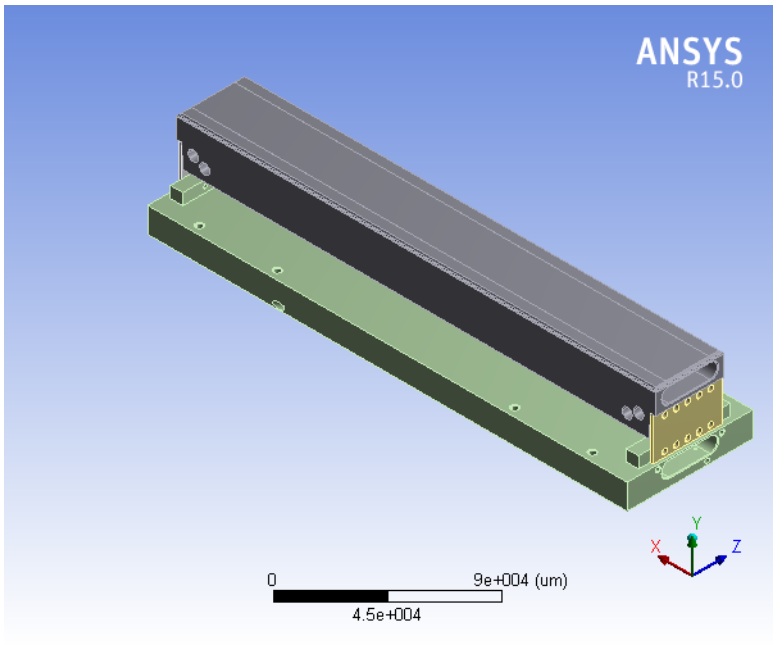
Lawrence Berkeley National Lab - ALS
One Cyclotron Road
Berkeley CA 94720



Thermal Analysis of the Beamline 7.3.1 Monochromator Grating

Date: Friday, May 30, 2014
Engineer: Jamie Nasiatkan Andrew Doran
Study name: Steady State Thermal
Analysis type: Thermal(Steady state)

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Description

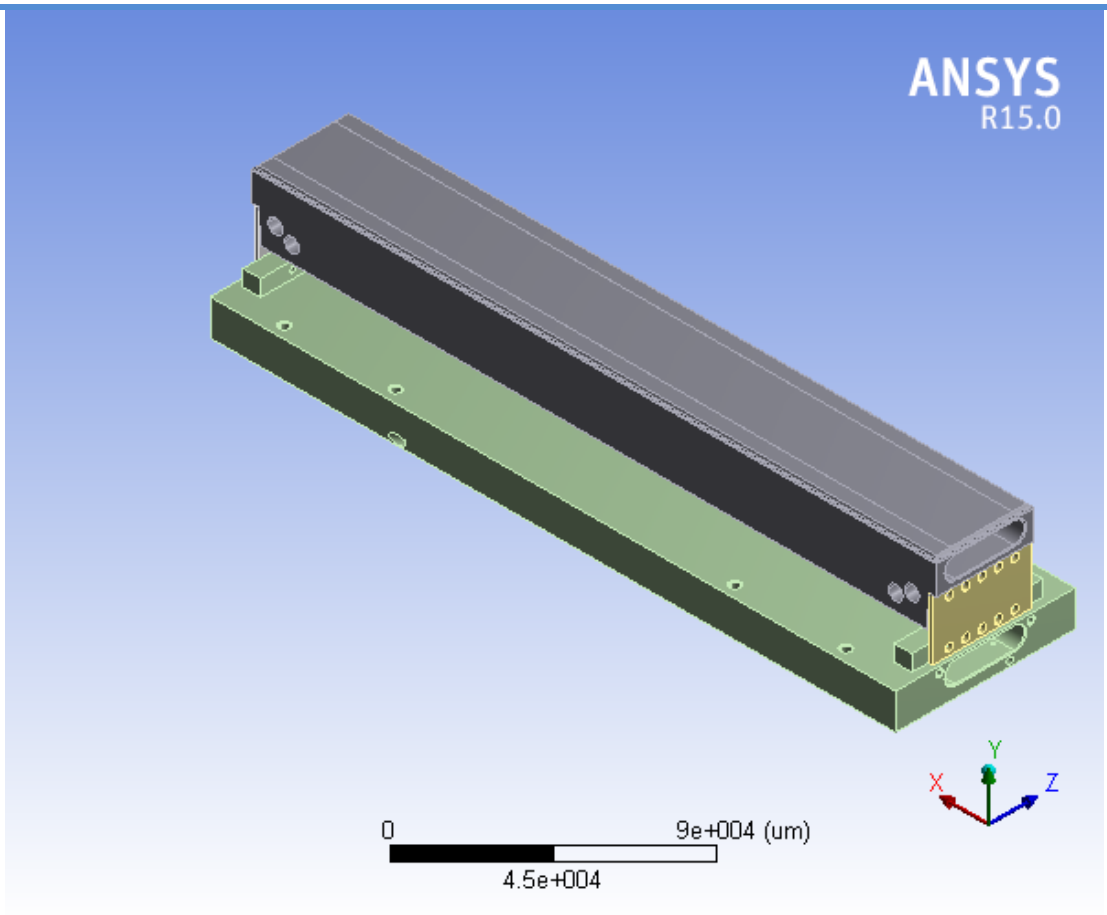
This report summarizes the thermal analysis of monochromator grating for Beamline 7.3.1 as part of the effort to re-bend and re-align the optic. This analysis looks at the overall temperature distribution across the grating and the deformation in the Y (vertical) axis as it would effectively un-bend the grating during operation.

Assumptions

The grating is located 12 meters downstream of the source and is 1mRad tall x 2mRad wide equating to a spot 12mm x 24mm. The heat load is spread out across the face of the grating which sits at nominally 2.5 degrees from the horizontal. Convective heat transfer from the cooling water is set to be 5,000W/m^2K.

The total power for the aperture in the horizontal is 18.5 Watts per milliradian, and in the vertical direction the beam is a Gaussian shape with peak power density of 44.95 Watts/$mRad^2$ and sigma = 0.1643 mRad This load is applied across the surface of the grating and cooling water runs through channels along the inside of the optic.

Model Information



Model name: Monochromator Grating
Current Configuration: Default

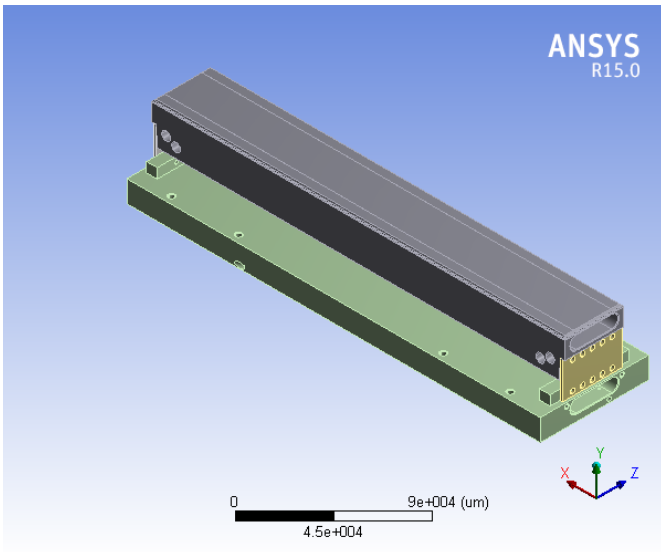
Study Properties

Study name	Steady State Thermal
Analysis type	Thermal(Steady state)
Mesh type	Solid Mesh
Solver type	FFEPlus
Solution type	Steady state
Contact resistance defined?	Yes

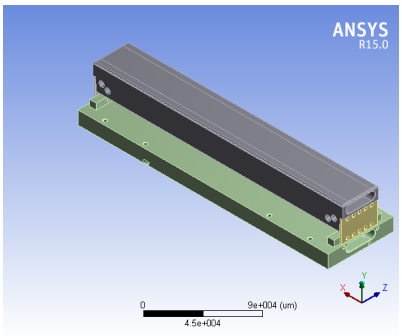
Units

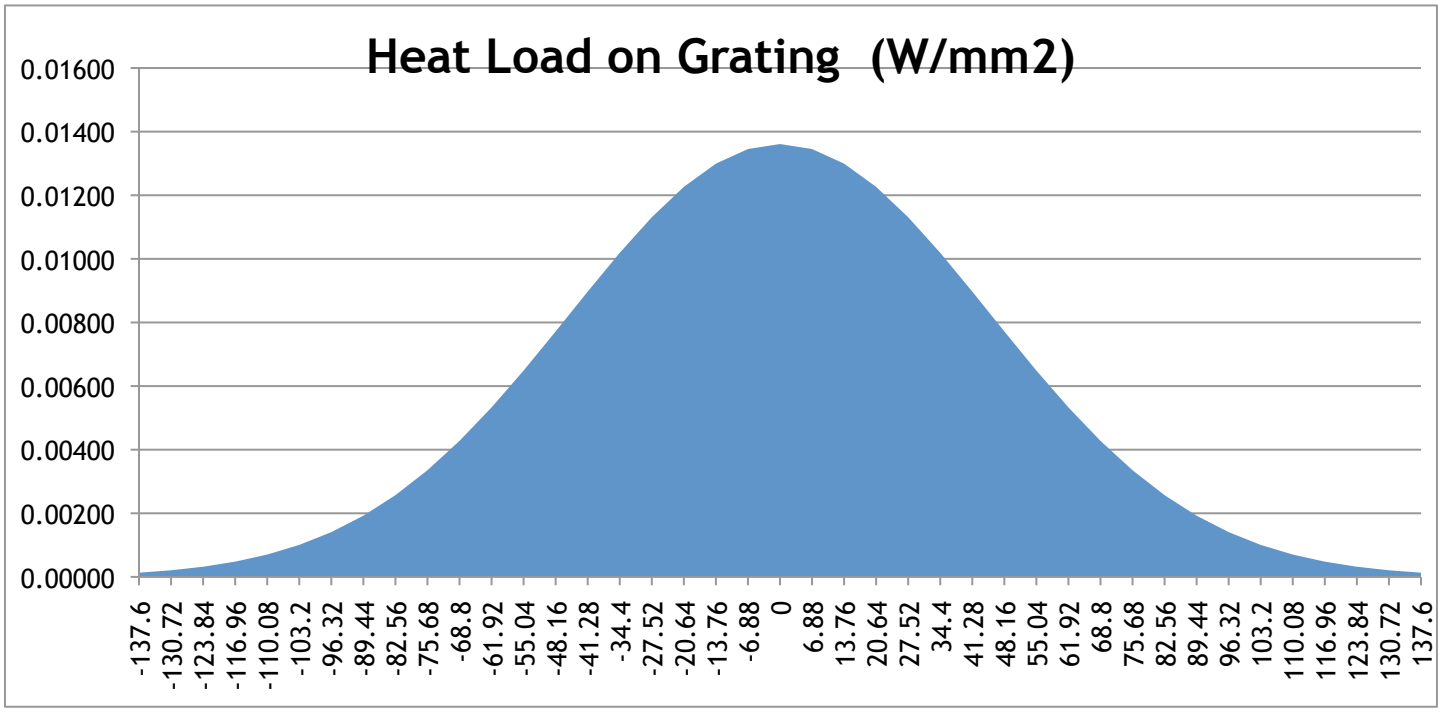
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

Material Properties

Model Reference	Materials
	**Grating:** Invar **Bender Frame:** ASI-304 Stainless Steel **Grating End Flexures:** ASI-304 Stainless Steel

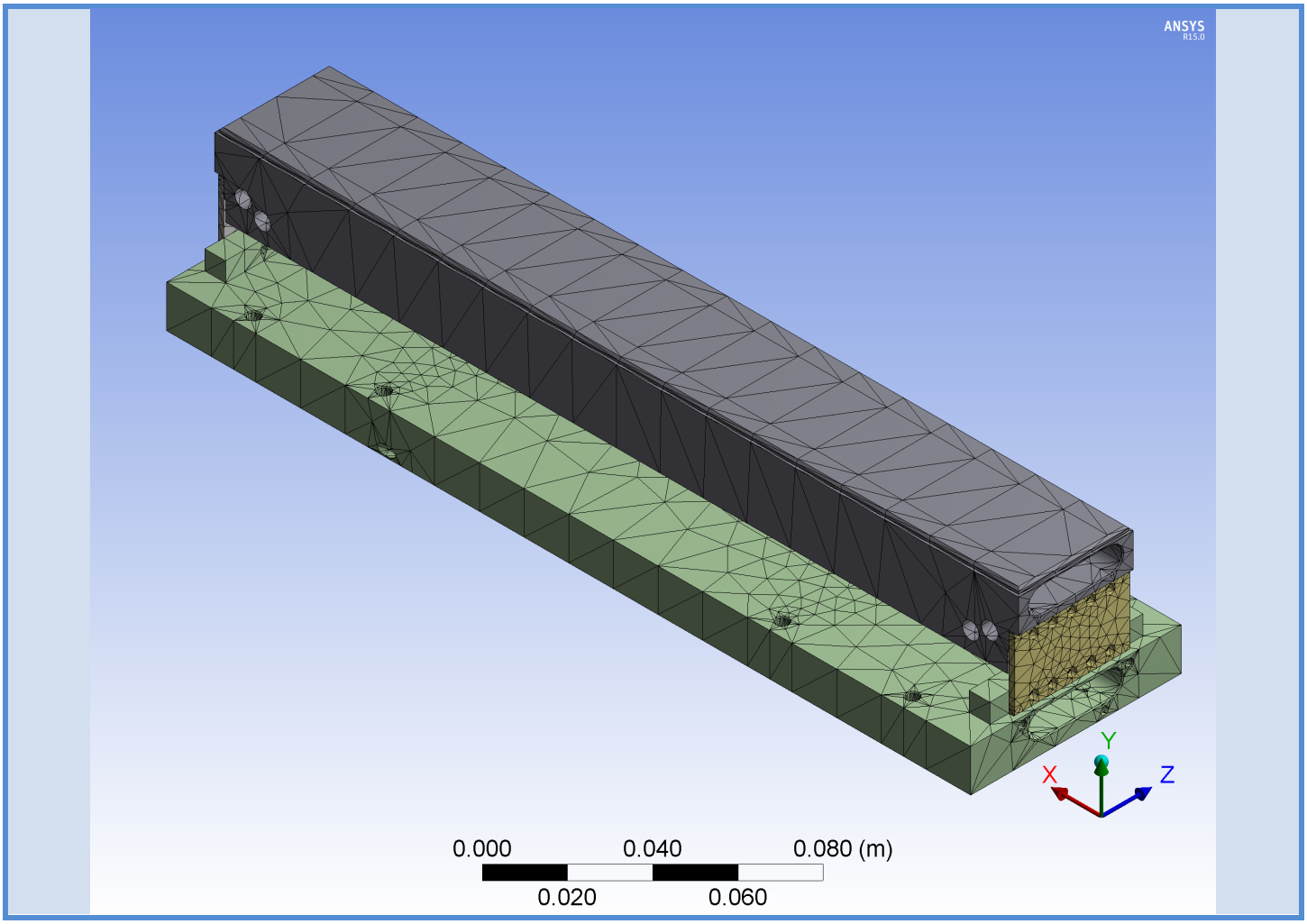
Thermal Loads

Load name	Load Image	Load Details
Convection		**Entities:** 8 face(s) **Convection Coefficient:** 5000 W/(m^2.K) **Time variation:** Off **Temperature variation:** Off **Bulk Ambient Temperature:** 293 Kelvin **Time variation:** Off


Heat Load on Grating (W/mm2)
0.01600
0.01400
0.01200
0.01000
0.00800
0.00600
0.00400
0.00200
0.00000
-137.6
-130.72
-123.84
-116.96
-110.08
-103.2
-96.32
-89.44
-82.56
-75.68
-68.8
-61.92
-55.04
-48.16
-41.28
-34.4
-27.52
-20.64
-13.76
-6.88
0
6.88
13.76
20.64
27.52
34.4
41.28
48.16
55.04
61.92
68.8
75.68
82.56
89.44
96.32
103.2
110.08
116.96
123.84
130.72
137.6

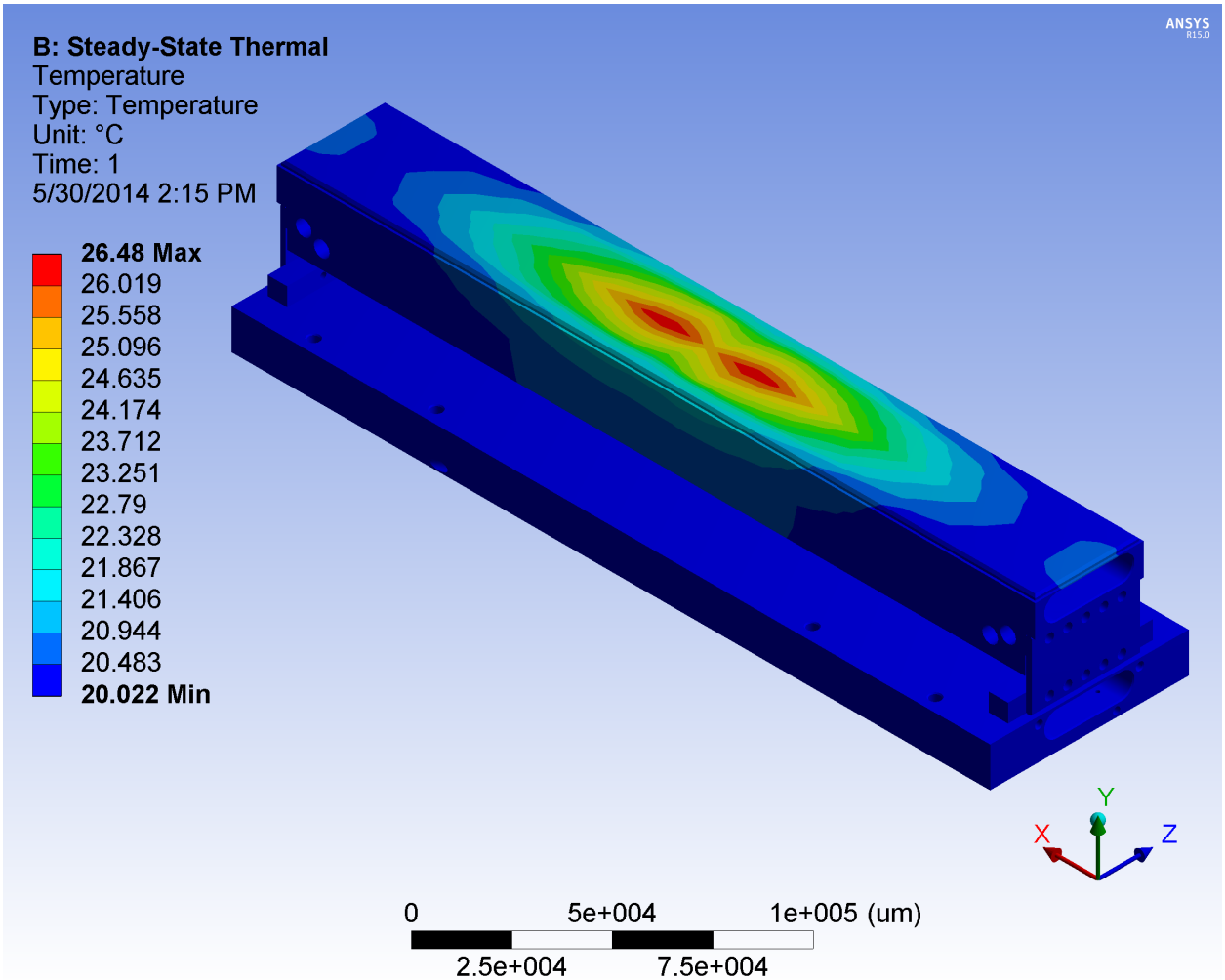
Mesh Information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	On



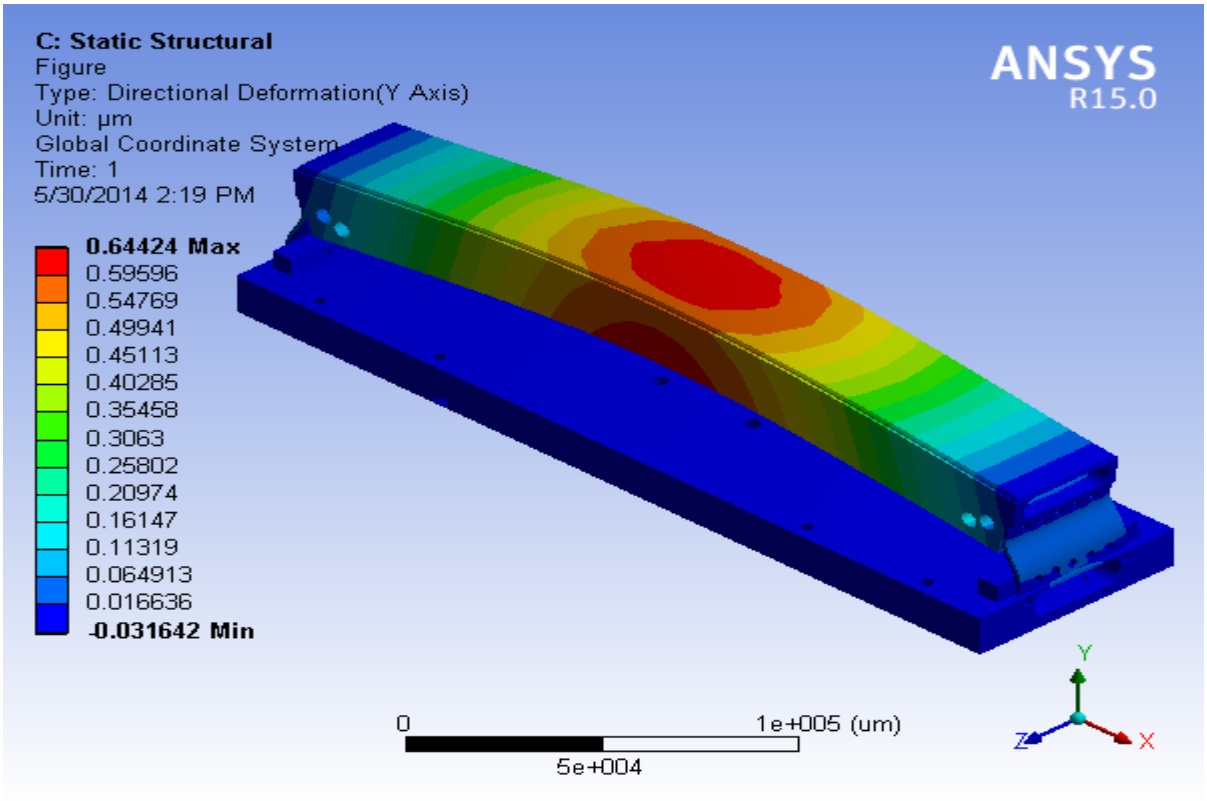
Study Results

Name	Type	Min	Max
Temperature Distribution	TEMP: Temperature	20.02°C	26.48°C



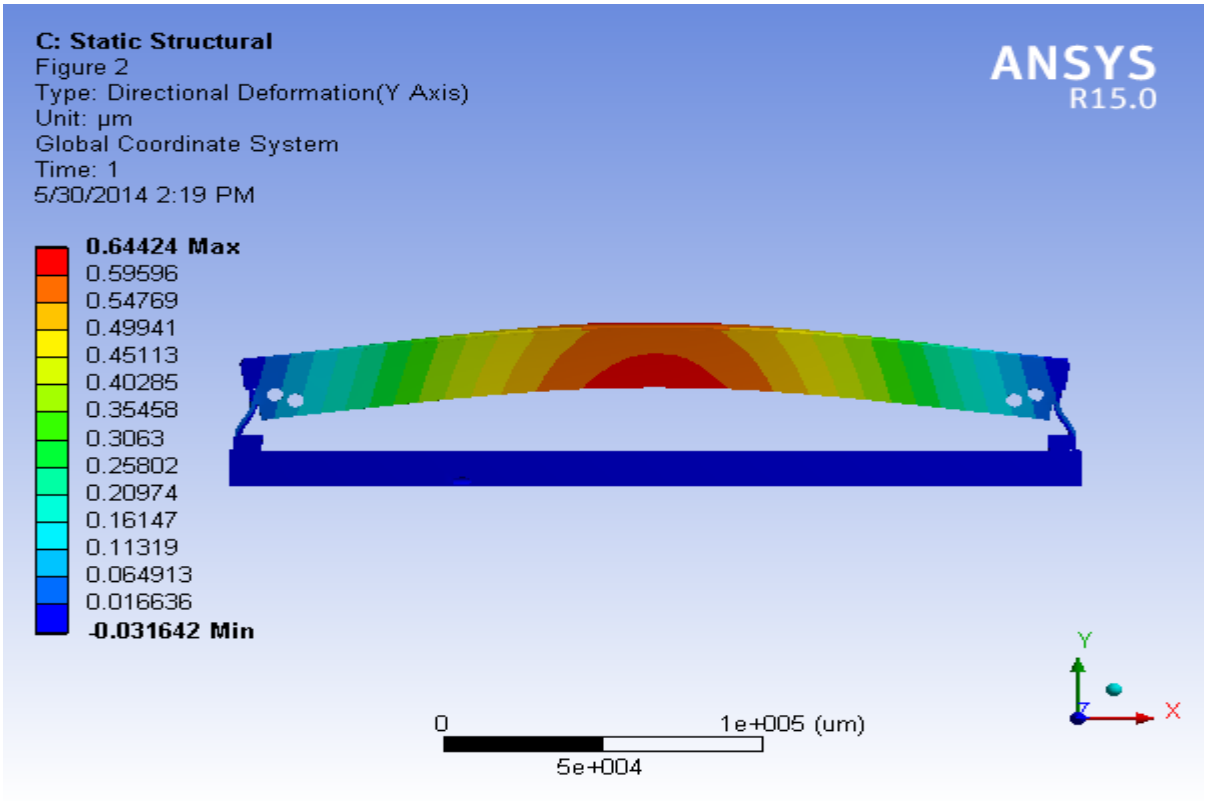
Grating Temperature Distribution

Name	Type	Min	Max
Vertical Deformation	Displacement	-0.03um	0.64um



Grating Vertical Displacement

Name	Type	Min	Max
Vertical Deformation	Displacement	-0.03um	0.64um



Grating Vertical Displacement