

Analysis of a Brake System

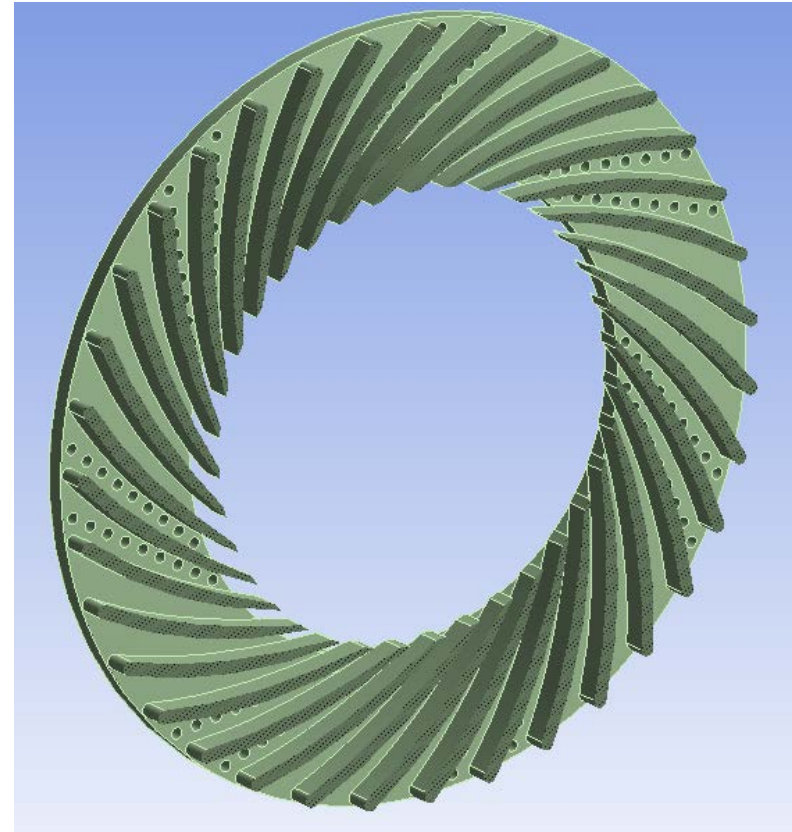
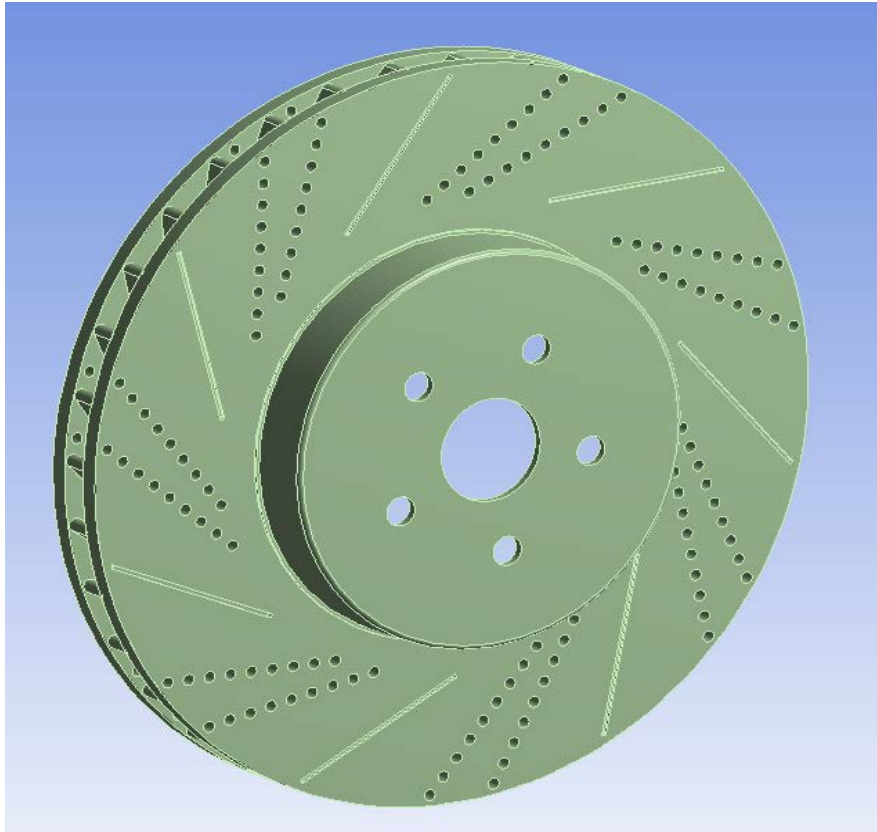
Mike Emerson | FEM Final Project

Overview

- Geometry and Material
- Static Analysis
- Steady State Thermal Analysis
- Modal Analysis
- Conclusions

Geometry and Material

- Geometry is a simplified Brembo automotive brake system



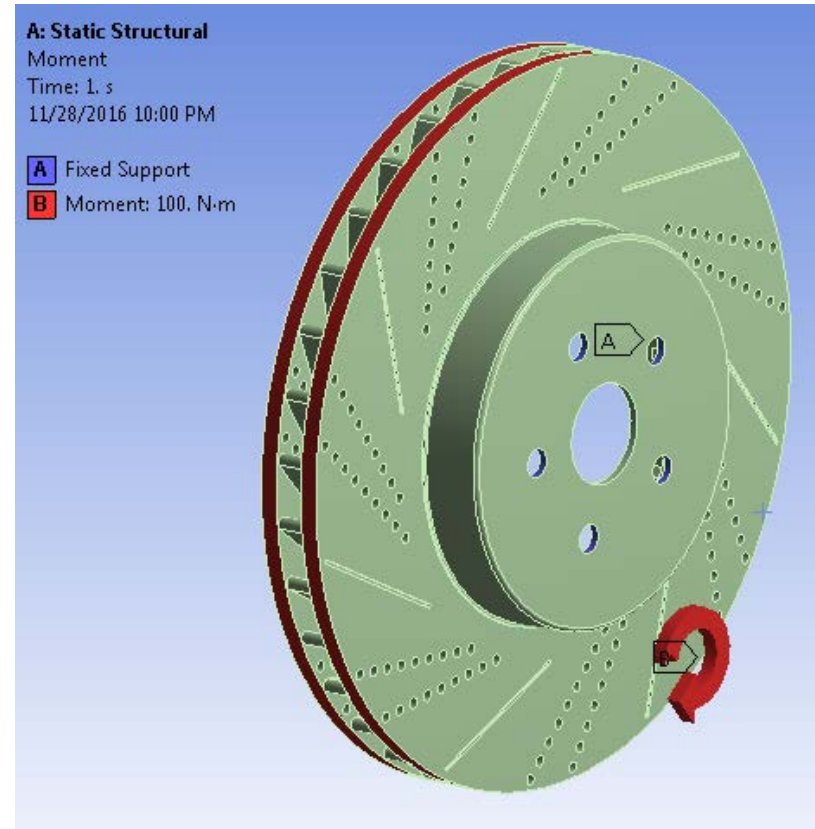
Geometry and Material

- Material is Structural Steel with the following properties:

Material Properties - Structural Steel		
Density	7850	kg m ⁻³
Young's Modulus	2.0 E+11	Pa
Poisson's Ratio	0.3	
Thermal Expansion Coefficient	1.20E-05	C ⁻¹
Zero-Thermal-Strain Reference Temperature	22	C

Static Analysis – Boundary Conditions

- 100 Nm moment applied as well as fixed supports at bolt holes



Static Analysis – Results

A: Static Structural

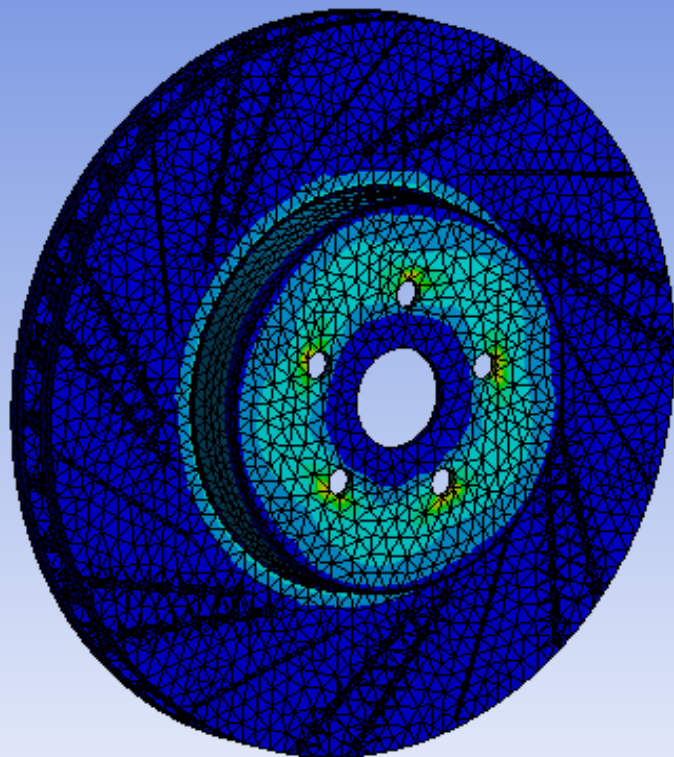
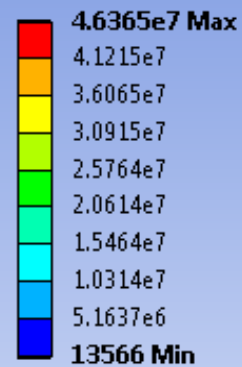
Equivalent Stress

Type: Equivalent (von-Mises) Stress

Unit: Pa

Time: 1

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A: Static Structural

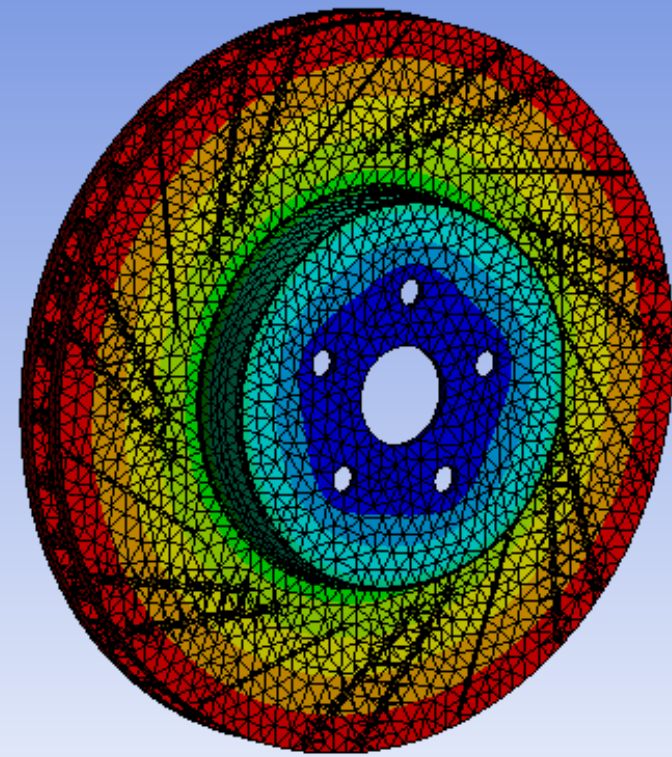
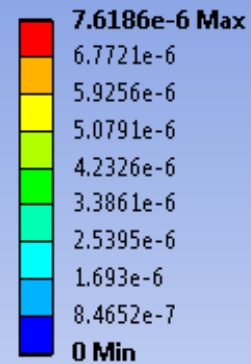
Total Deformation

Type: Total Deformation

Unit: m

Time: 1

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c Structu
x Von Mi
4.6
4.9
5.3

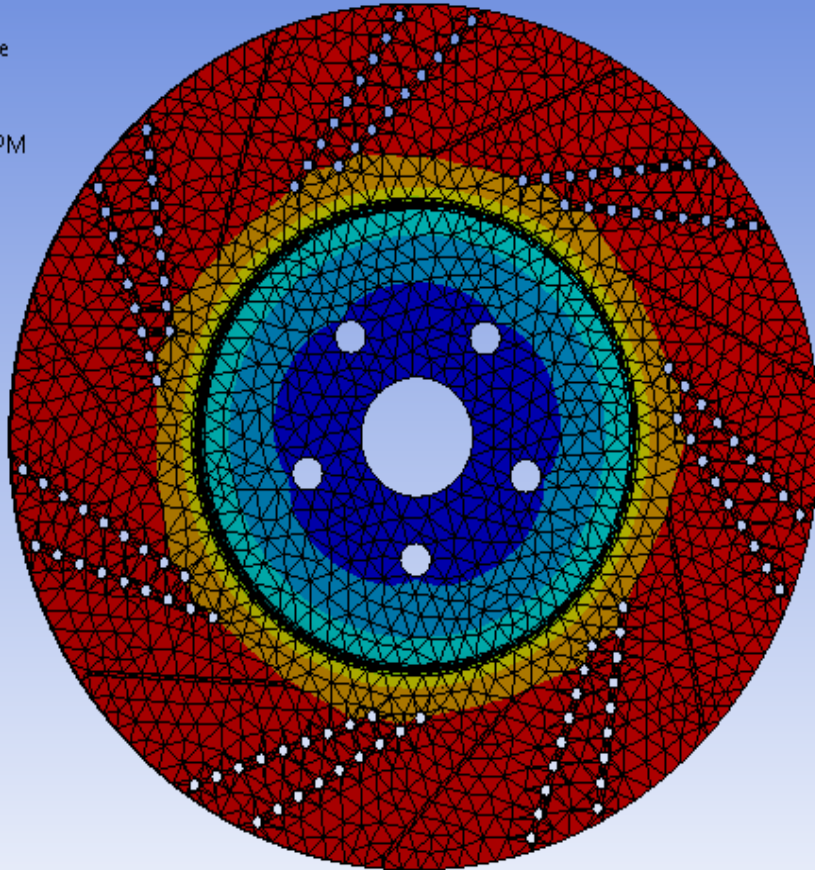
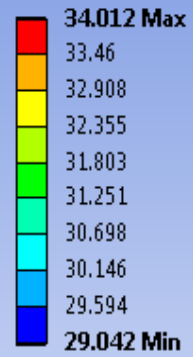
Steady State Thermal – Temperature Results

- Fixed at bolt holes, uniform heat flux on rotor faces, convection on all others
- Heat Flux = 1000 W/m^2
- Convective film coefficient of $30 \text{ W/(C}^{\circ}\text{m}^2)$
- Ambient Temperature of 22 C

Steady State Thermal – Temperature Results

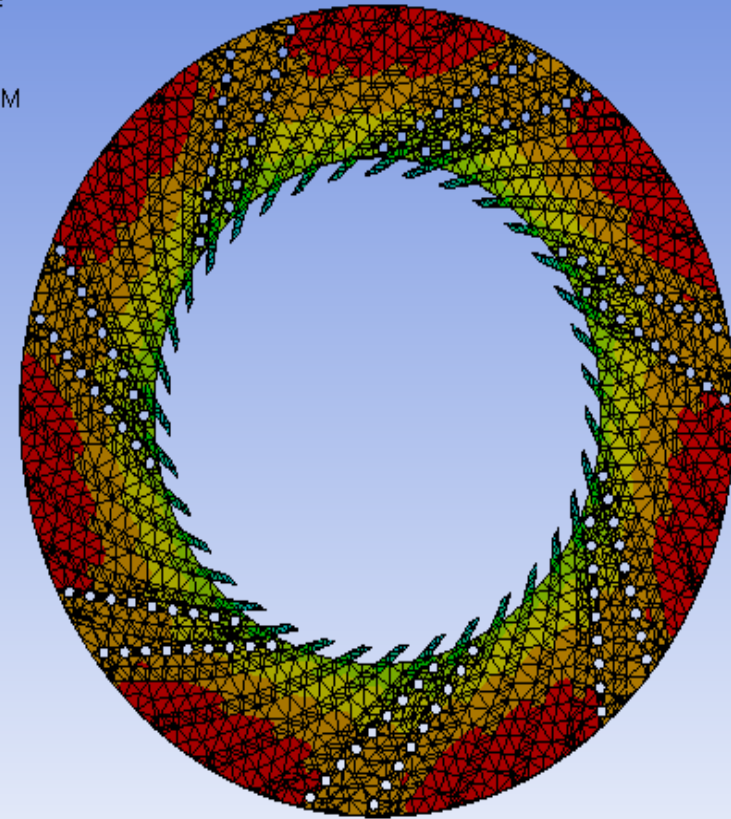
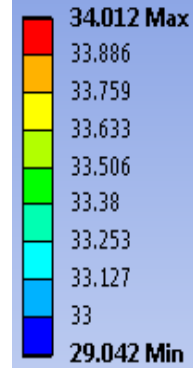
B: Steady-State Thermal

Temperature
Type: Temperature
Unit: °C
Time: 1
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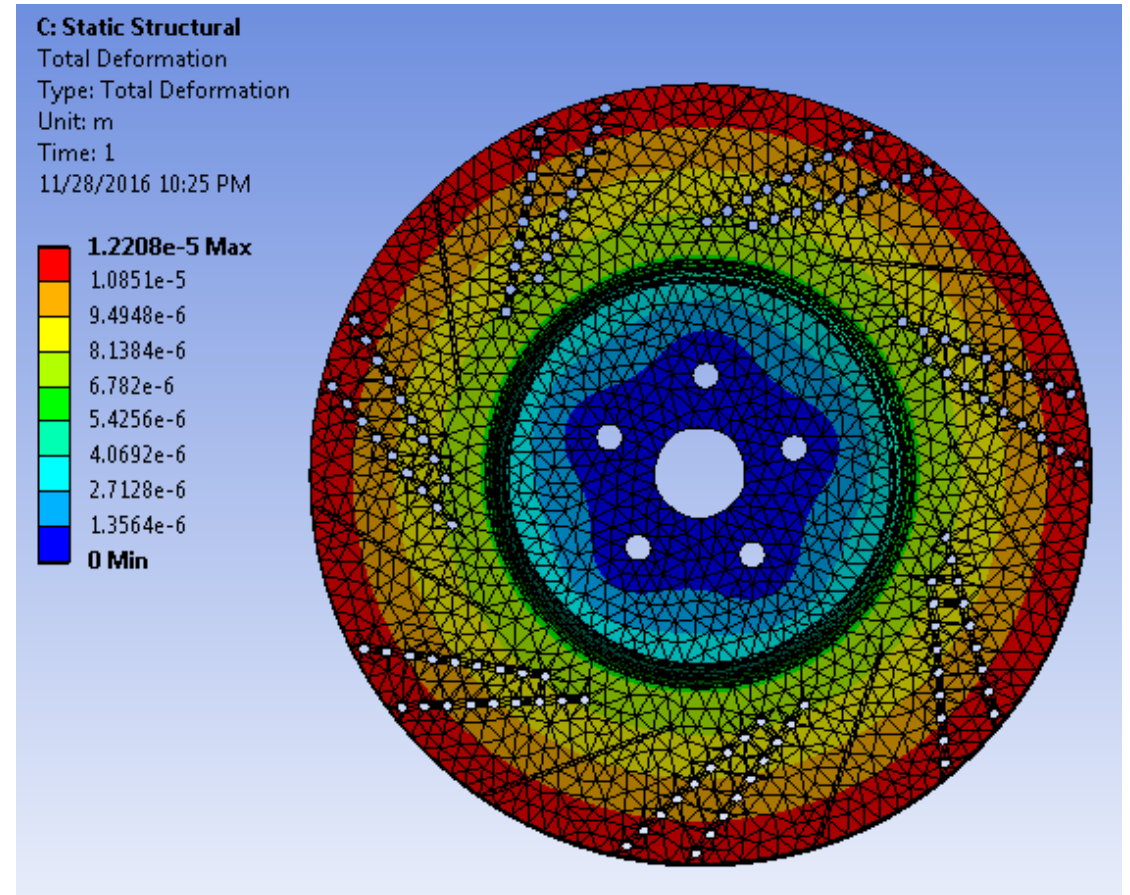
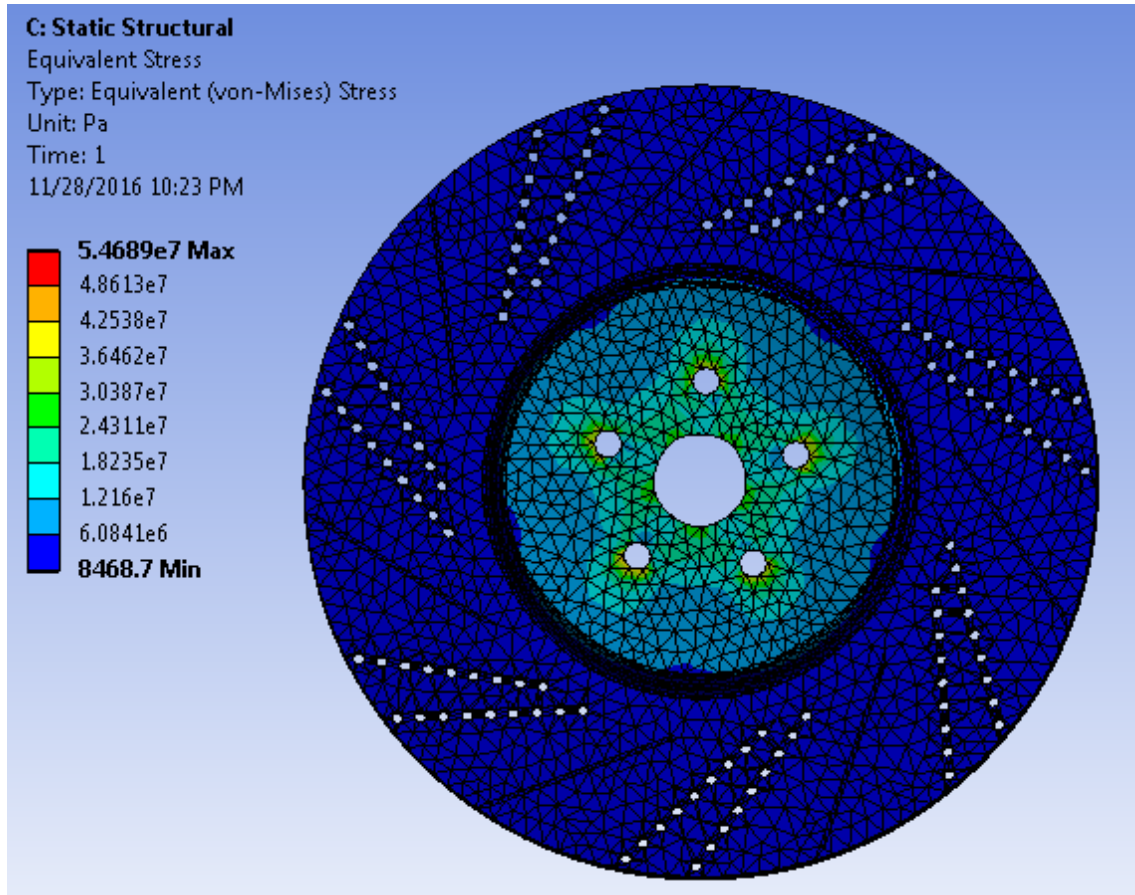


B: Steady-State Thermal

Temperature
Type: Temperature
Unit: °C
Time: 1
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Steady State Thermal – Thermal Stress Results



Modal Analysis - Results

- Mode shapes as well as modal frequencies were analyzed
- Fixed support on bolt holes
- First 6 modes were analyzed
- Modes 1 and 2 as well as 5 and 6 are repeated

Mode	Freq (Hz)
1	387.26
2	387.9
3	795.52
4	2142.4
5	2161.2
6	2161.9

Modal Analysis - Results

D: Modal

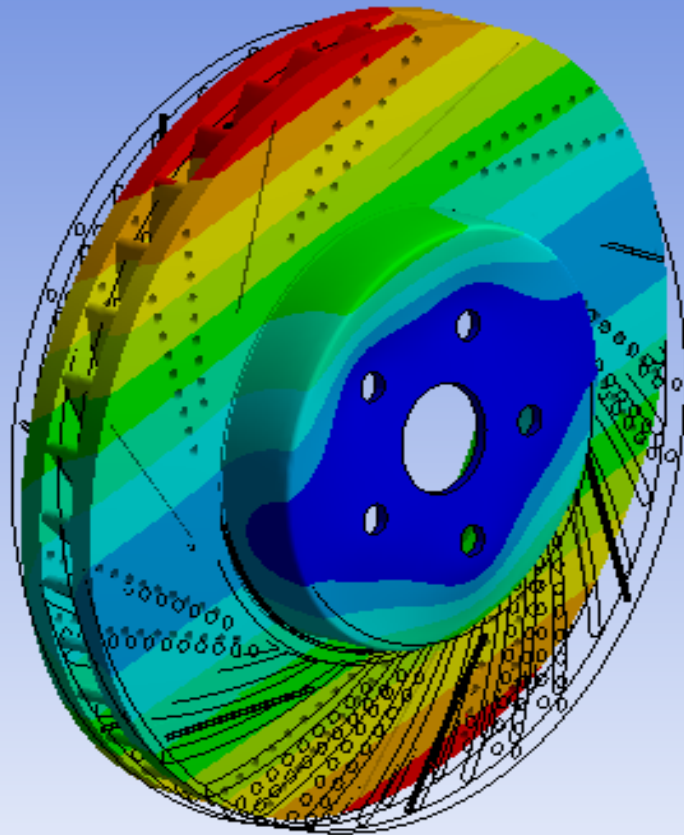
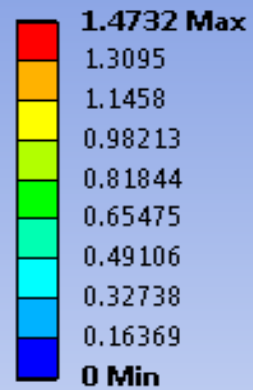
Total Deformation

Type: Total Deformation

Frequency: 387.26 Hz

Unit: m

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D: Modal

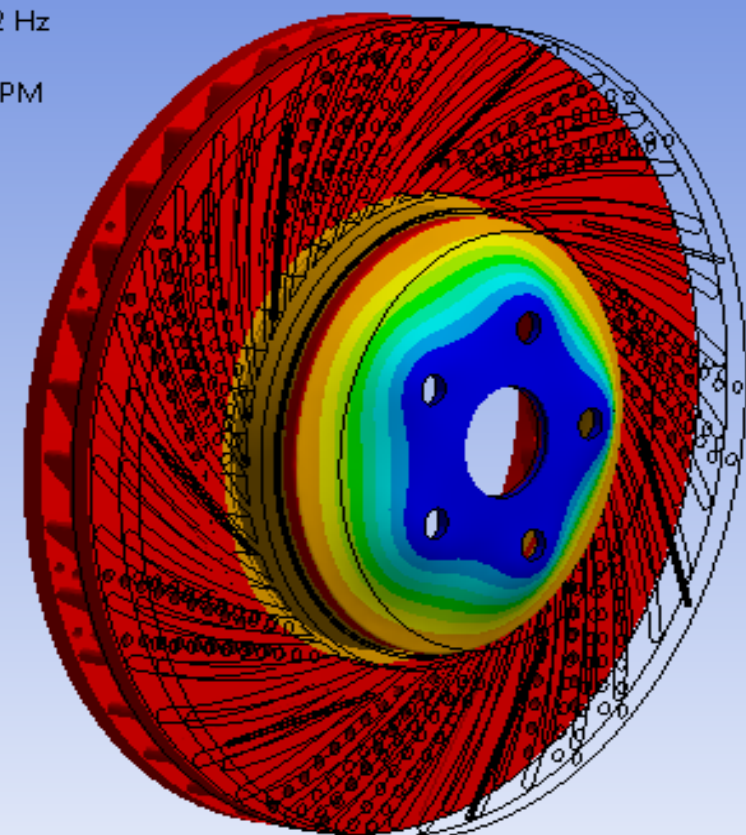
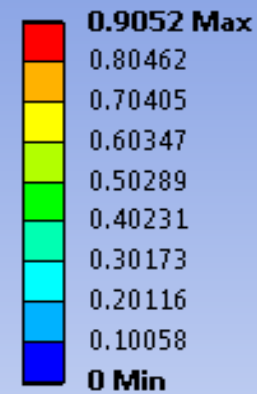
Total Deformation 3

Type: Total Deformation

Frequency: 795.52 Hz

Unit: m

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Modal Analysis - Results

