**Nhat Cao**

Final Project
6/4/09

Introduction to FEA II
20-MECH-526
Spring Quarter, 2009

# Brief Background of Miter Gears

- Miter gears are bevel gears put together with equal numbers of teeth and axes that are usually at right angles.

- They are known for efficient power transfer and durability.

- They can carry heavy loads.

- Miter gears are used in printing, agriculture, bottling, and material handling and steering.

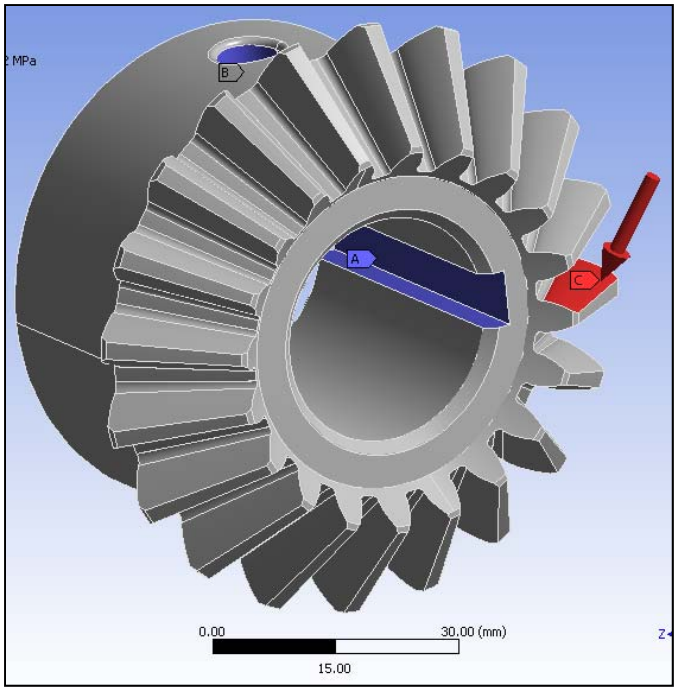
# Problem Descriptions

- Perform static and modal analyses using ANSYS Workbench.

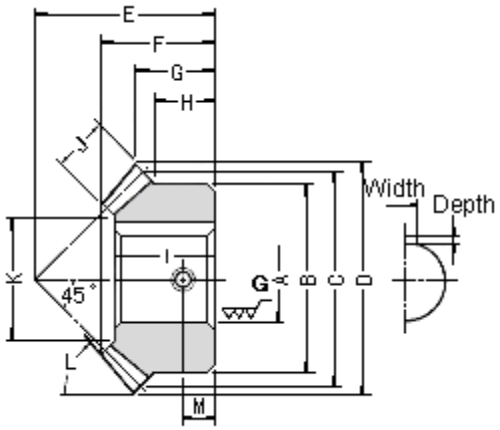
- A load of 500 lb is transmitted to the upper surface of the tooth. The area of the surface is 0.16313 $in^2$. So, the pressure applied to the surface is 3065 psi (21.113 Mpa).

- The rectangular and cylindrical slots are fixed.

- Gear is made out of SAE 1045 CD steel.



# Gear Descriptions

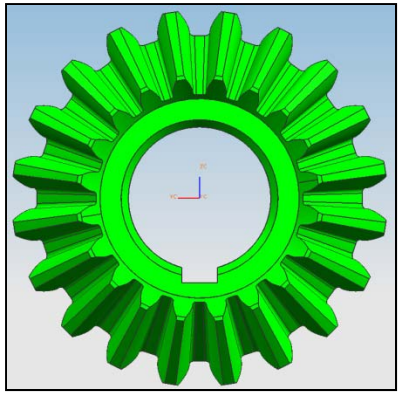



Section View

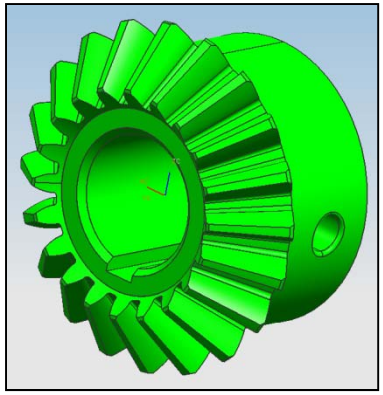
**Miter Gear Description**

| | | | |
|---|---|---|---|
| No. of Teeth | 20 | Crown to back length (G) | 32.47 |
| Bore (A) | 28 | Hub witdth (H) | 25 |
| Hub. dia. (B) | 60 | Length of bore (I) | 40 |
| Pitch dia. (C) | 70 | Face width (J) | 18 |
| Outside dia. (D) | 74.95 | Holding surface distance (K) | 39.09 |
| Mounting distance (E) | 65 | Face angle (L) | 49° 48" |
| Total Length (F) | 44.13 | Threaded hole (M) | 12.5 |

Note: Dimensions are in mm



Front View



Side View

**SAE 1045 CD Properties**

| | | |
|---|---|---|
| Modulus of elasticity | 201 | GPa |
| Possion's Ratio | 0.3 | ~~~ |
| Tensile strength (CD) | 625 | Mpa |
| Yield strength (CD) | 530 | Mpa |
| Hardness (CD) | 88 | RB |
| Density | 7872 | $kg/m^3$ |
| Thermal expansion (20 °C) | 0.000117 | $°C^{-1}$ |
| Specific heat capacity | 486 | J/(kg*K) |
| Thermal conductivity | 50.9 | W/(m*K) |

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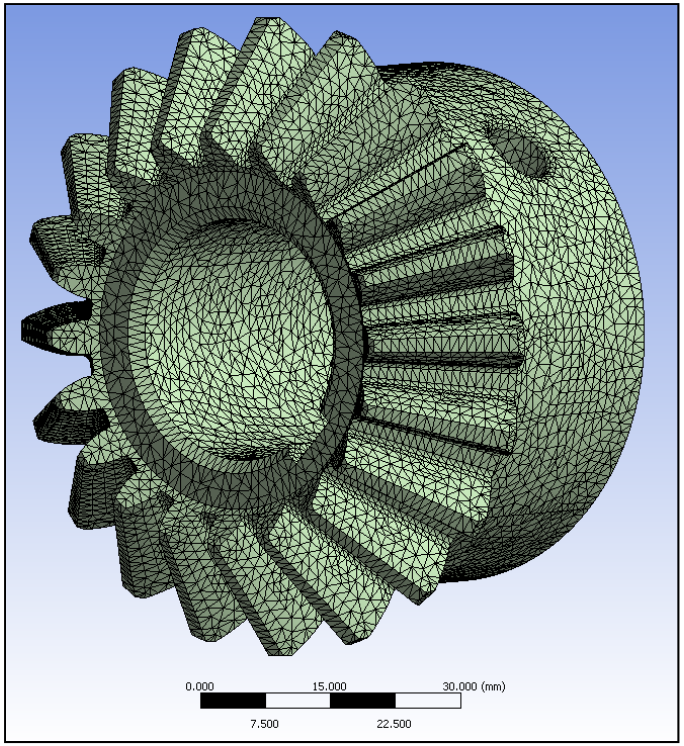
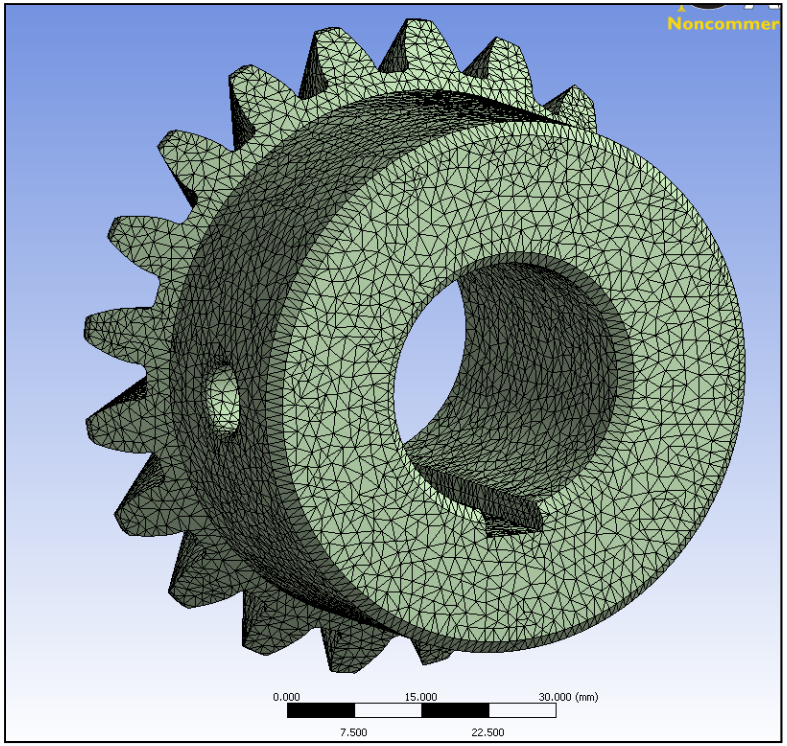
# Meshing of Model




Front View




Side View



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# Results

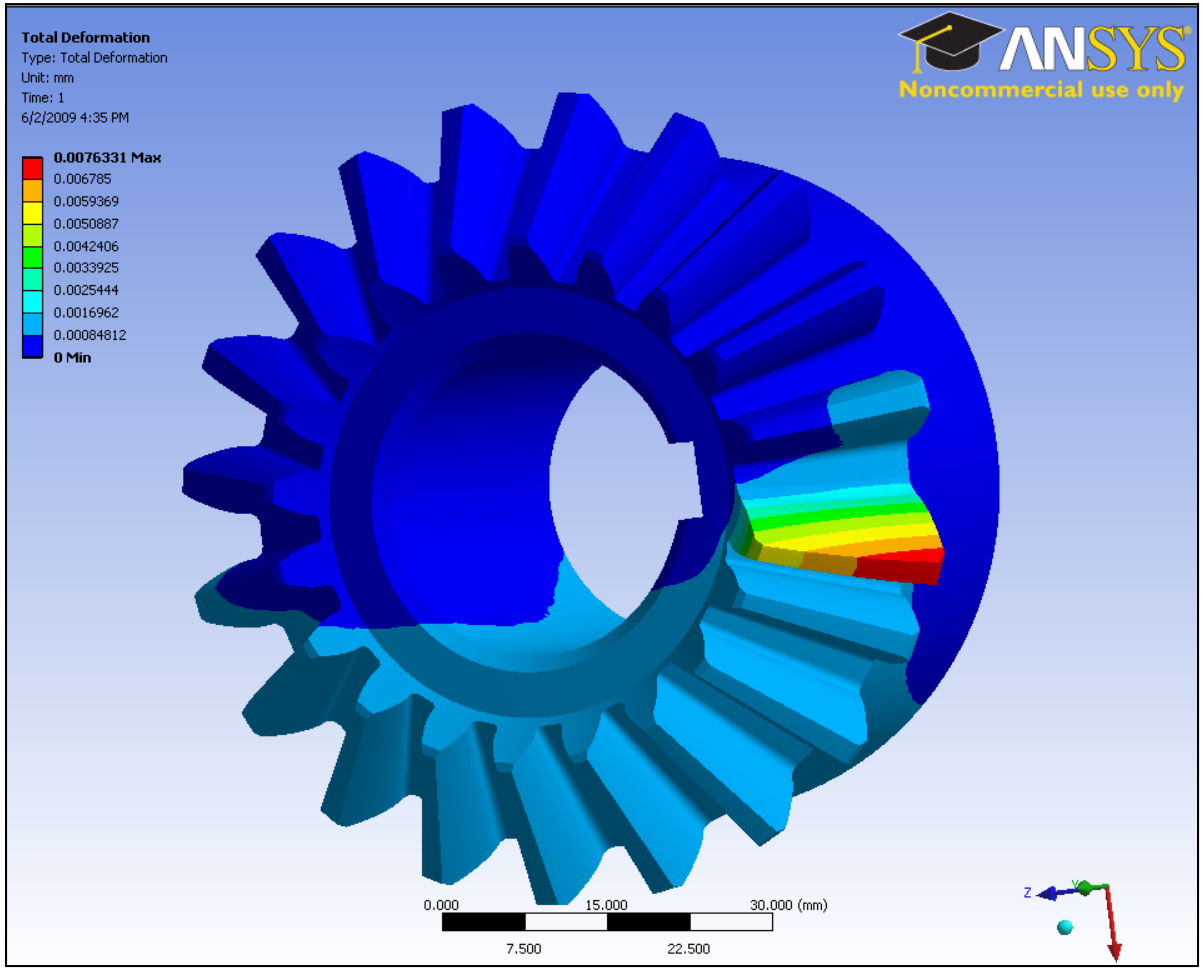
## *Static Analysis*

| | # Elements | Von Mises Stress (Mpa) | Total Deformation(mm) |
|---|---|---|---|
| Mesh #1 | 16382 | 139.08 | 7.49E-03 |
| Mesh #2 | 90596 | 139.96 | 7.63E-03 |
| % Difference | ~~~~~ | 0.63 | 1.93 |

## *Modal Analysis*

| | Frequency (Hz) | | |
|---|---|---|---|
| Mode #1 | Mesh #1 | Mesh#2 | % Difference |
| 1 | 15518 | 15450 | 0.44 |
| 2 | 16261 | 16189 | 0.44 |
| 3 | 17163 | 17105 | 0.34 |
| 4 | 17359 | 17293 | 0.38 |
| 5 | 29262 | 29191 | 0.24 |

# Deformation



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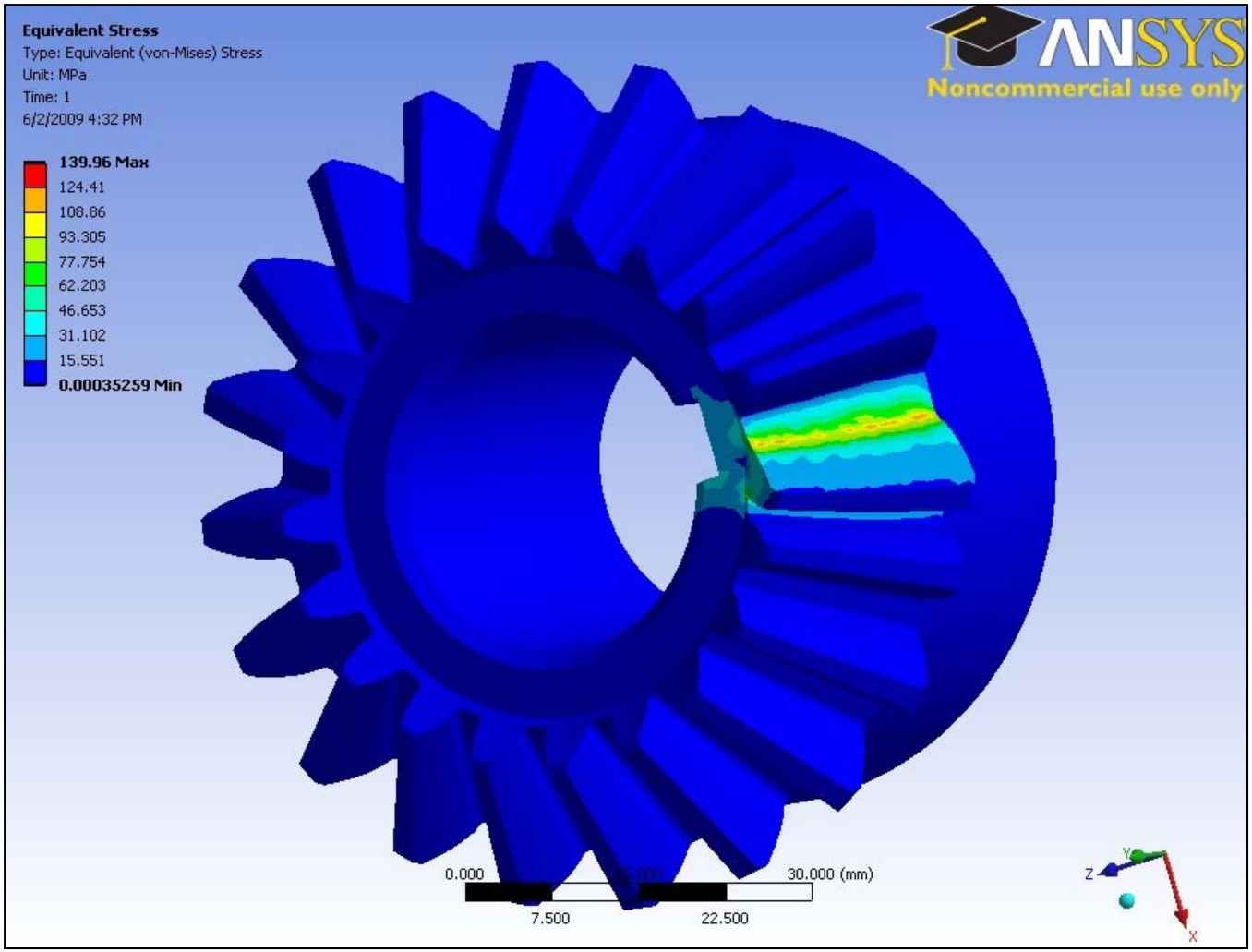
# Von Mises Stress (Mpa)



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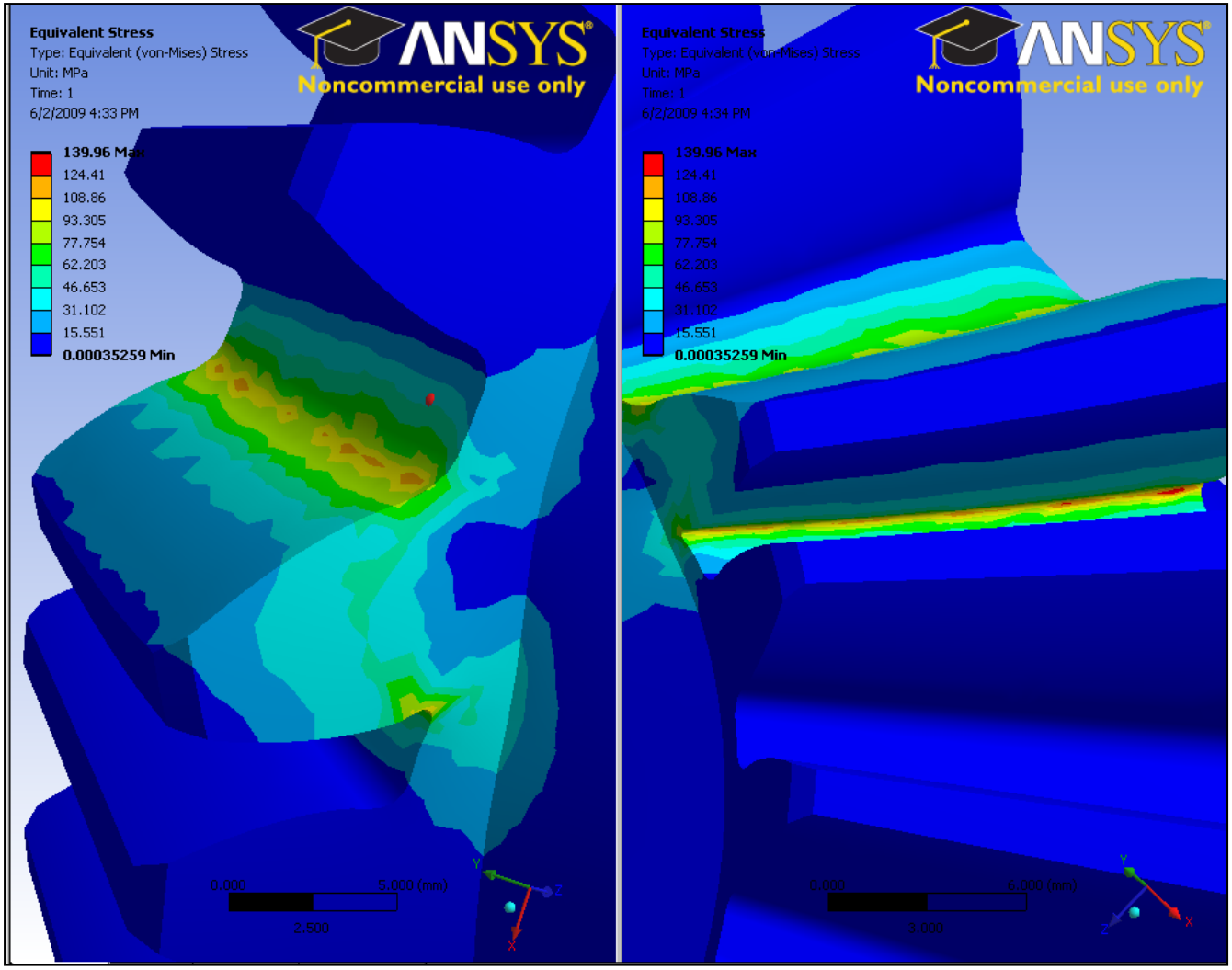
# Von Mises Stress (Closer Look)



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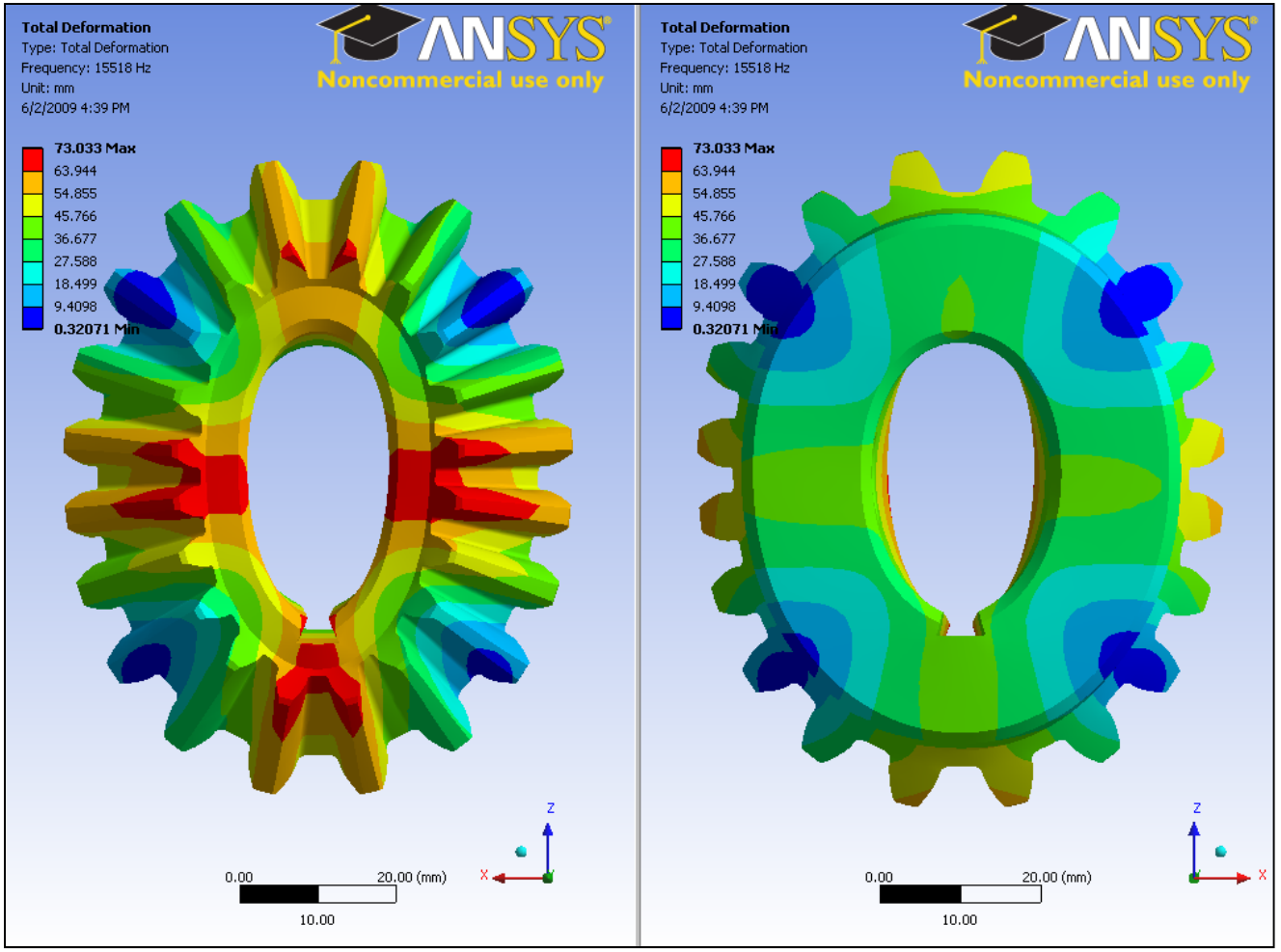
# Mode #1 (15518 Hz)



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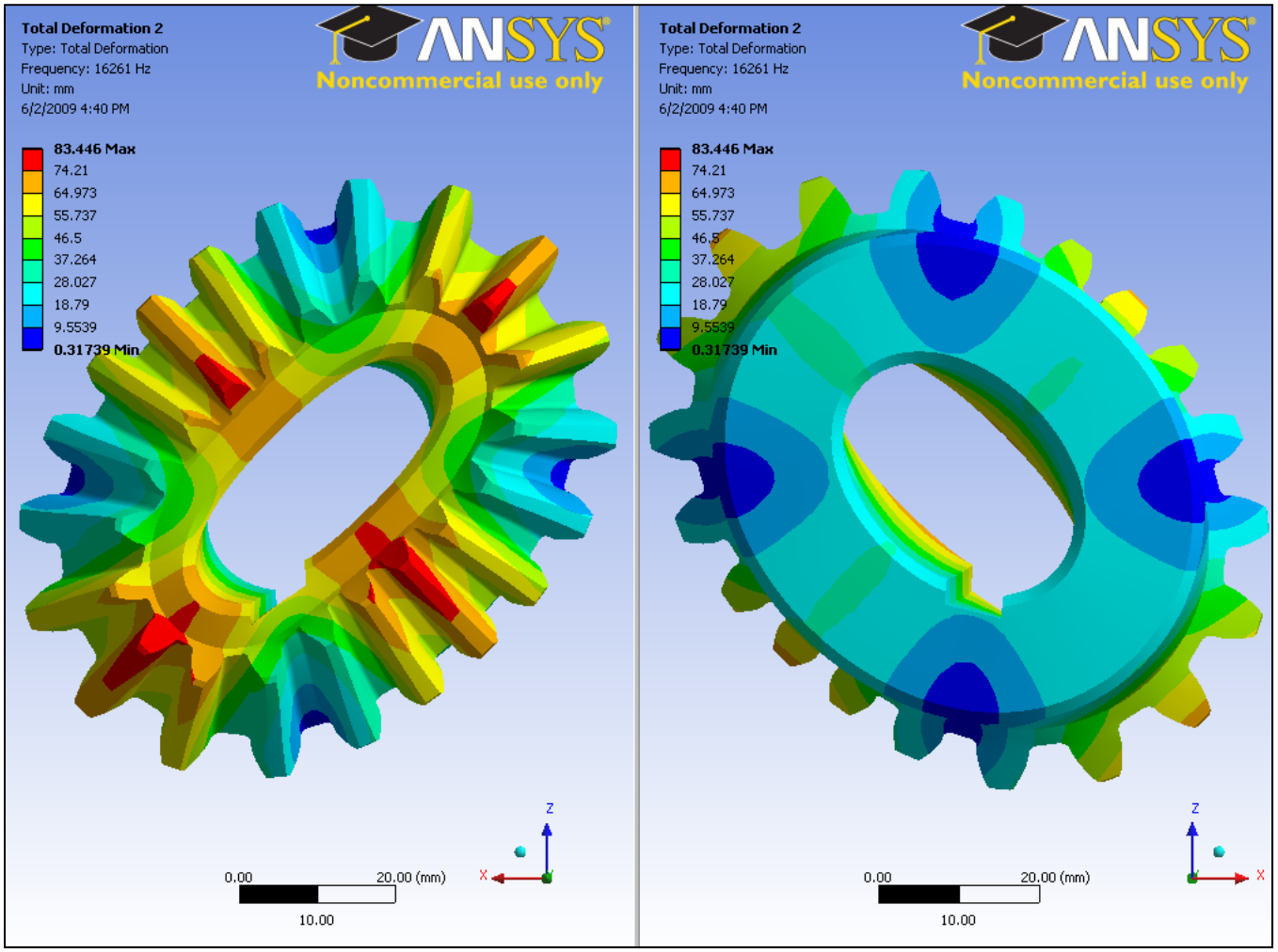
# Mode #2 (16261 Hz)



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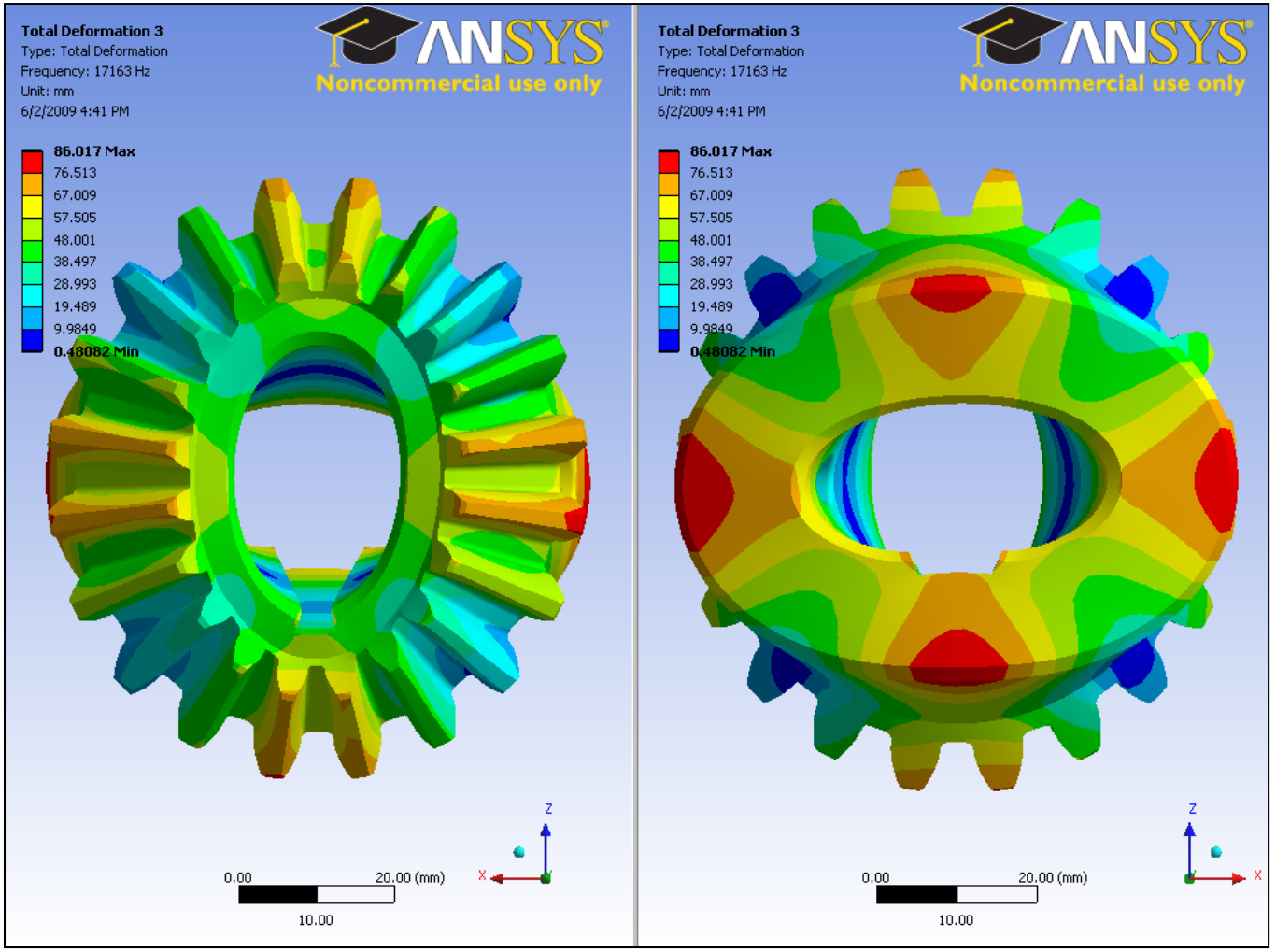
# Mode #3 (17163 Hz)



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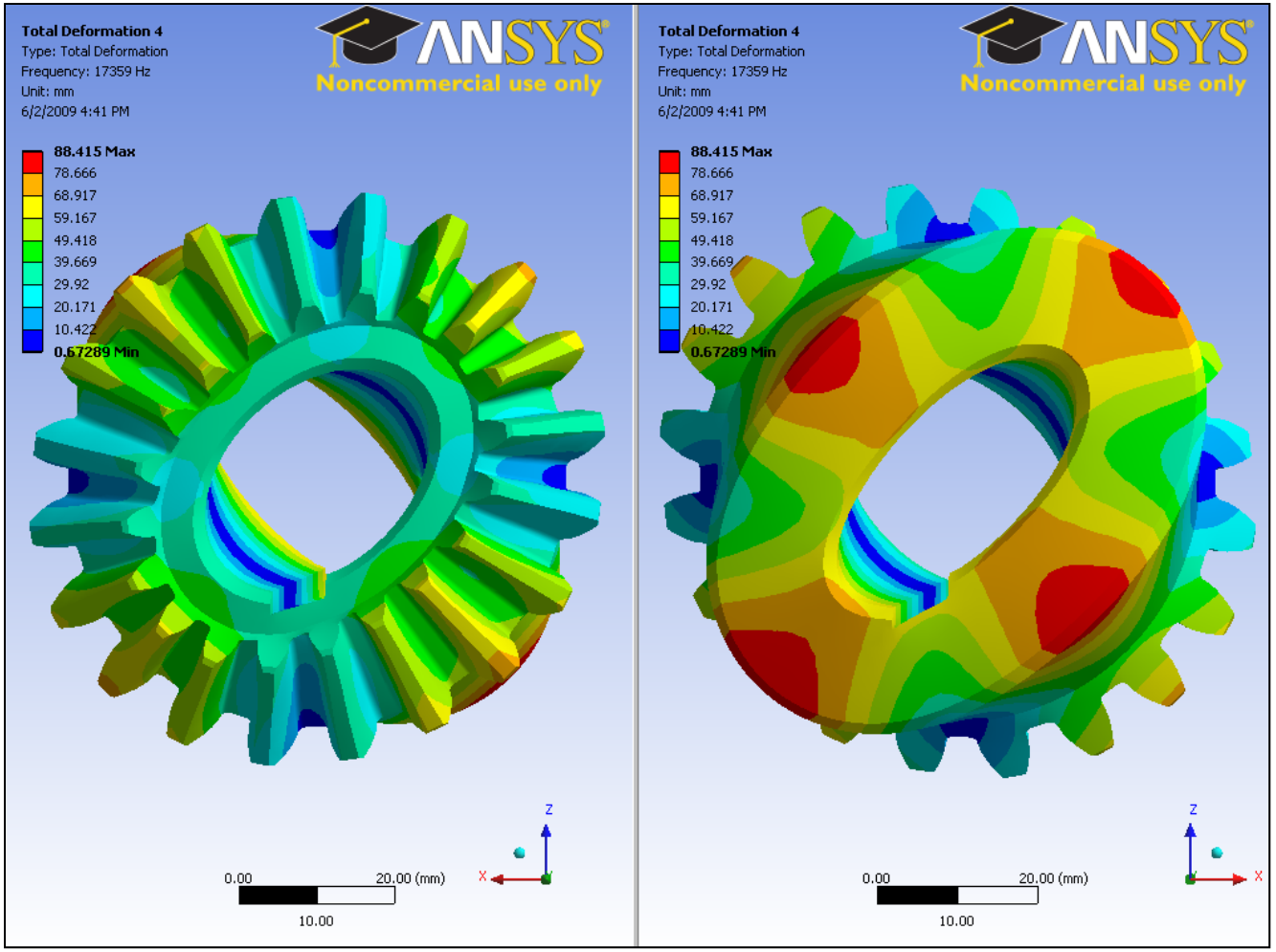
# Mode #4 (17359 Hz)



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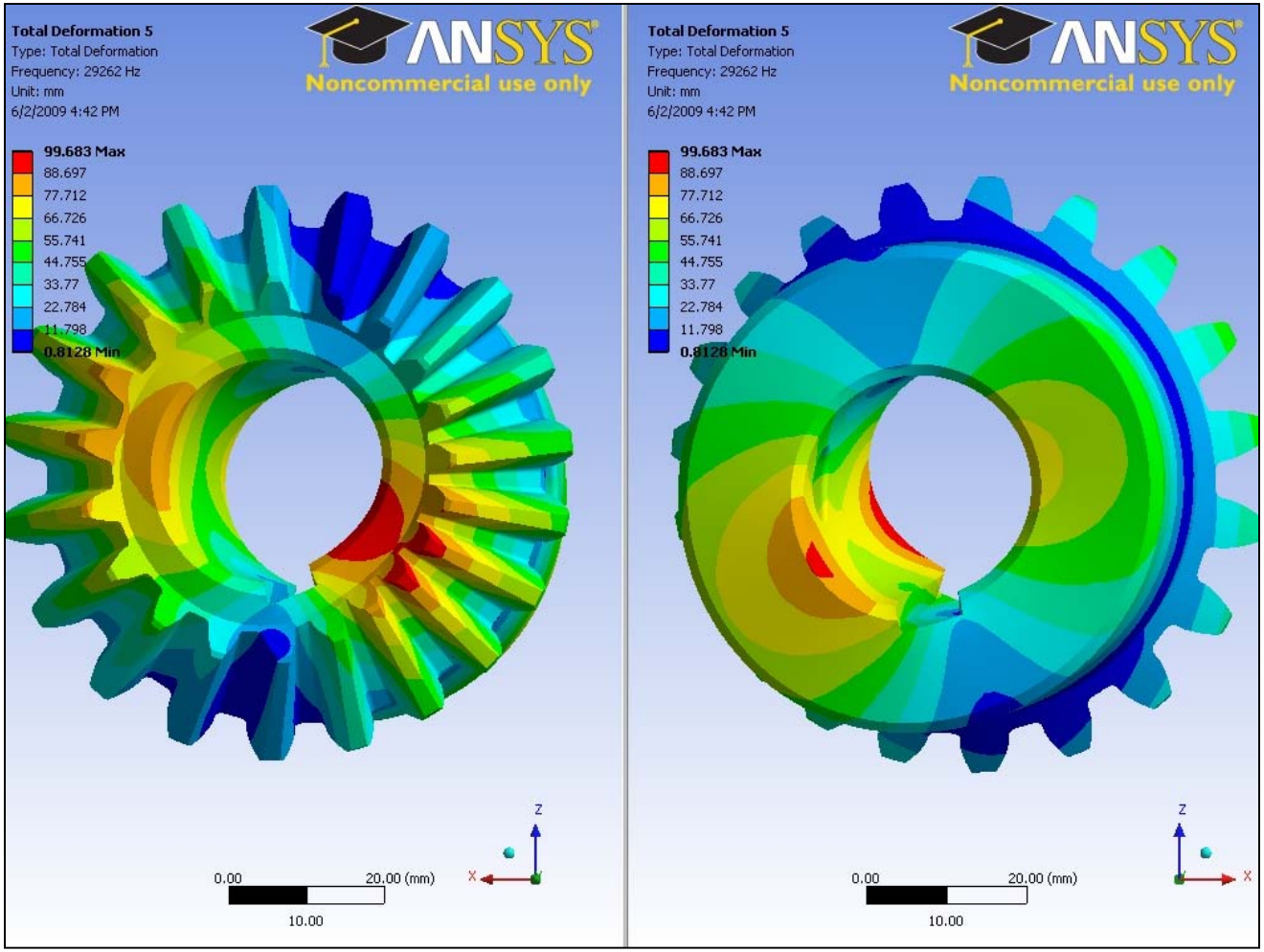
# Mode #5 (29262 Hz)



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