Quality1	Mesh	-	-



Study Results

Name	Type	Min	Max
Thermal1	TEMP: Temperature	3.531e+02Kelvin Node: 1	3.531e+02Kelvin Node: 1



3 units- Thermal-Thermal