# Double frame vs. single frame horns supporting concept

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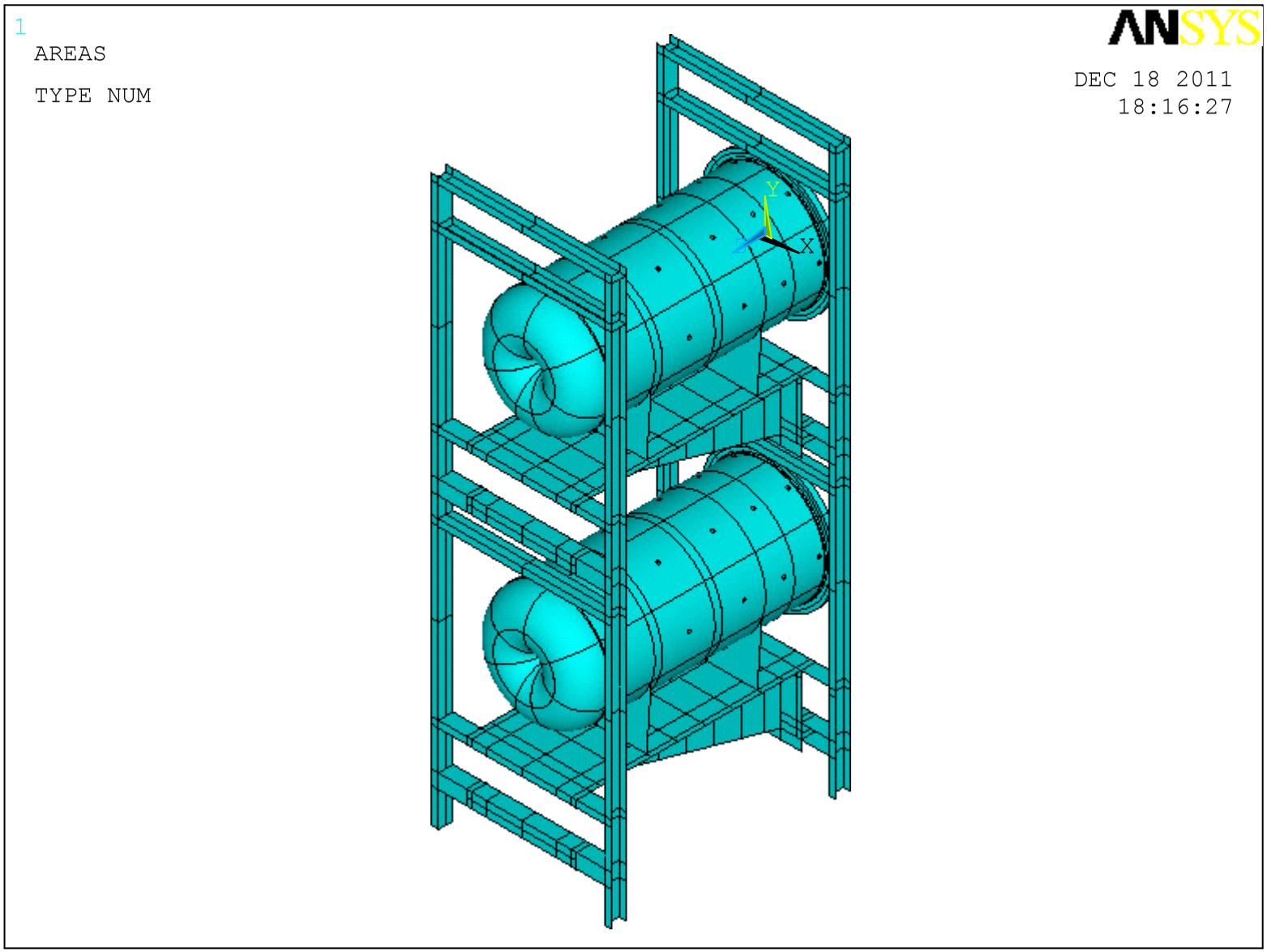
*Piotr Cupiał, AGH Univ. of Science andTechnology*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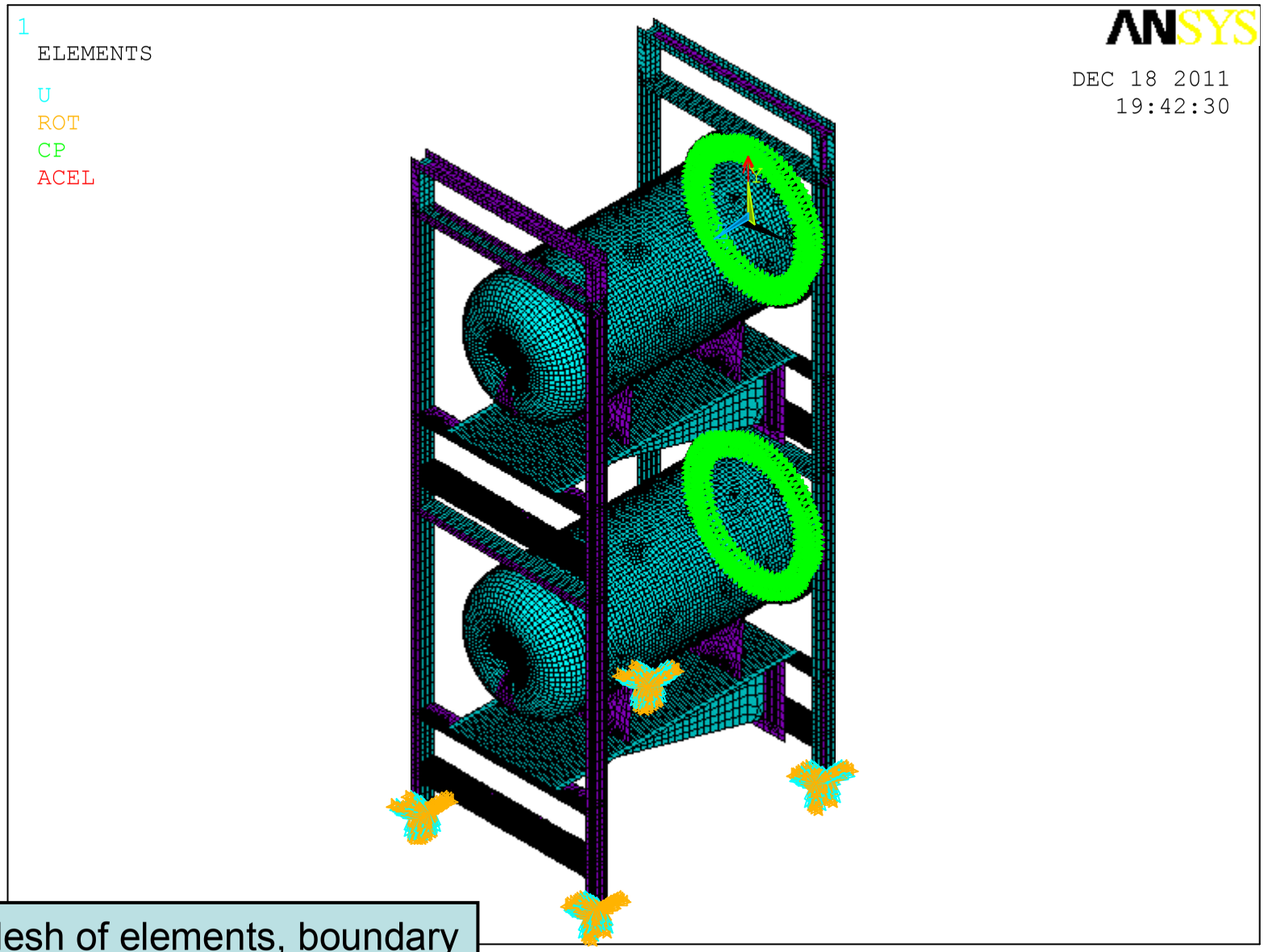
Frames supported at the bottom,

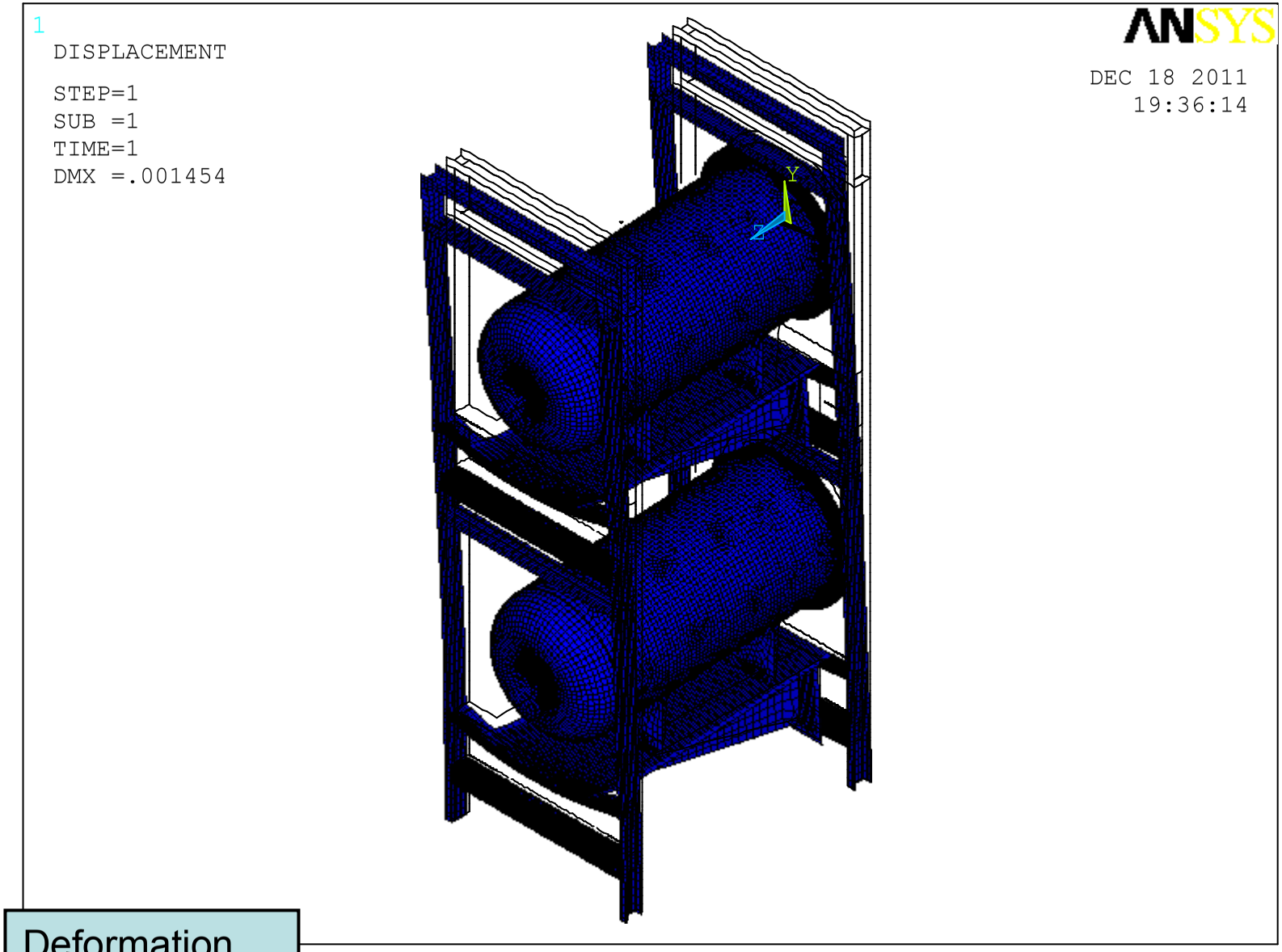
Slides: 4 - 12

Frames supported at the bottom



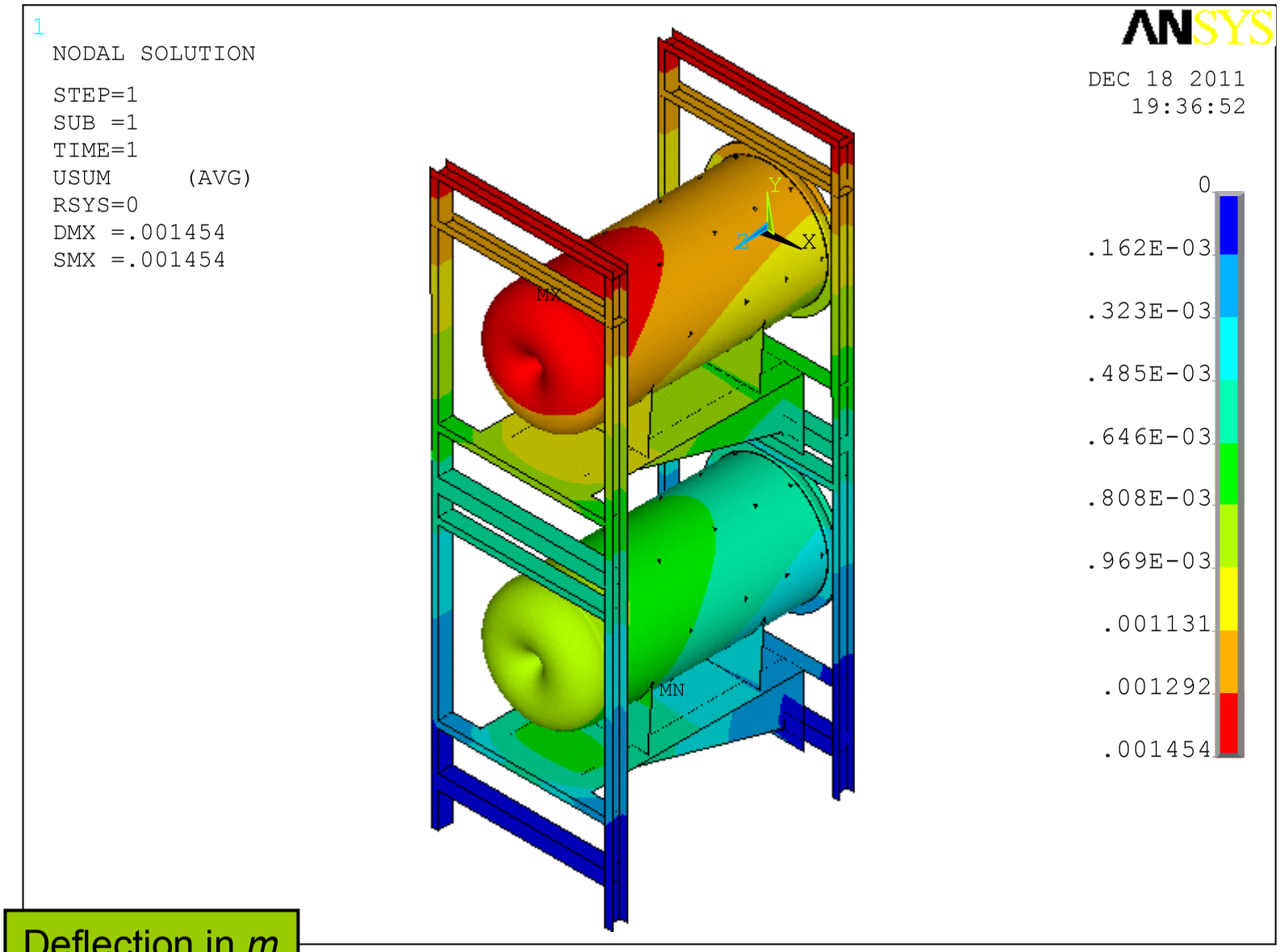

Mesh of elements, boundary conditions

# Frames supported at the bottom



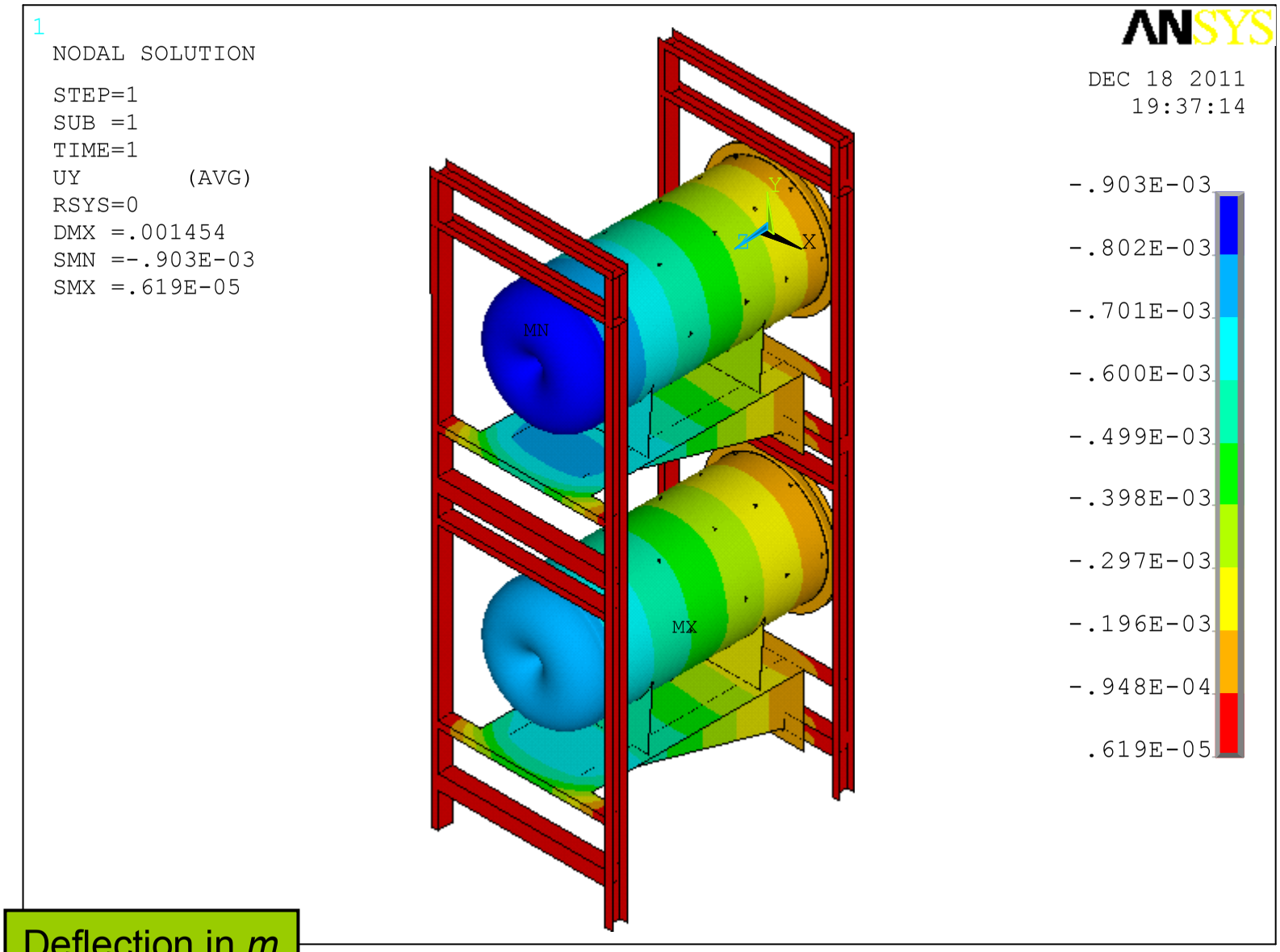

Deformation

# Frames supported at the bottom



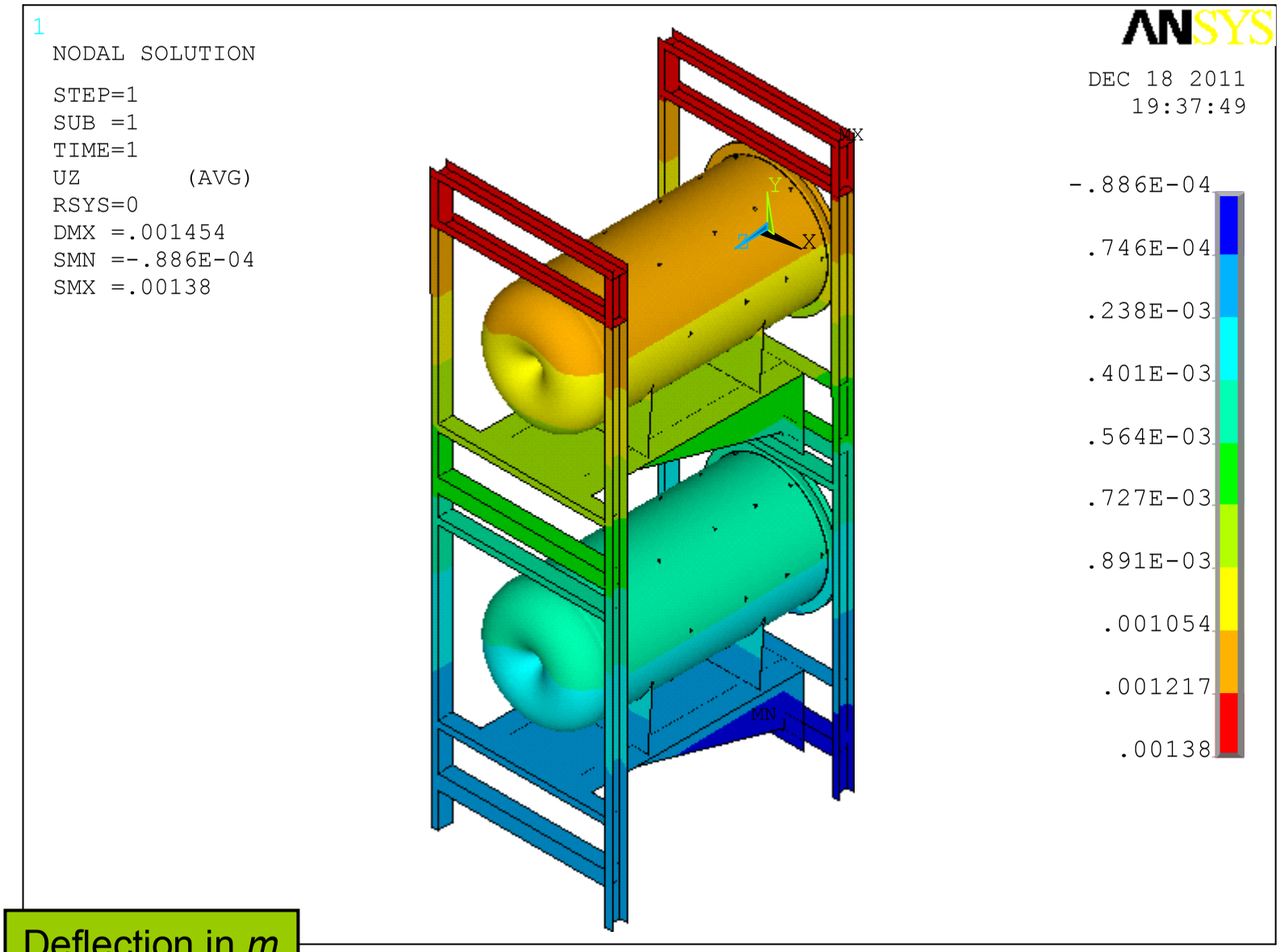

Deflection in *m*

# Frames supported at the bottom



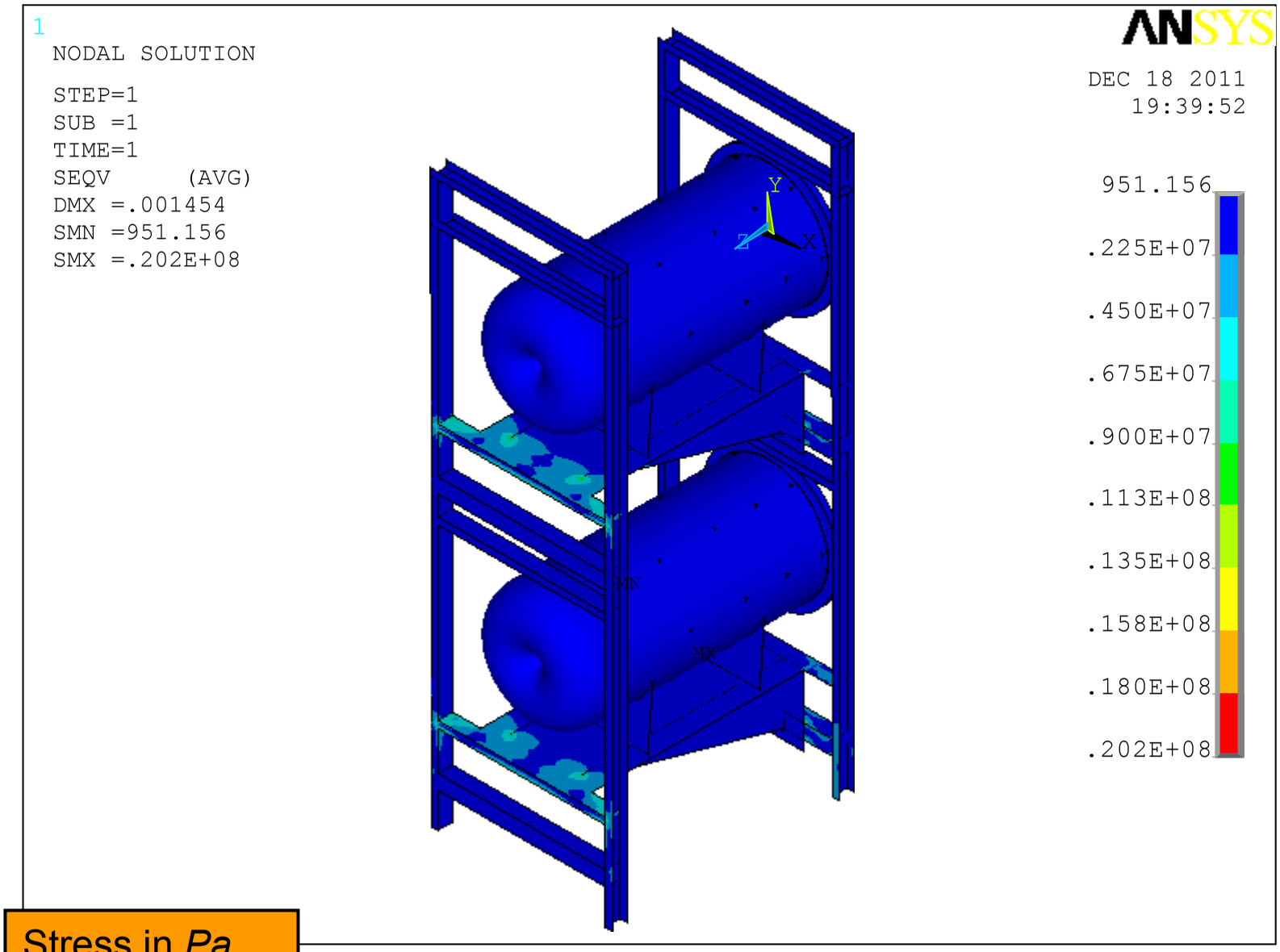

Deflection in *m*

# Frames supported at the bottom



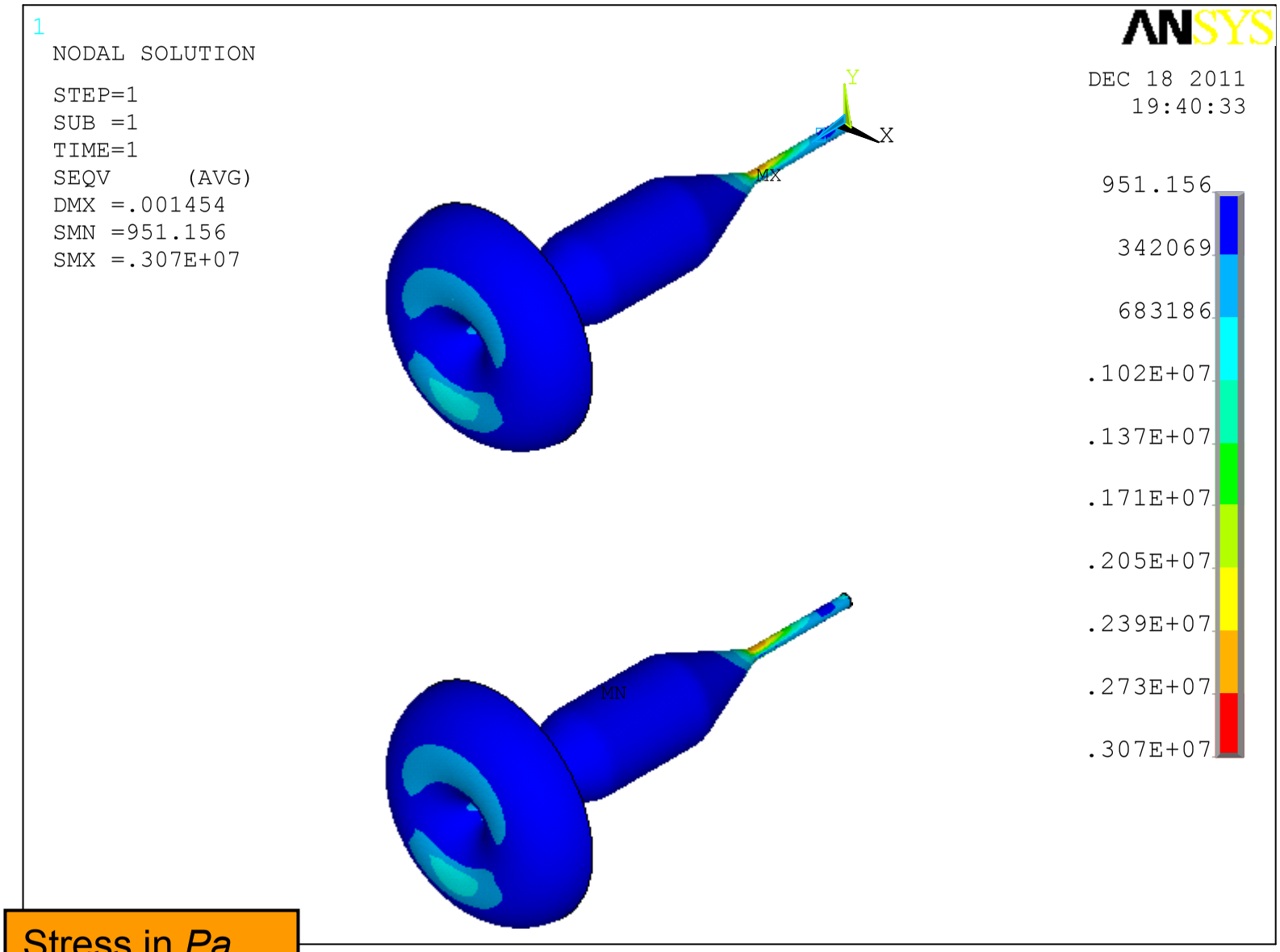

Deflection in *m*

# Frames supported at the bottom



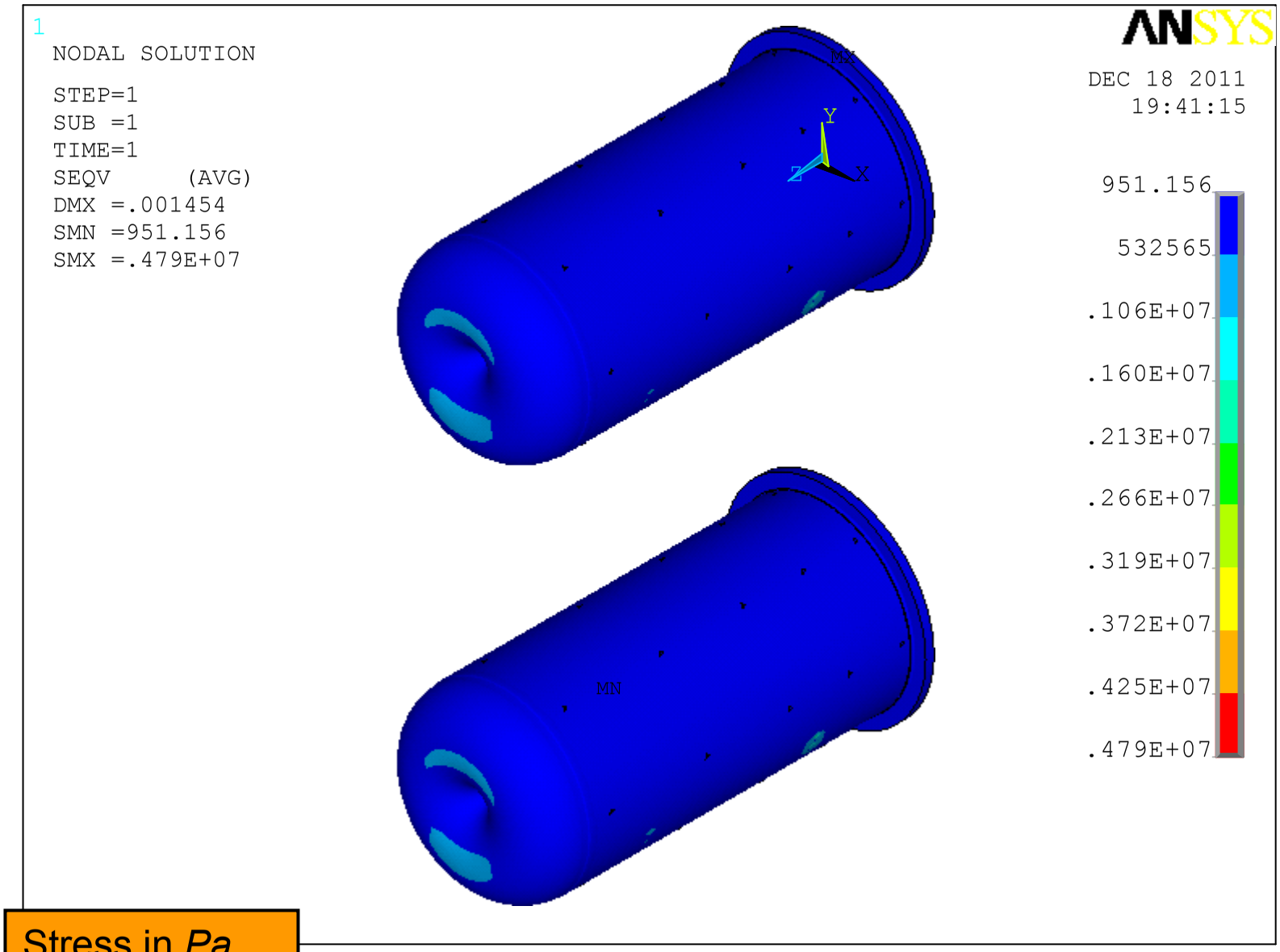

Stress in *Pa*

# Frames supported at the bottom



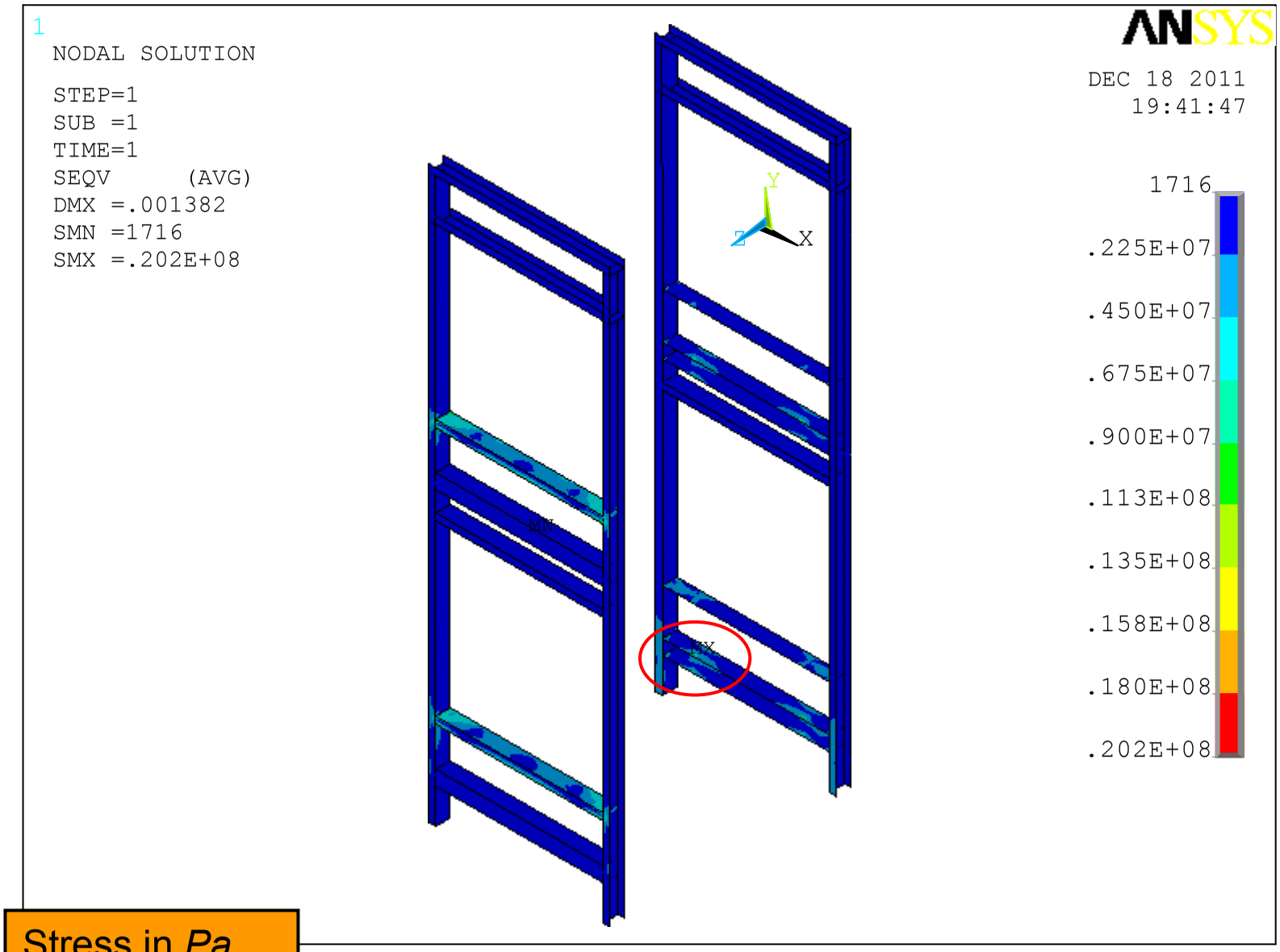

Stress in *Pa*

# Frames supported at the bottom




Stress in *Pa*

# Frames supported at the bottom

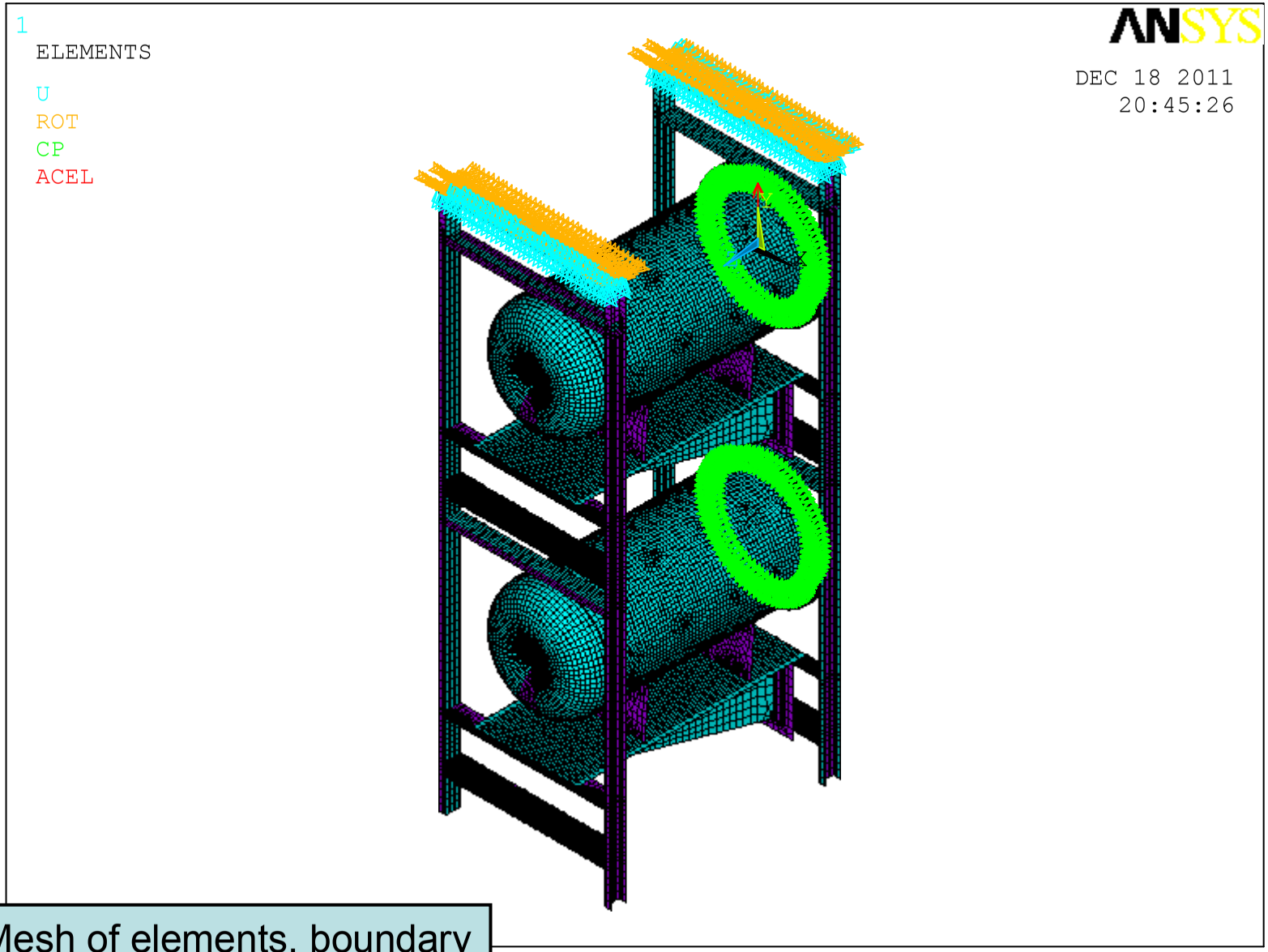



Stress in *Pa*

Frames supported on the top,

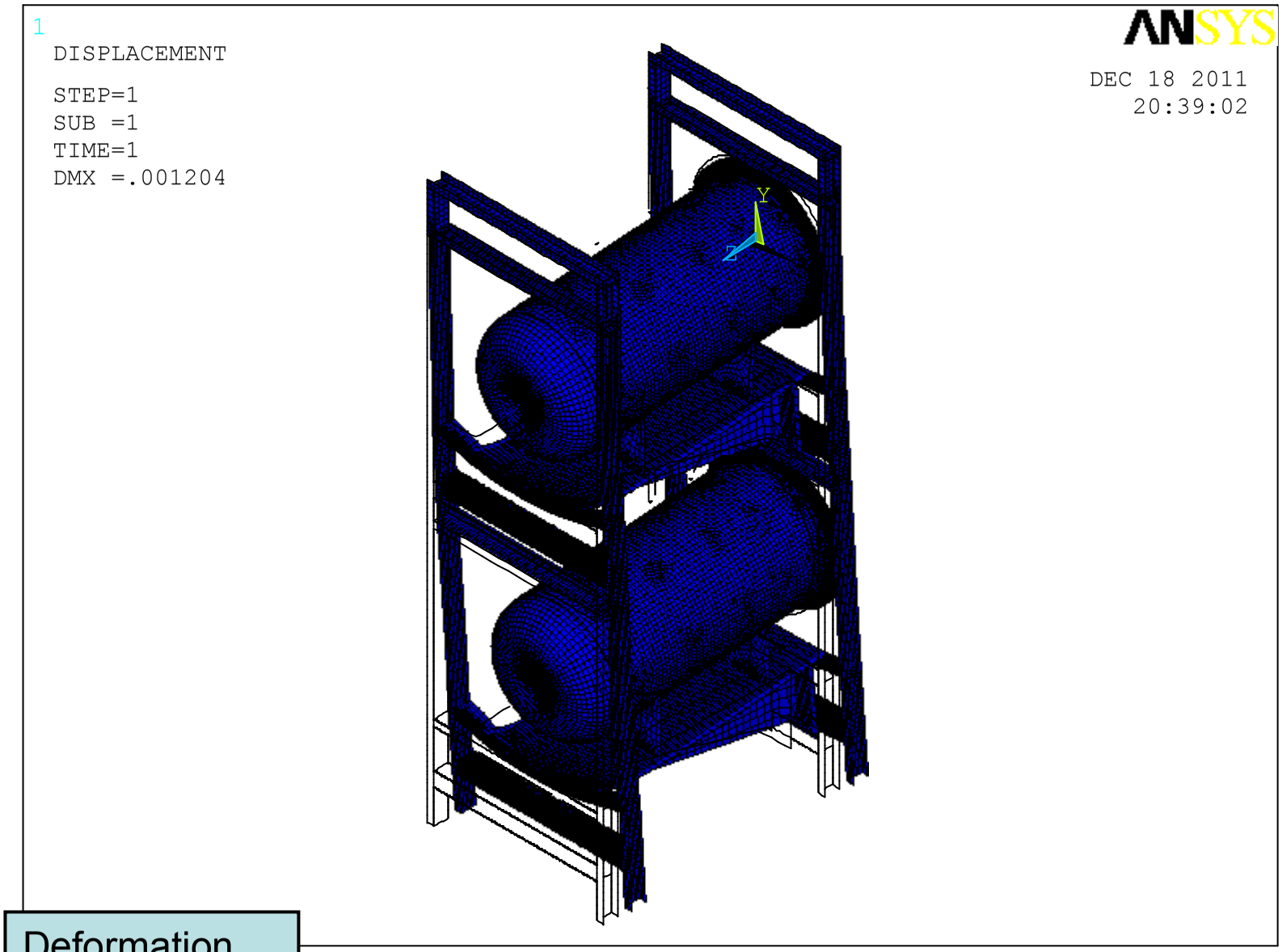
Slides: 14 - 22

Frames supported on the top



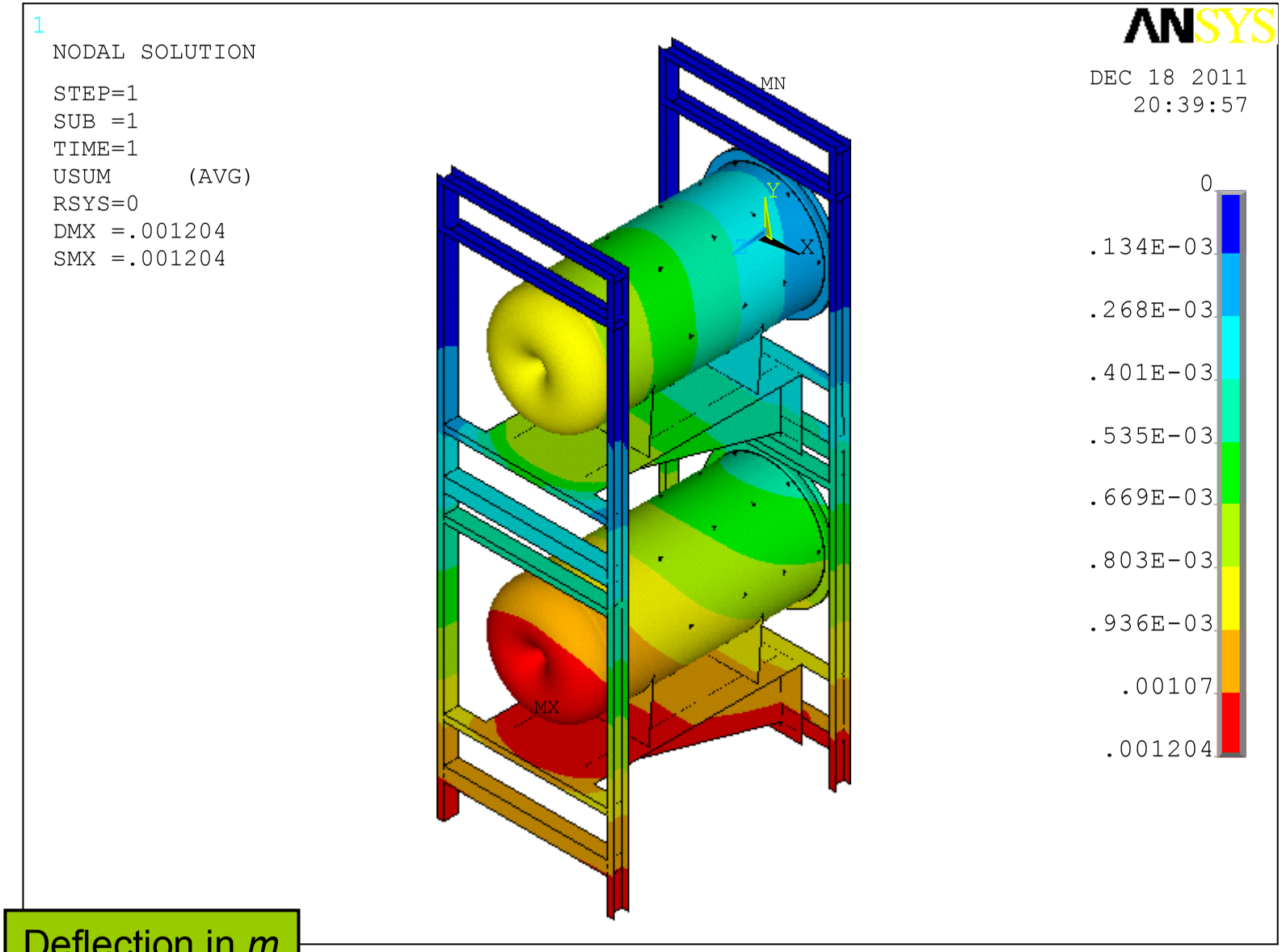

Mesh of elements, boundary conditions

# Frames supported on the top




Deformation

# Frames supported on the top




Deflection in *m*

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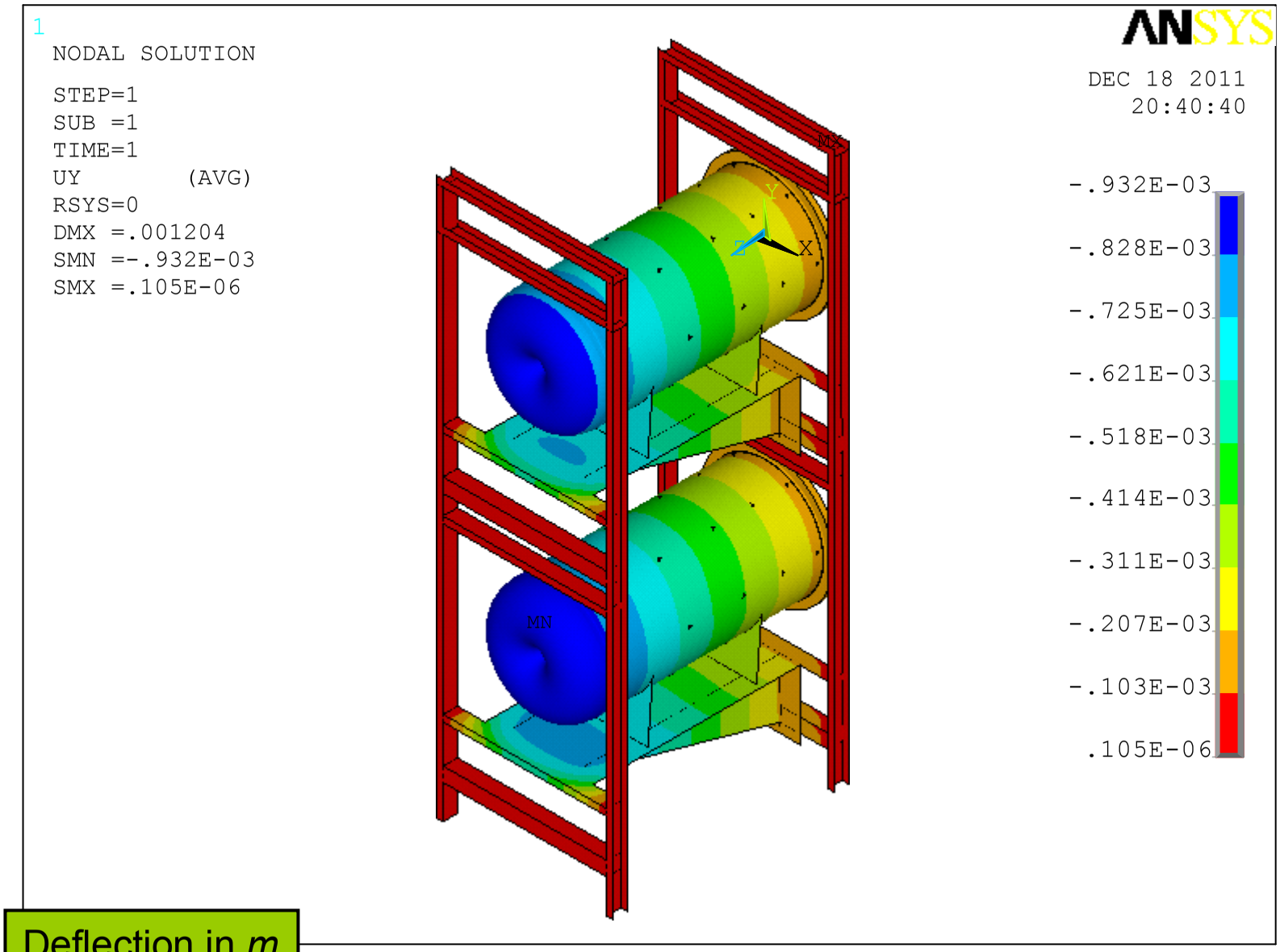
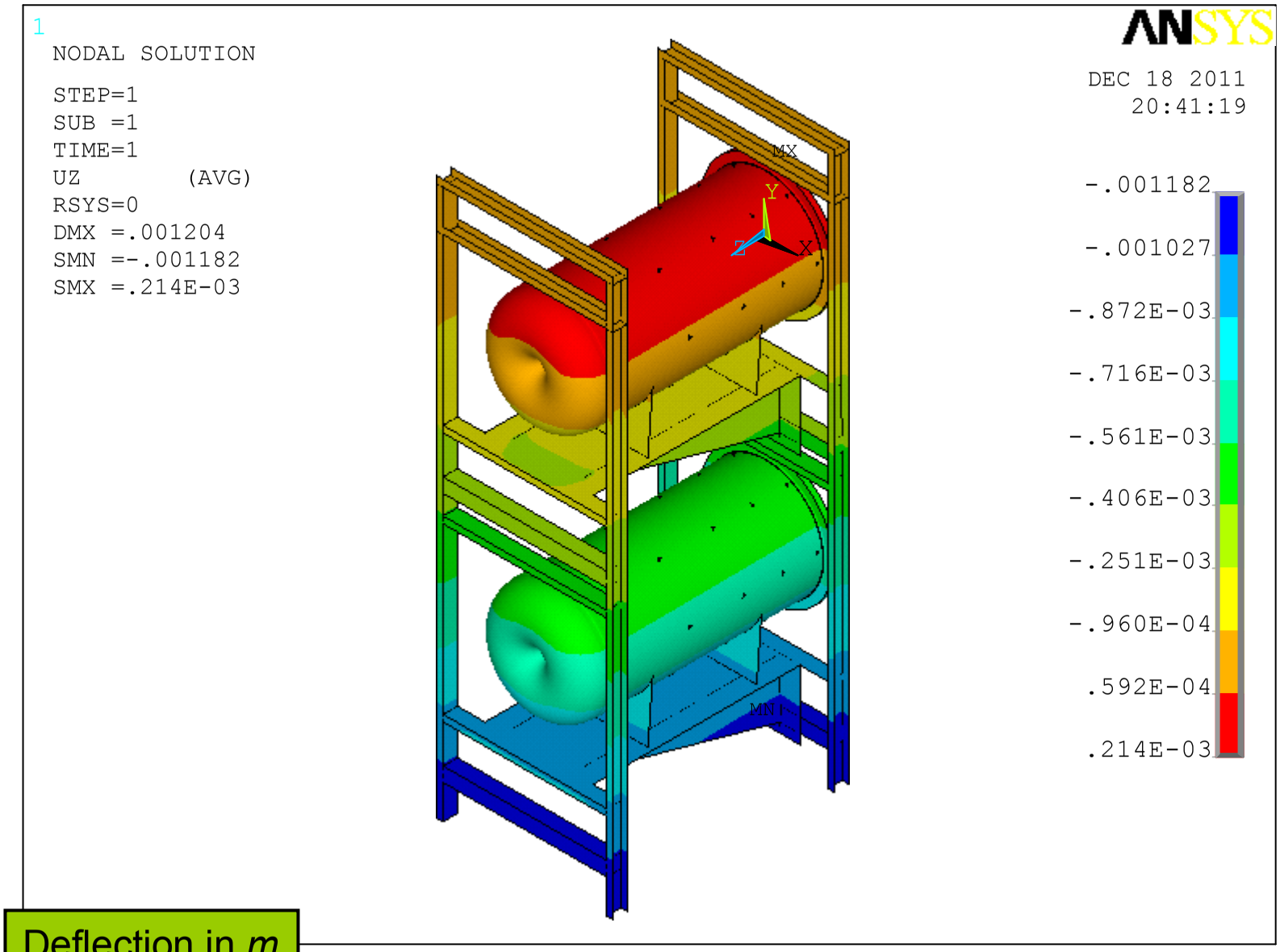


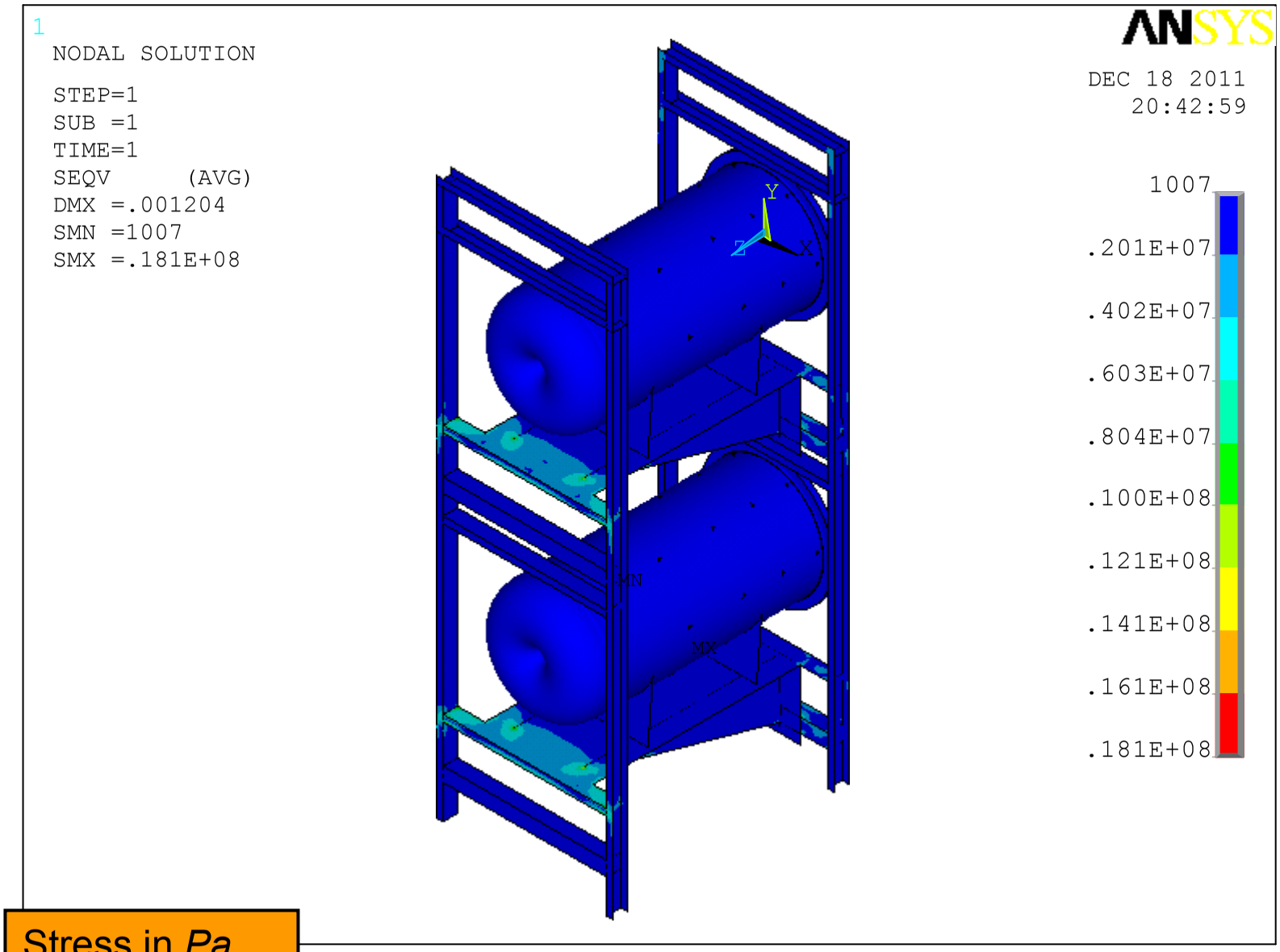

Deflection in *m*

# Frames supported on the top



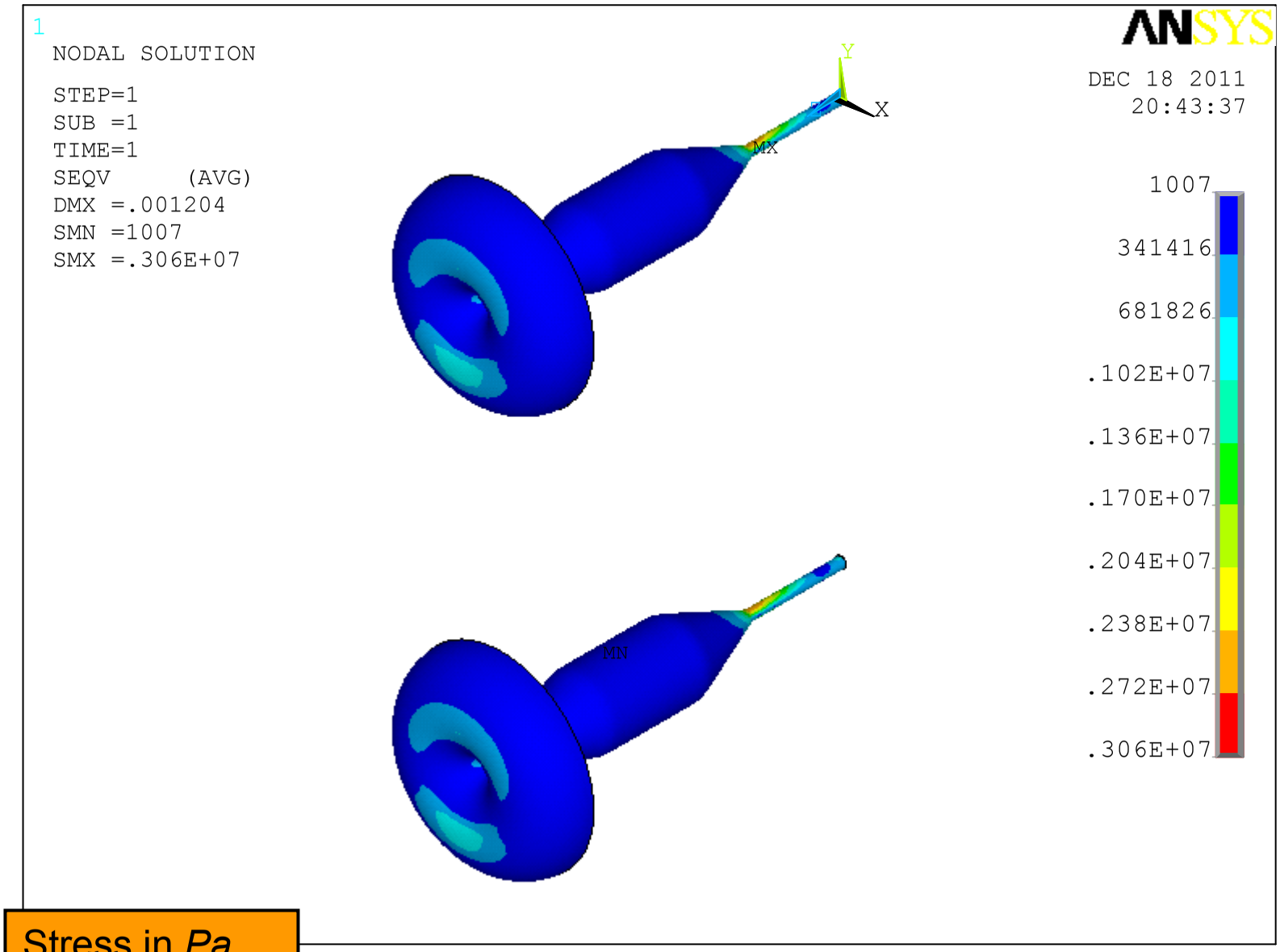

Deflection in *m*

# Frames supported on the top



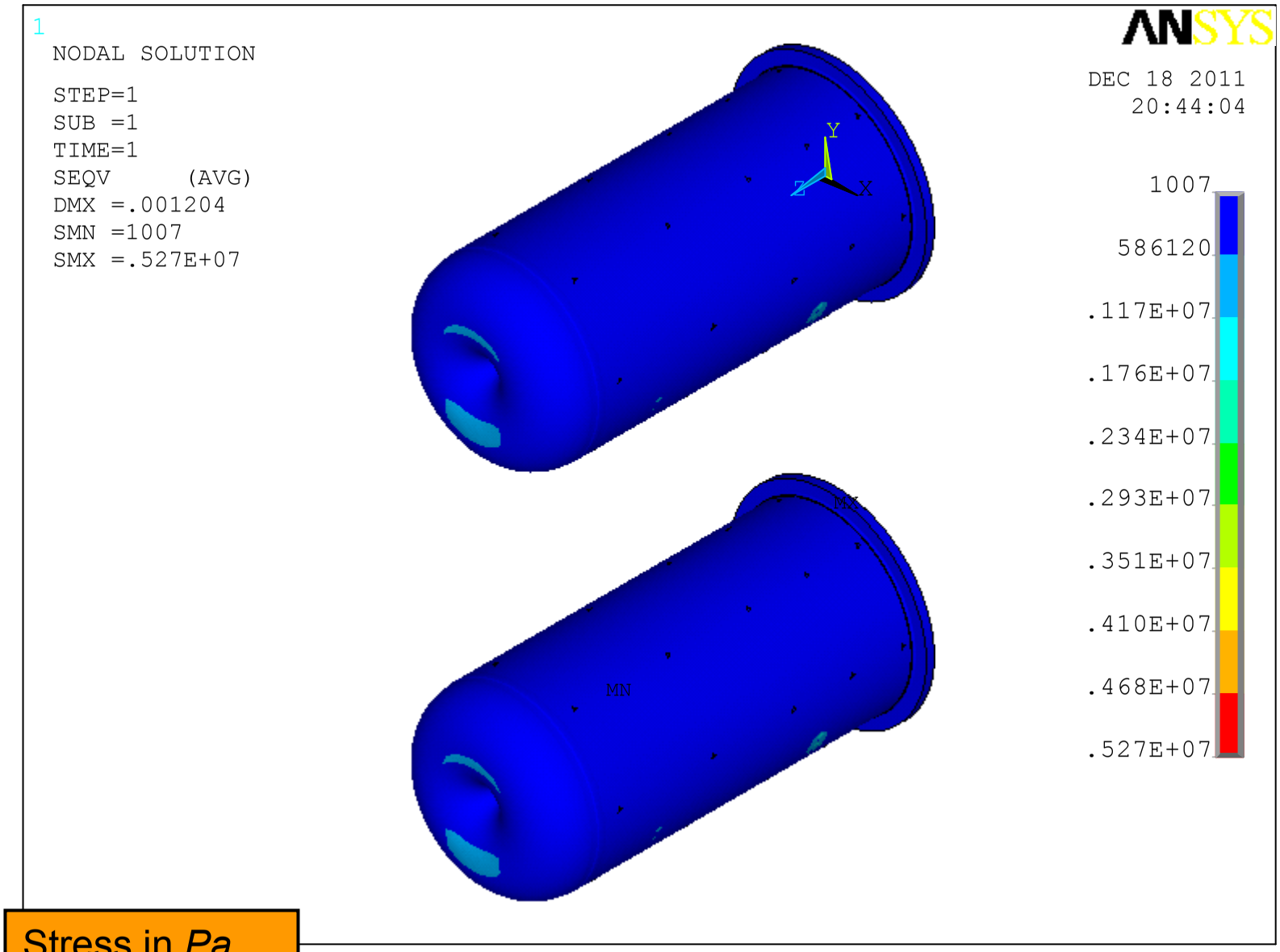

Stress in *Pa*

Frames supported on the top



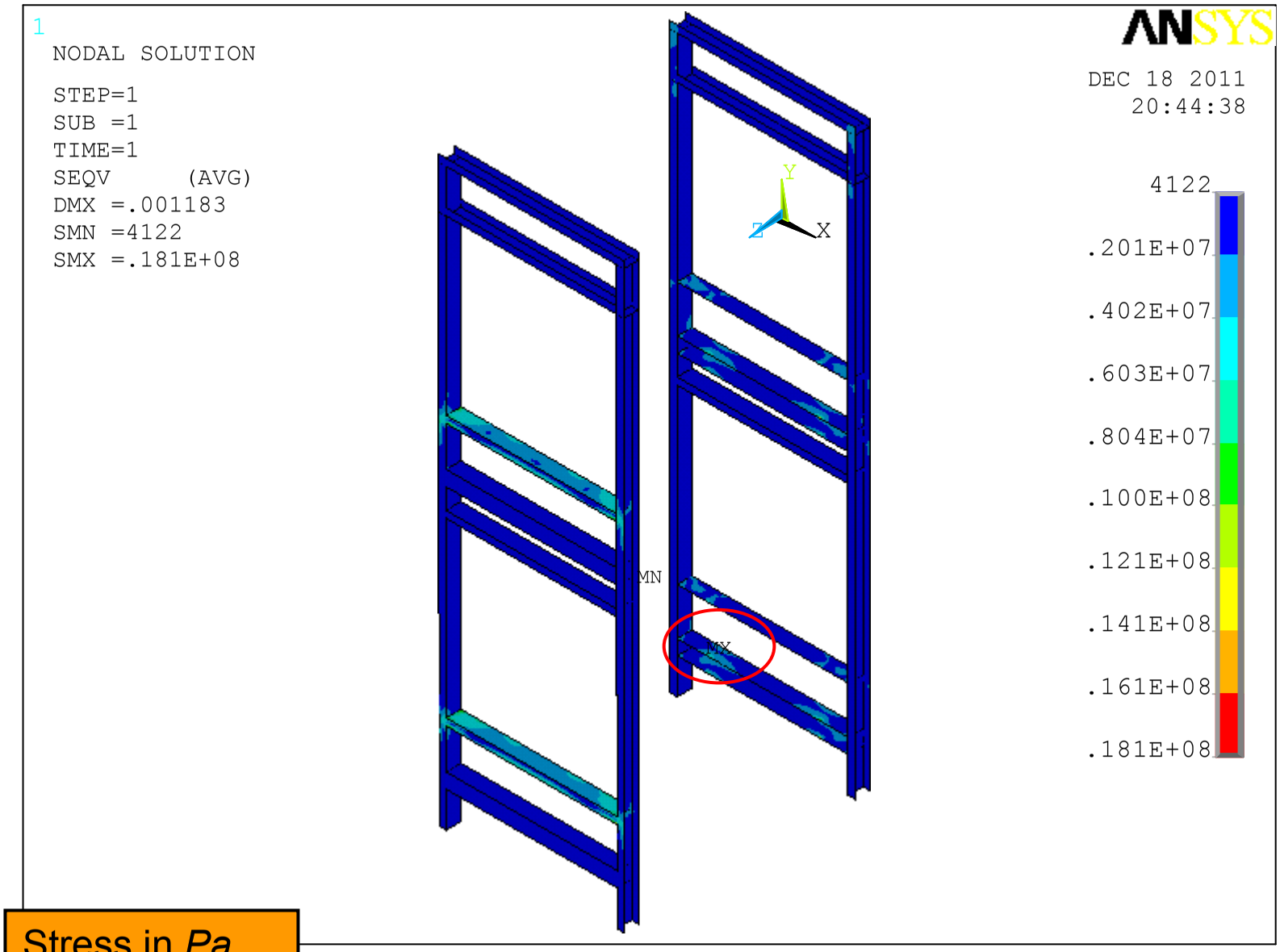

Stress in *Pa*

# Frames supported on the top




Stress in *Pa*

# Frames supported on the top

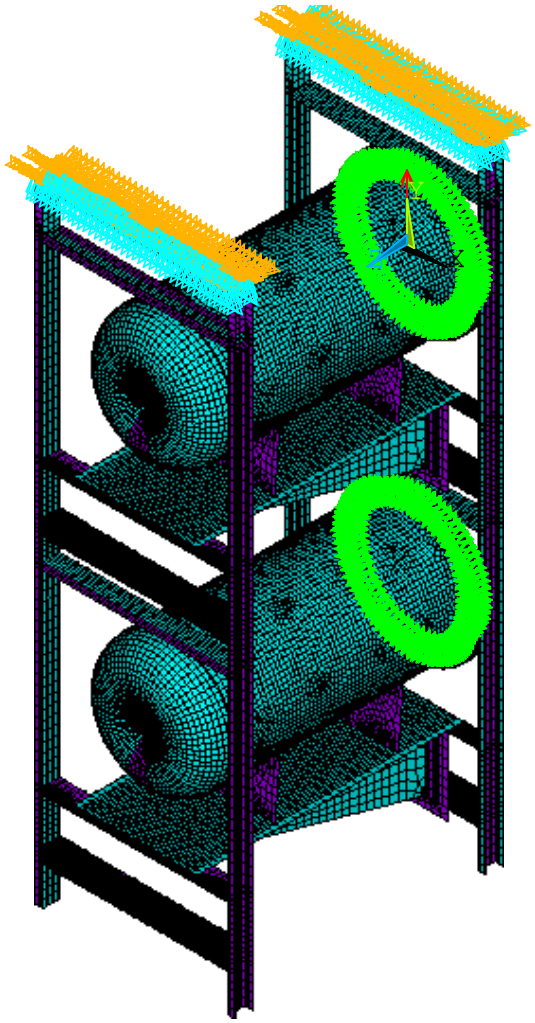



Stress in *Pa*

Two horns supported in two frames – summary of static results

| Supports location | $\|u_y\|_{max}$ *mm* | $\|u_z\|_{max}$ *mm* | $u_{sum,max}$ *mm* | $\sigma_{eqv,\ max}$ *MPa* | Remarks |
|---|---|---|---|---|---|
| Bottom | 0.90 | 1.38 | 1.45 | 20.2 | Max. Stress in frame |
| Top | 0.93 | 1.18 | 1.20 | 18.1 | Max. Stress in frame |

Modal results for 2 horns supported in 2 frames on the top



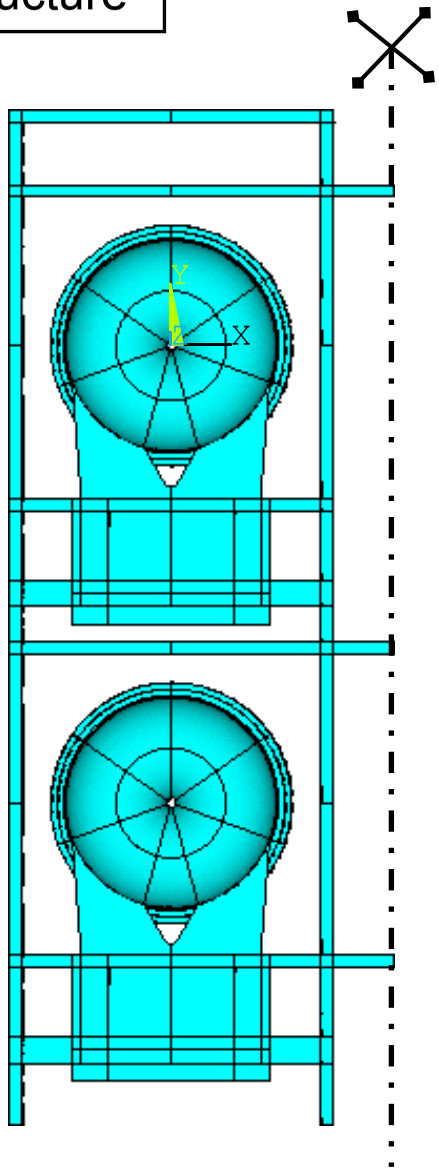
Frames supported on the top

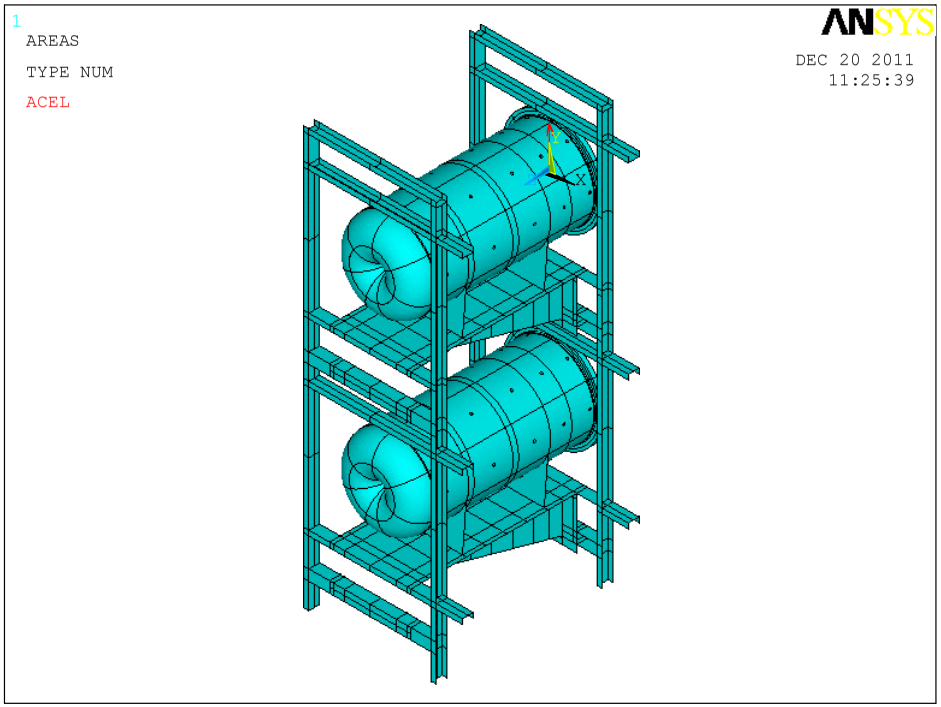
Lowest five natural frequencies

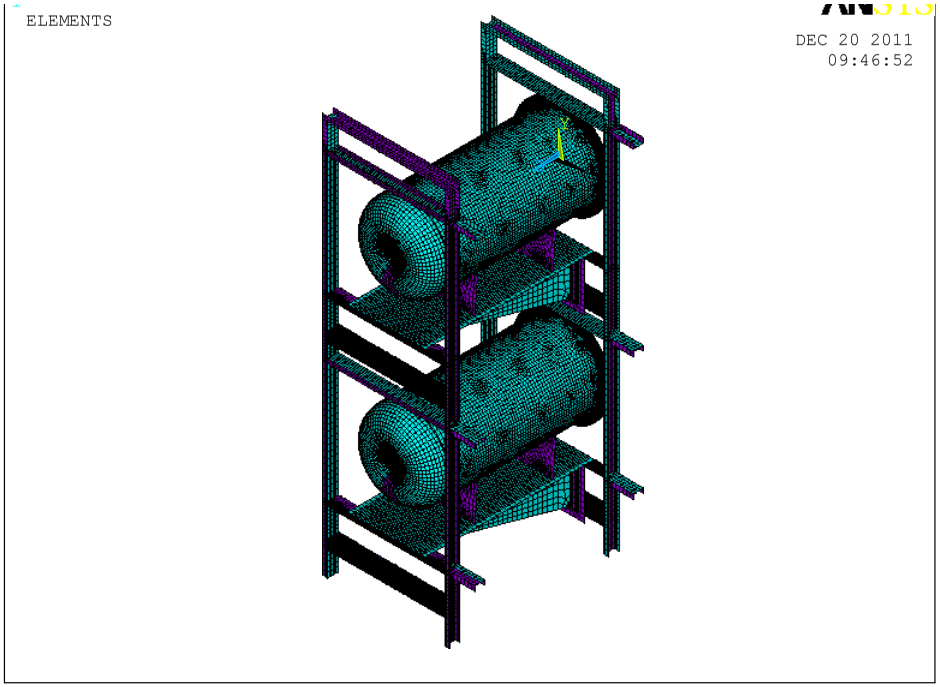
| | |
|---|---|
| 1 | 1.99 Hz |
| 2 | 3.34 Hz |
| 3 | 4.32 Hz |
| 4 | 7.15 Hz |
| 5 | 9.18 Hz |

System of four horns supported
in two frames

FE analysis of symmetric half of the structure



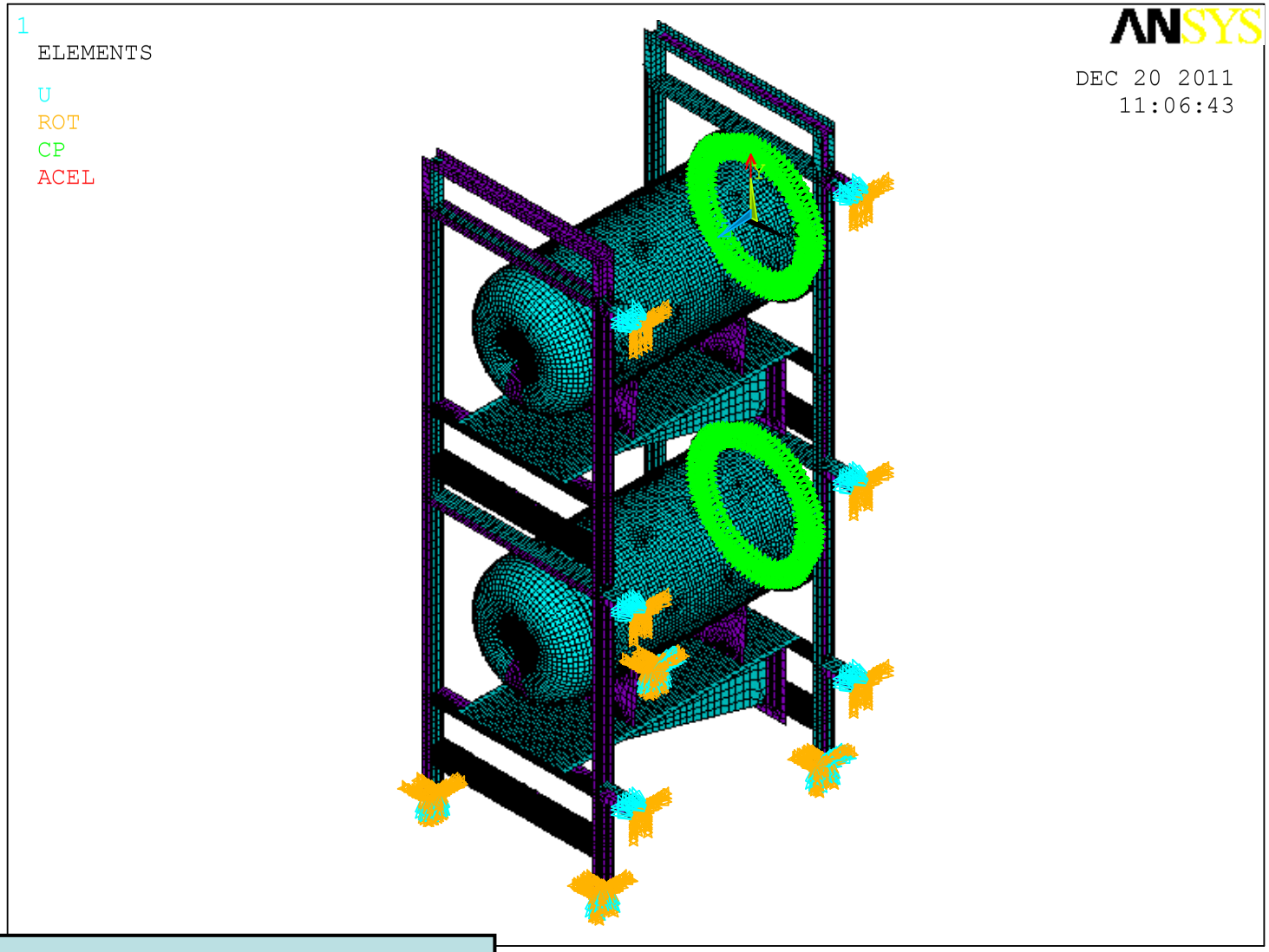



Frames supported at the bottom,

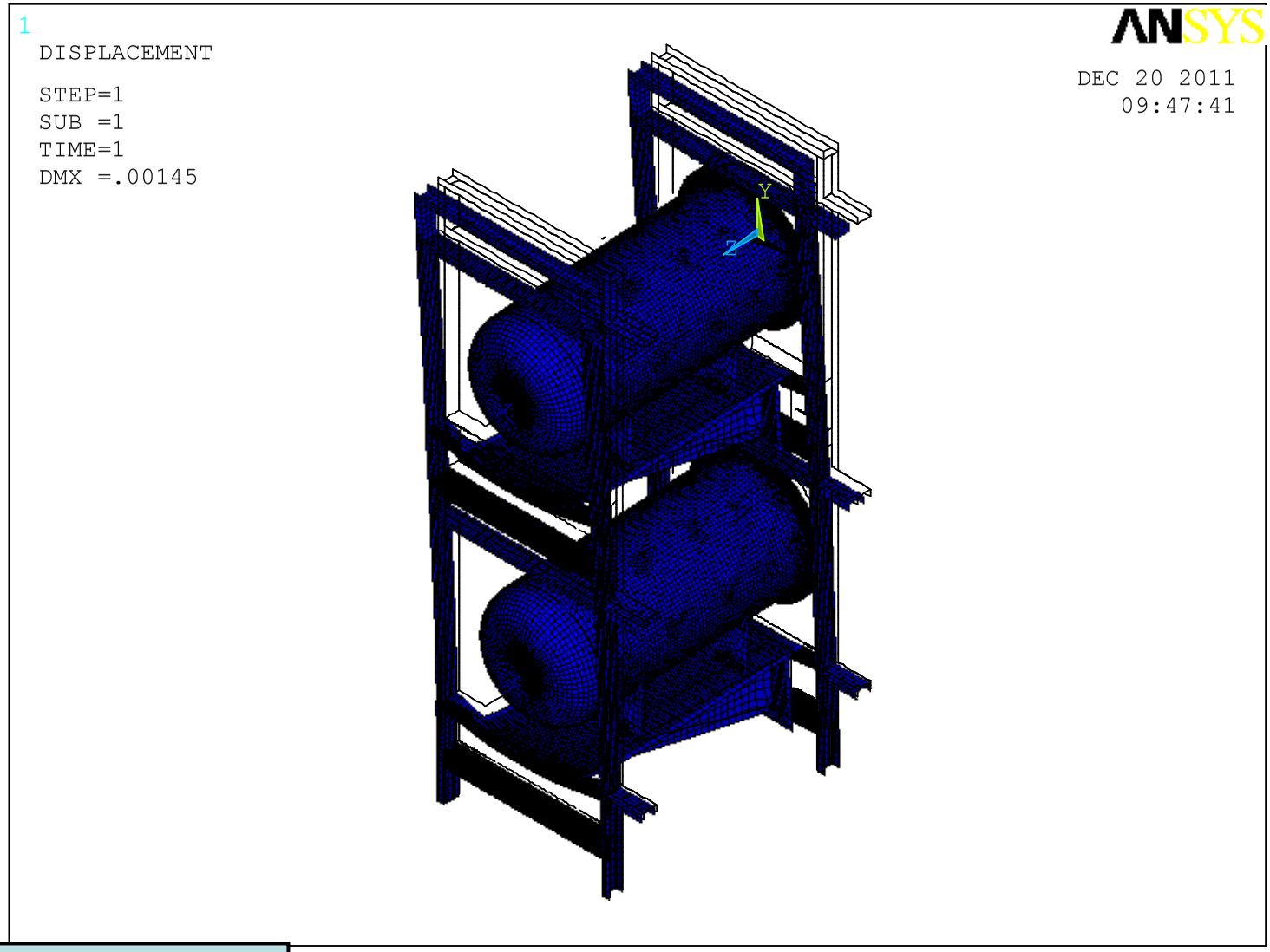
slides: 28 - 36

Frames supported at the bottom



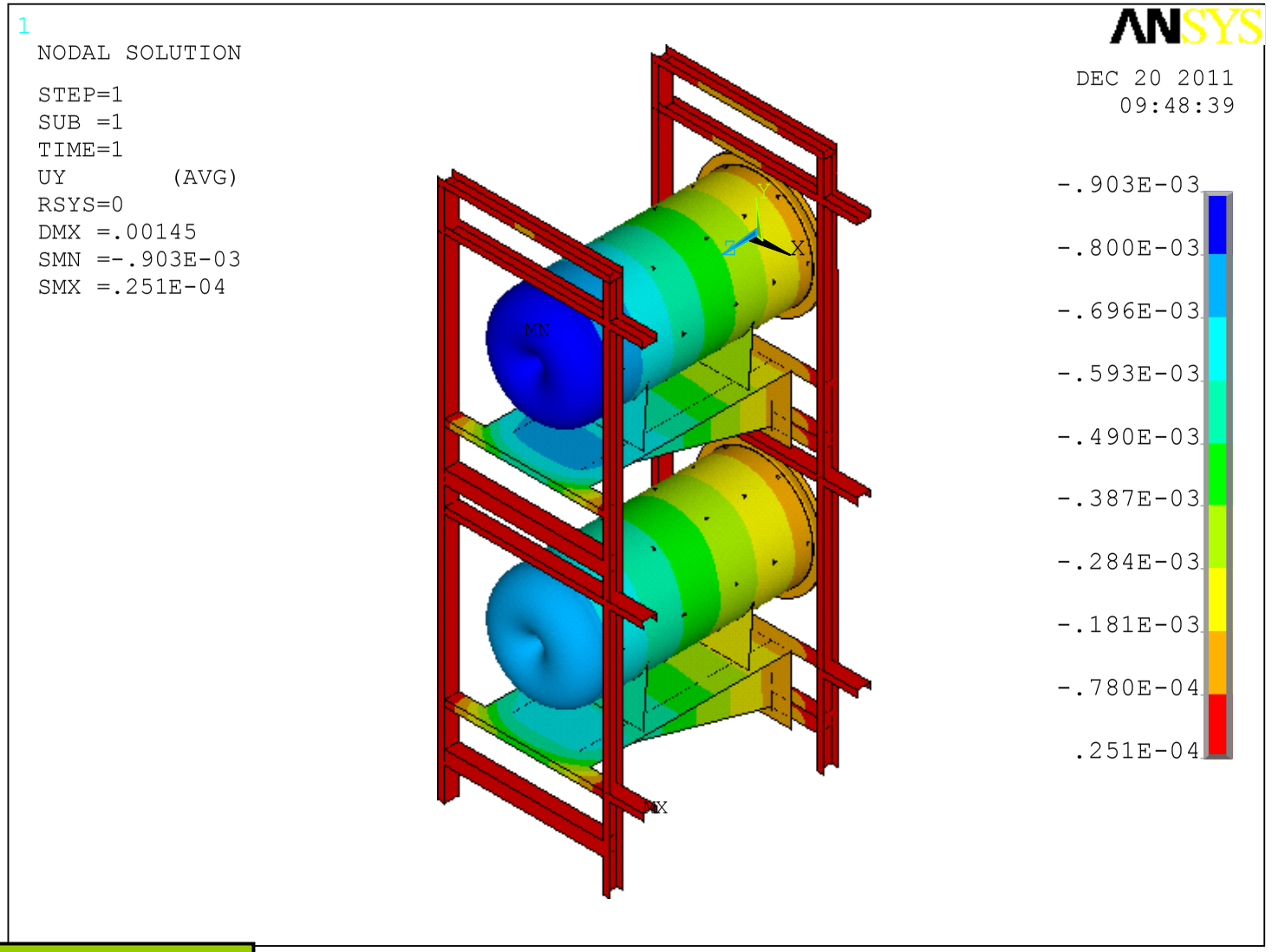

Mesh of elements, boundary conditions

# Frames supported at the bottom



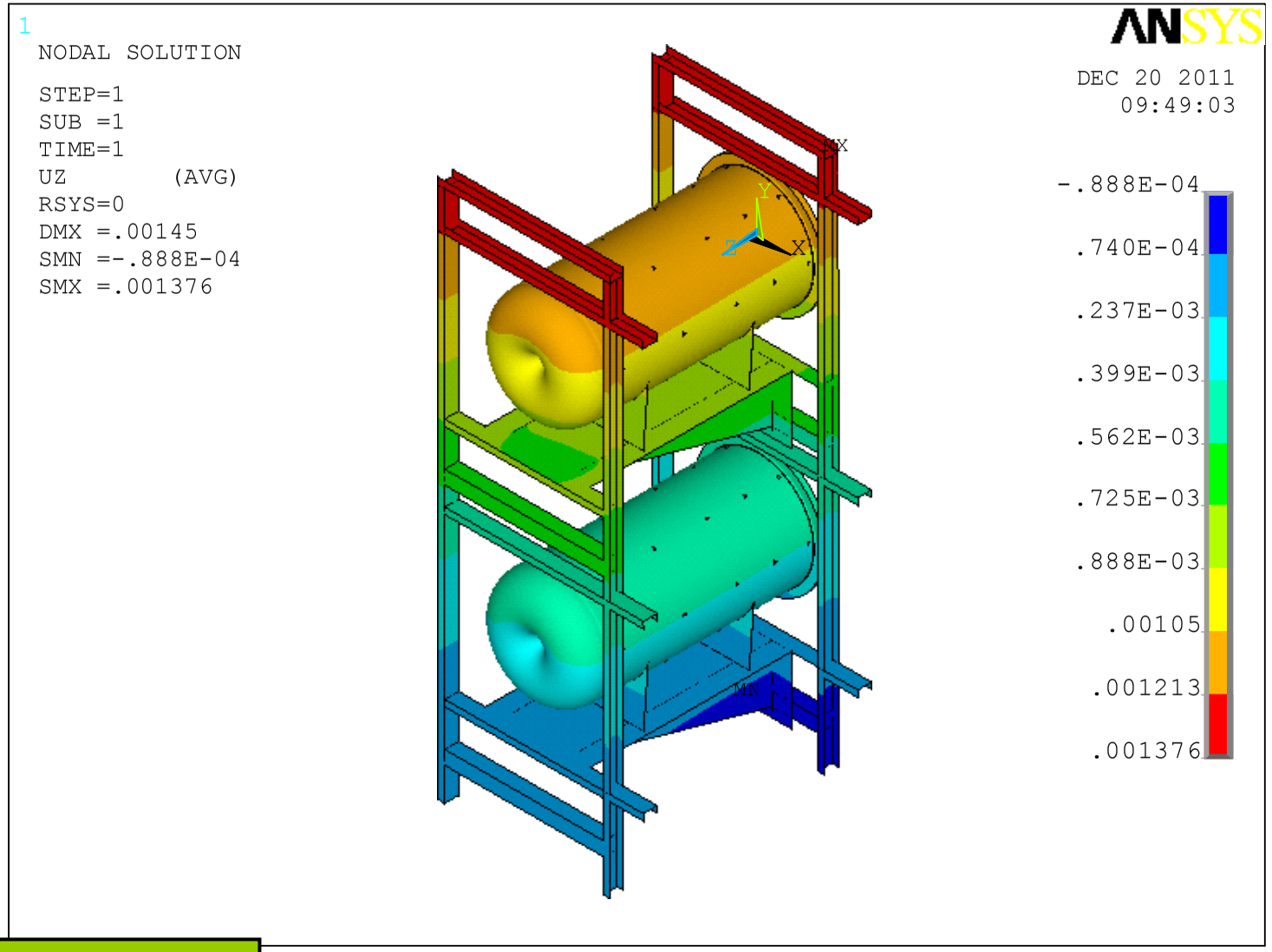

Deformation

# Frames supported at the bottom



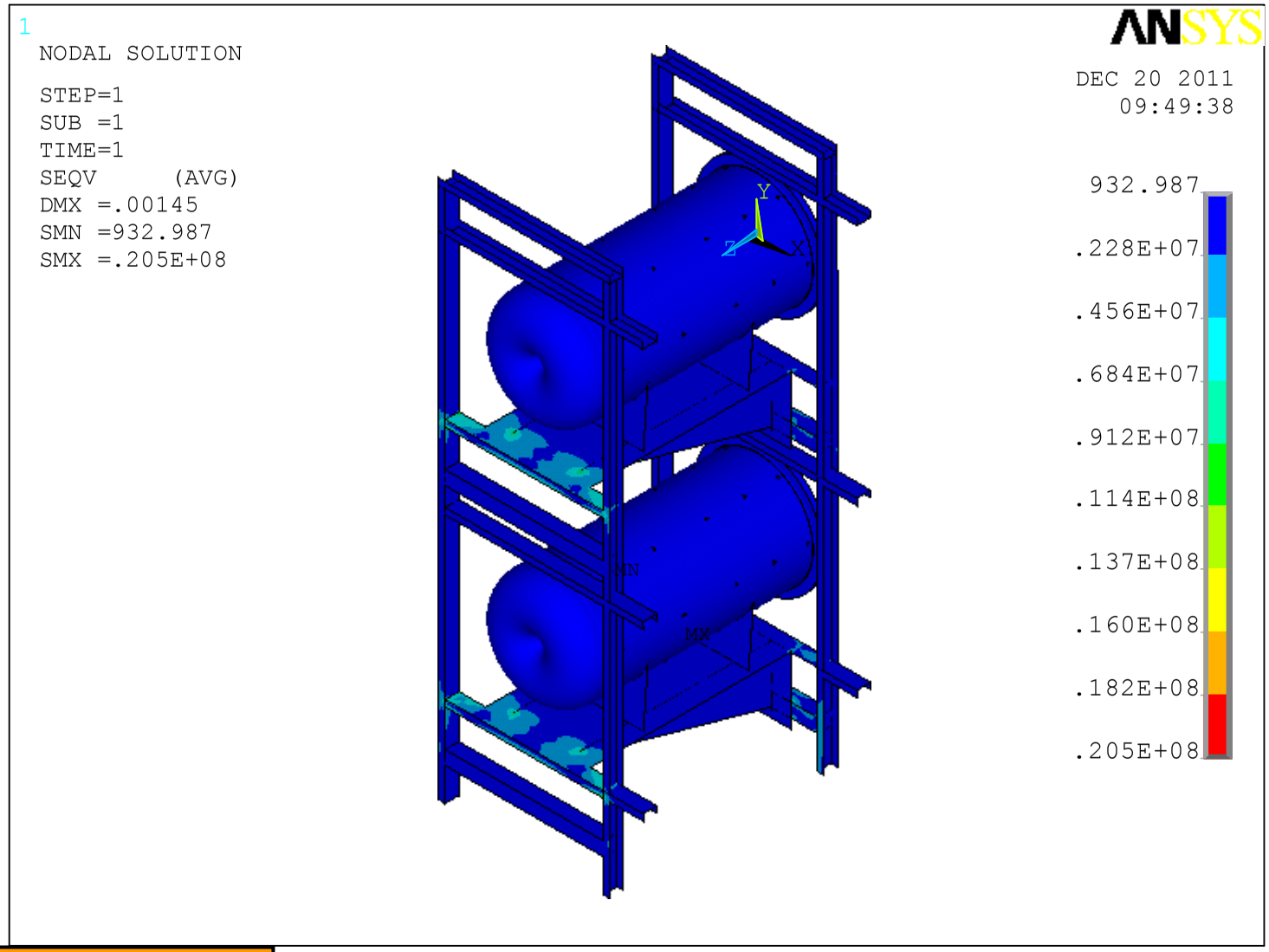

Deflection in *m*

# Frames supported at the bottom

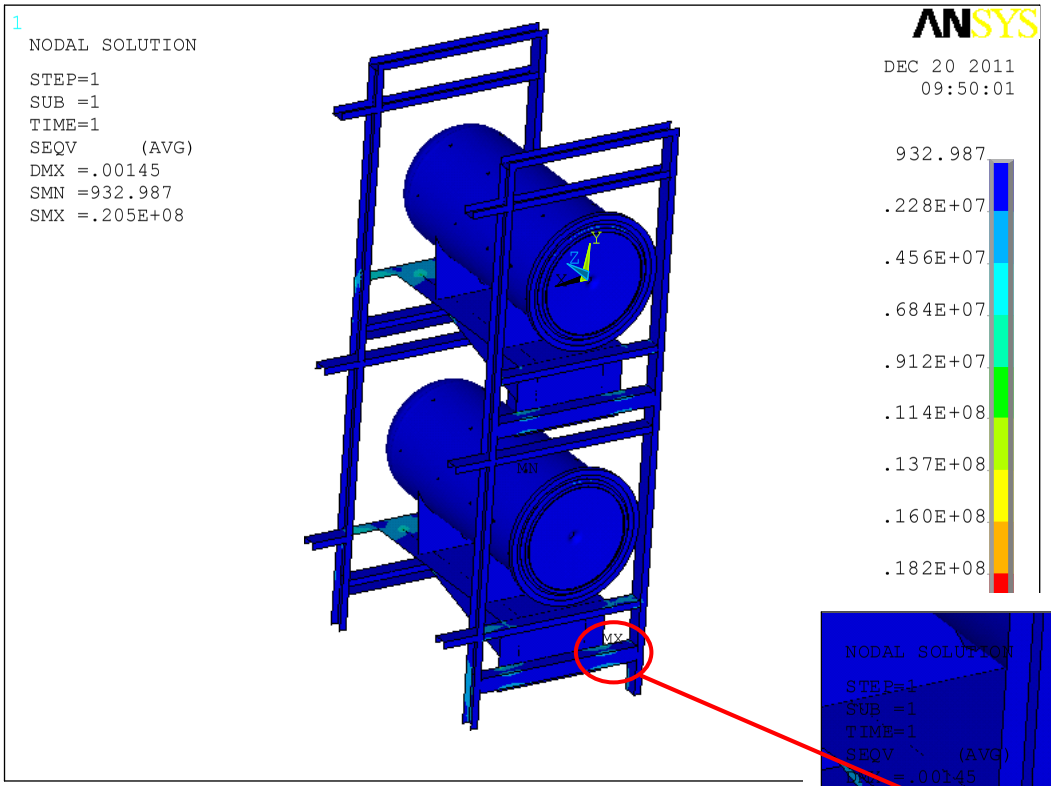



Deflection in *m*

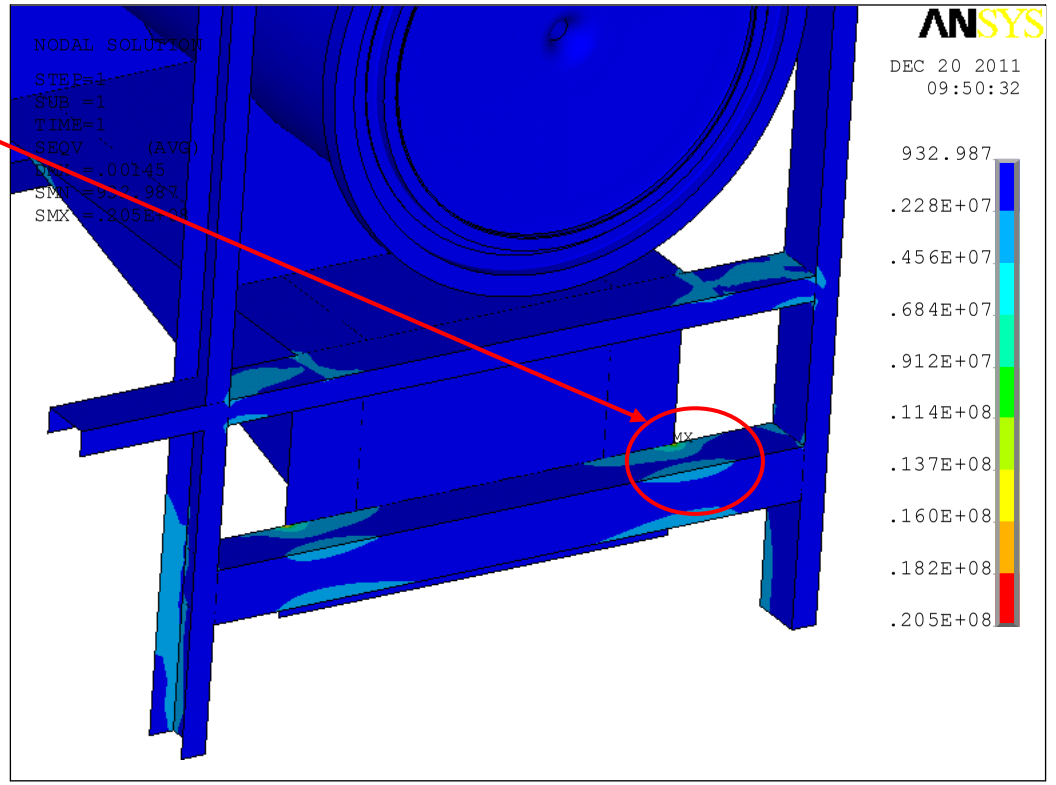
# Frames supported at the bottom




Stress in *Pa*

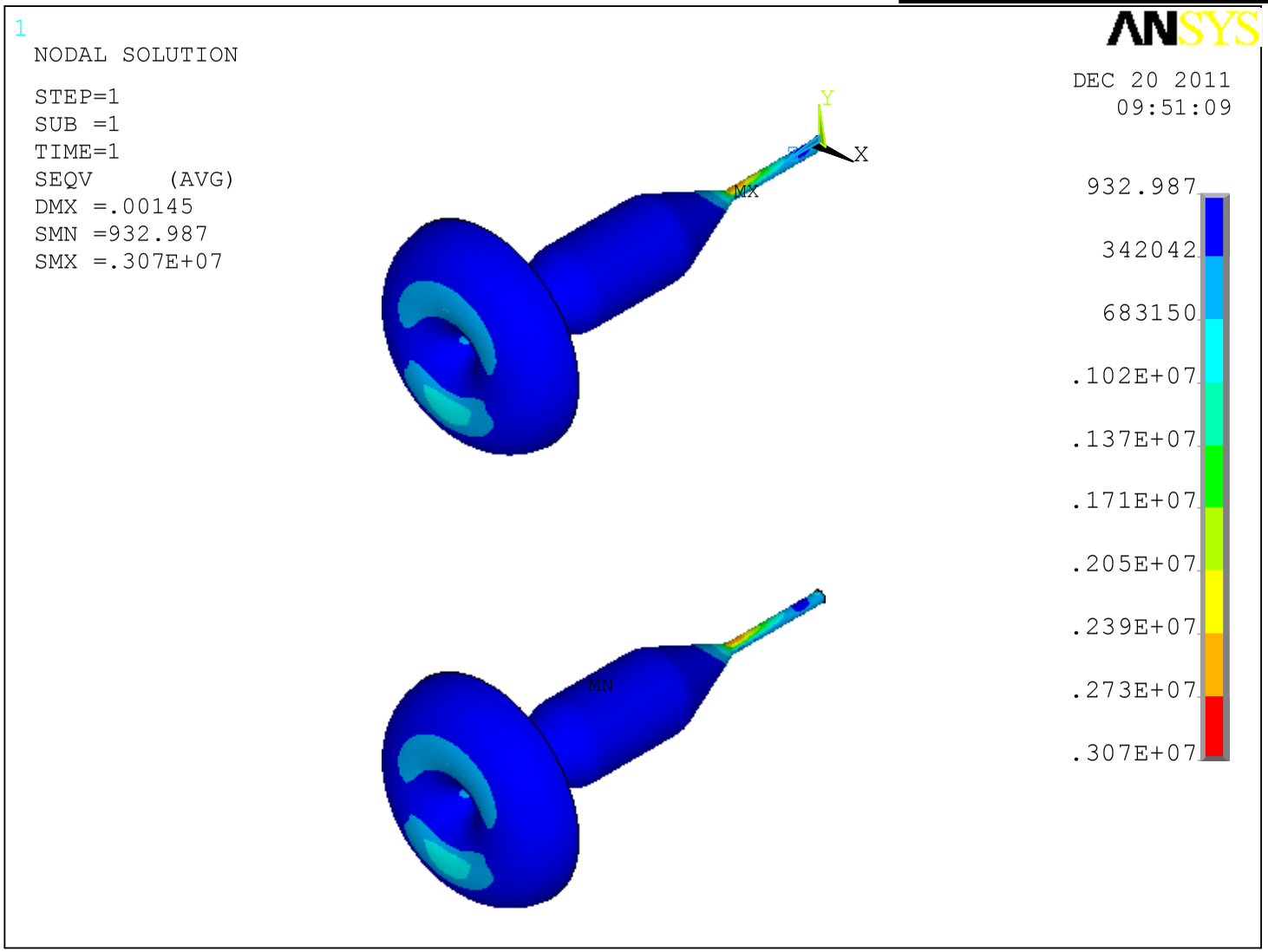



Frames supported at the bottom



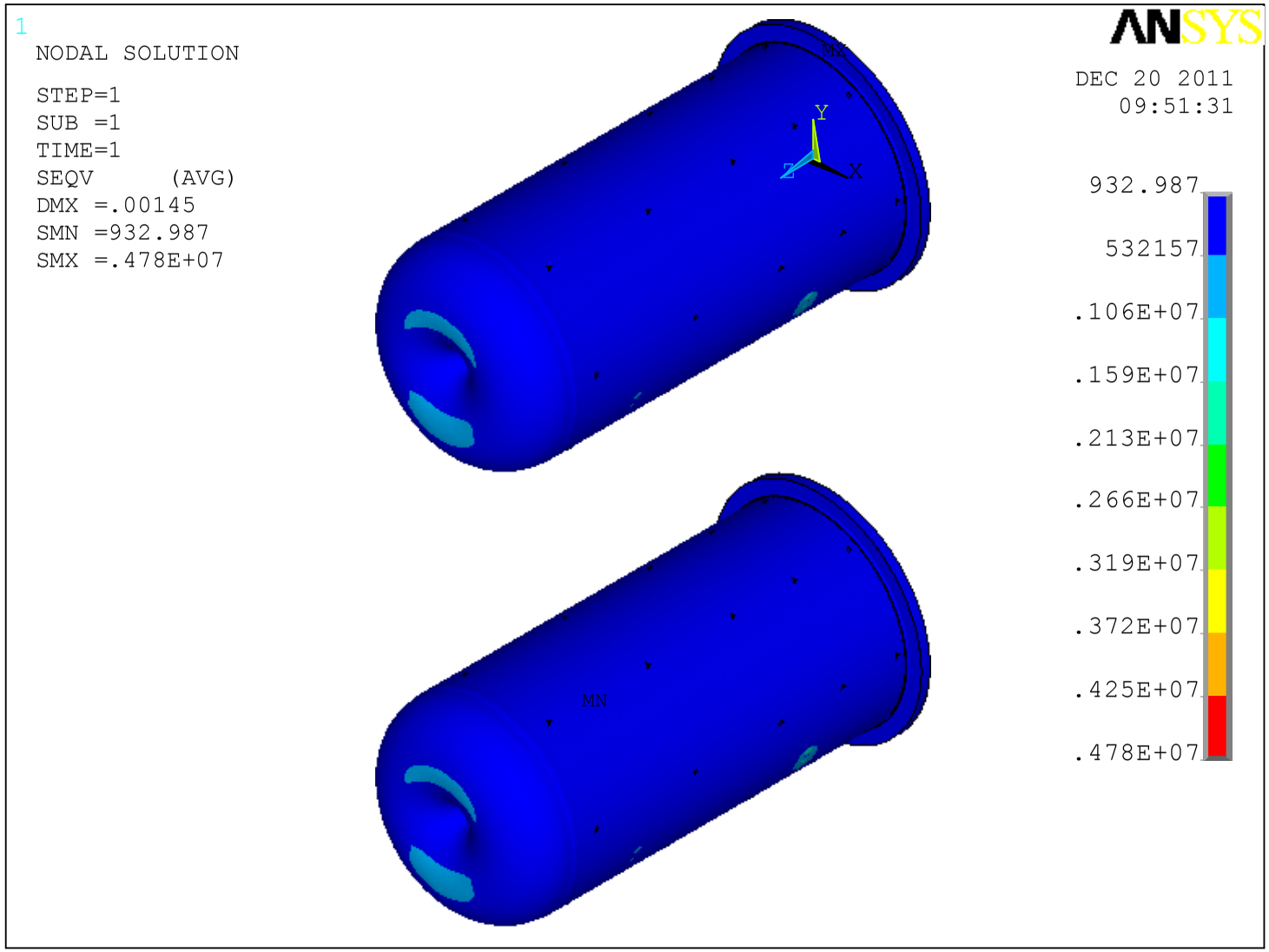

Stress in *Pa*

# Frames supported at the bottom



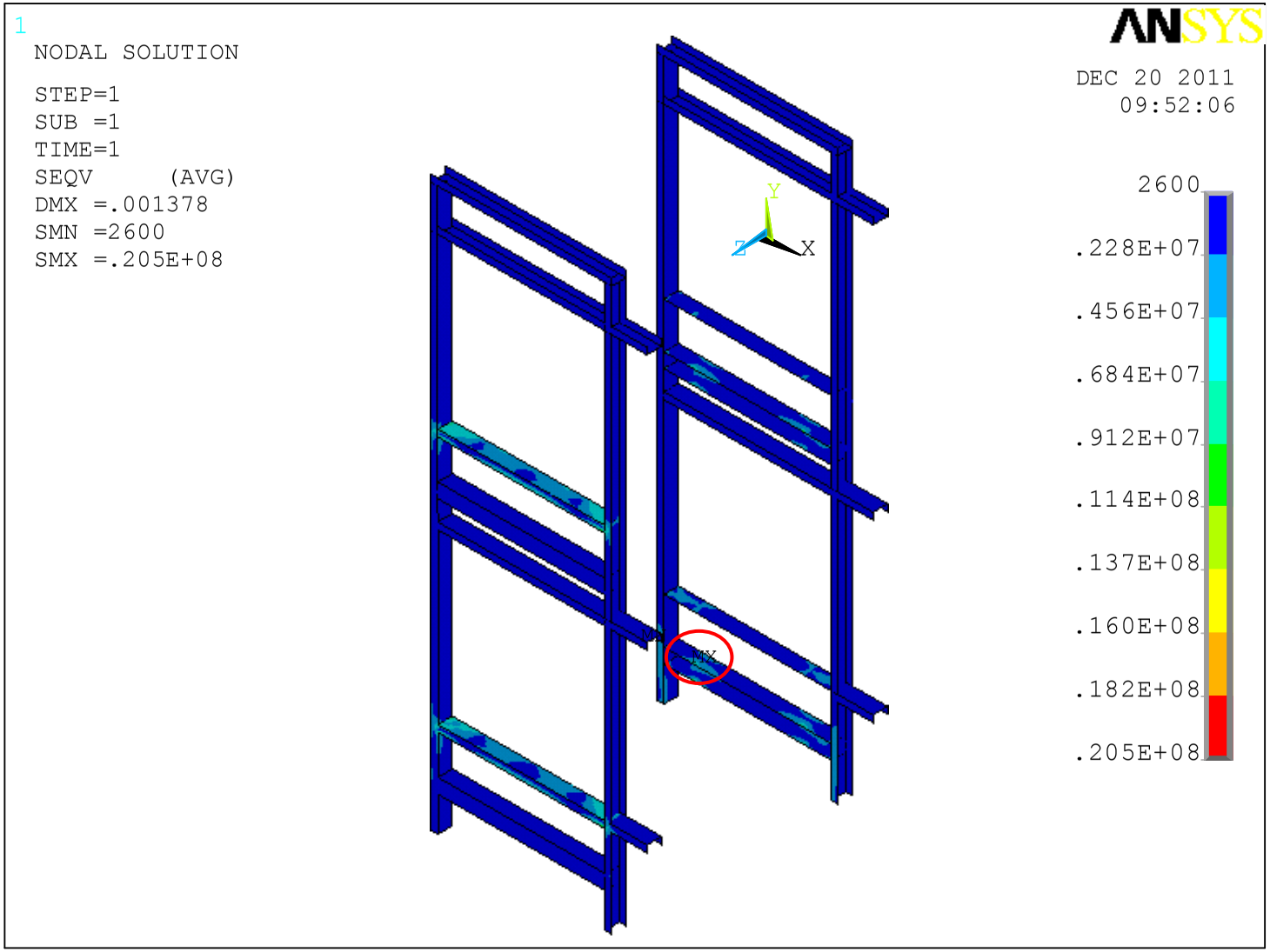

Stress in *Pa*

Frames supported at the bottom




Stress in *Pa*

# Frames supported at the bottom

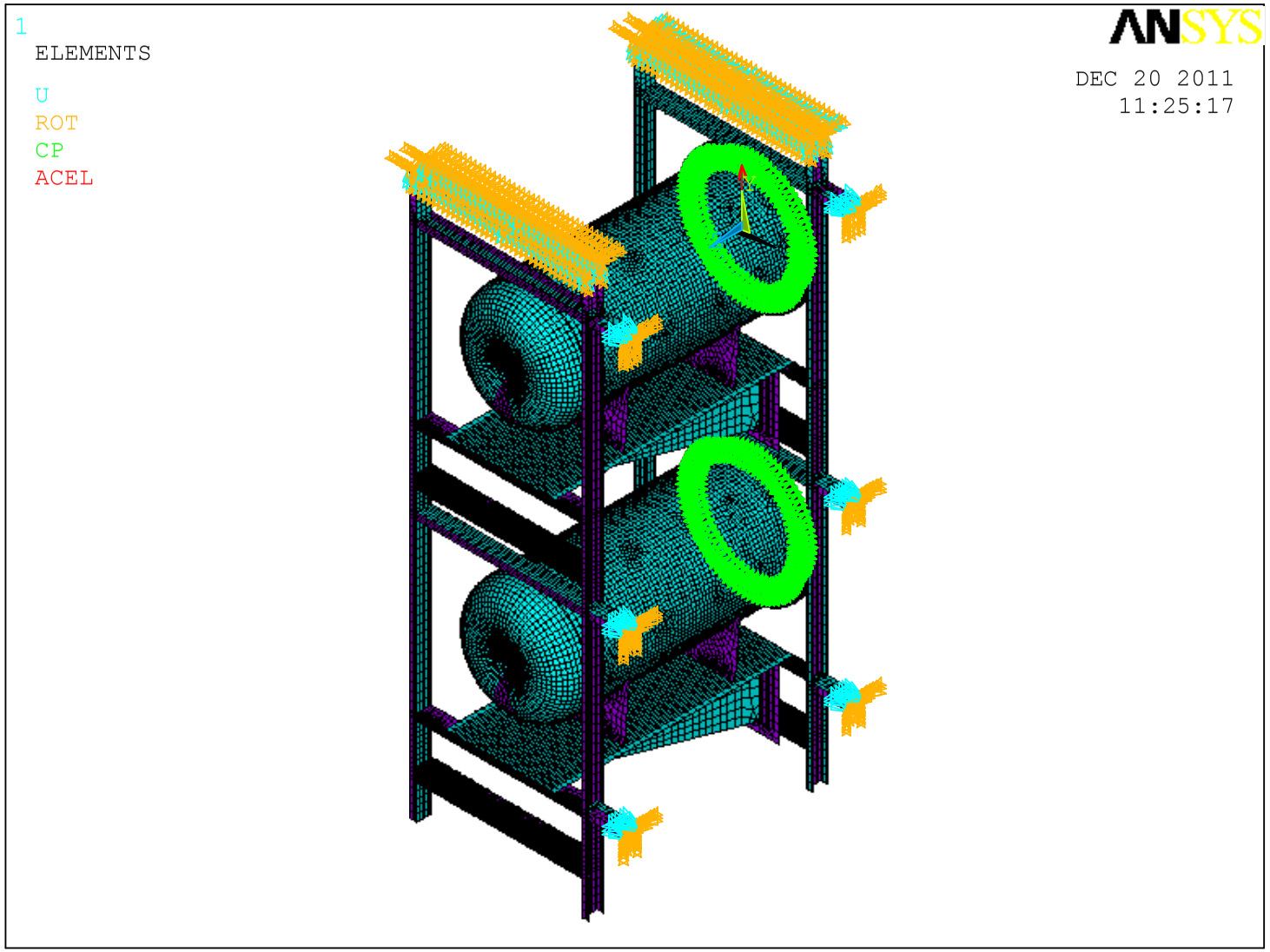



Stress in *Pa*

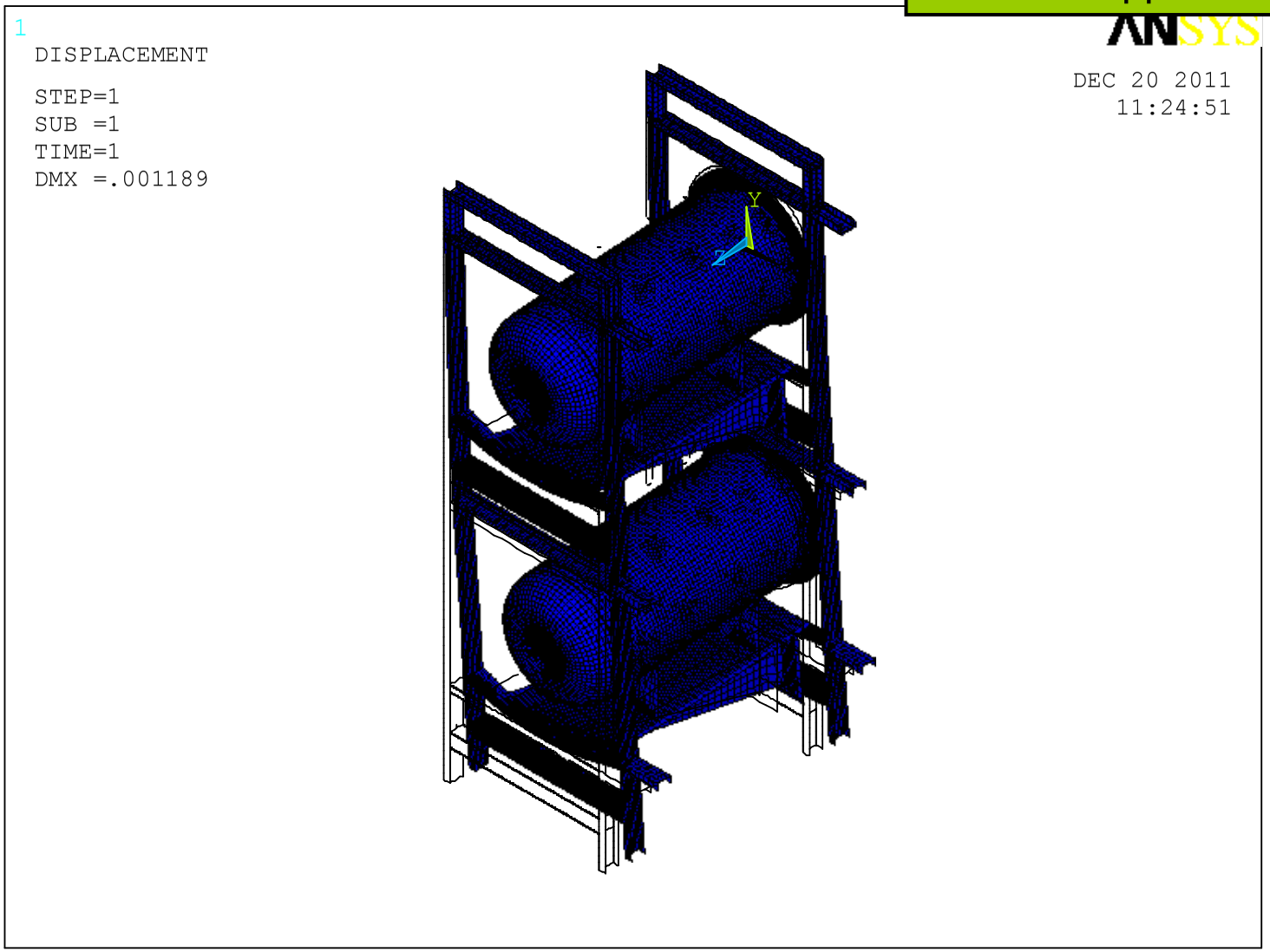
Frames supported on the top,

Slides: 38 - 46

# Frames supported on the top

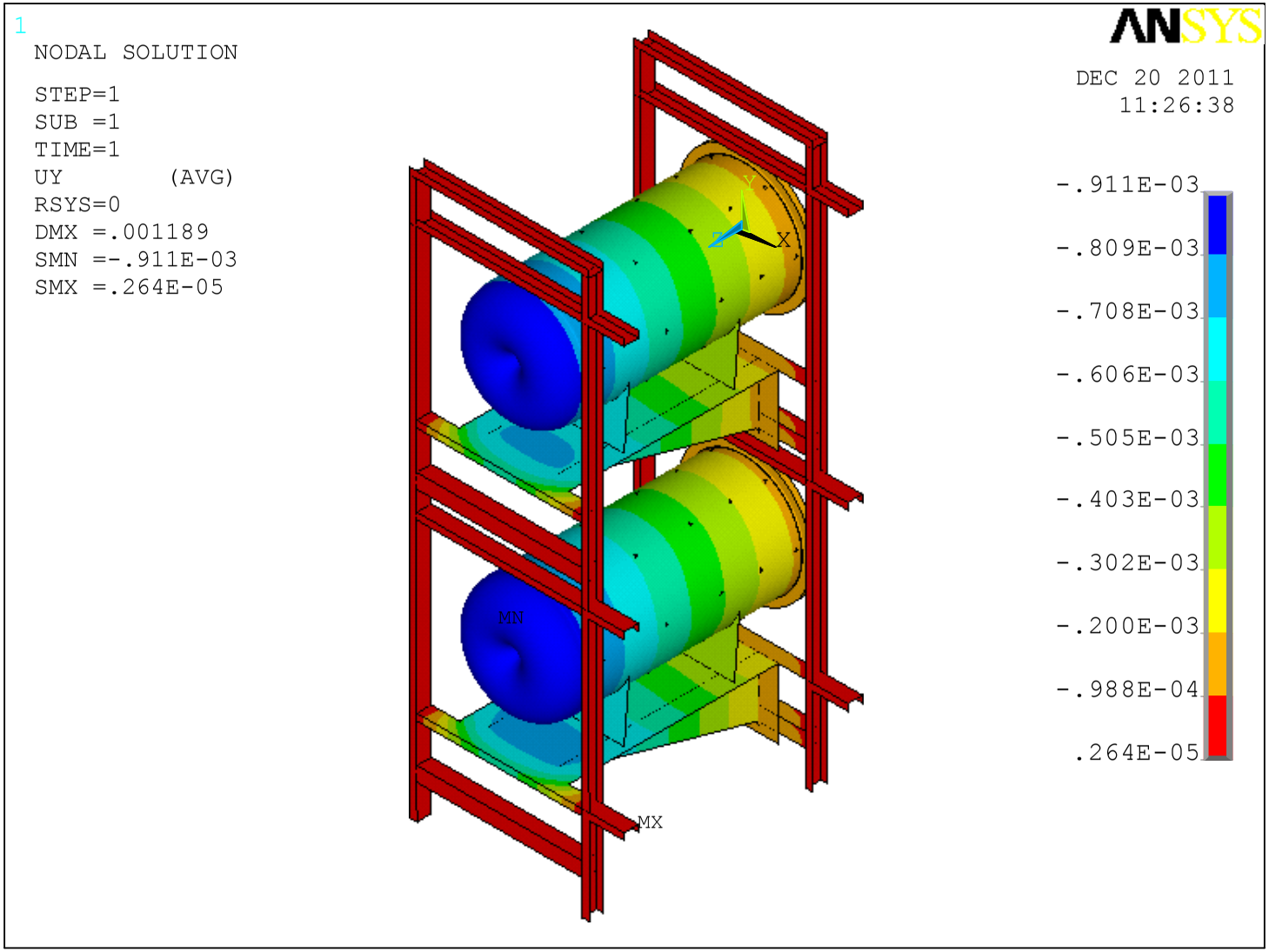


# Frames supported on the top



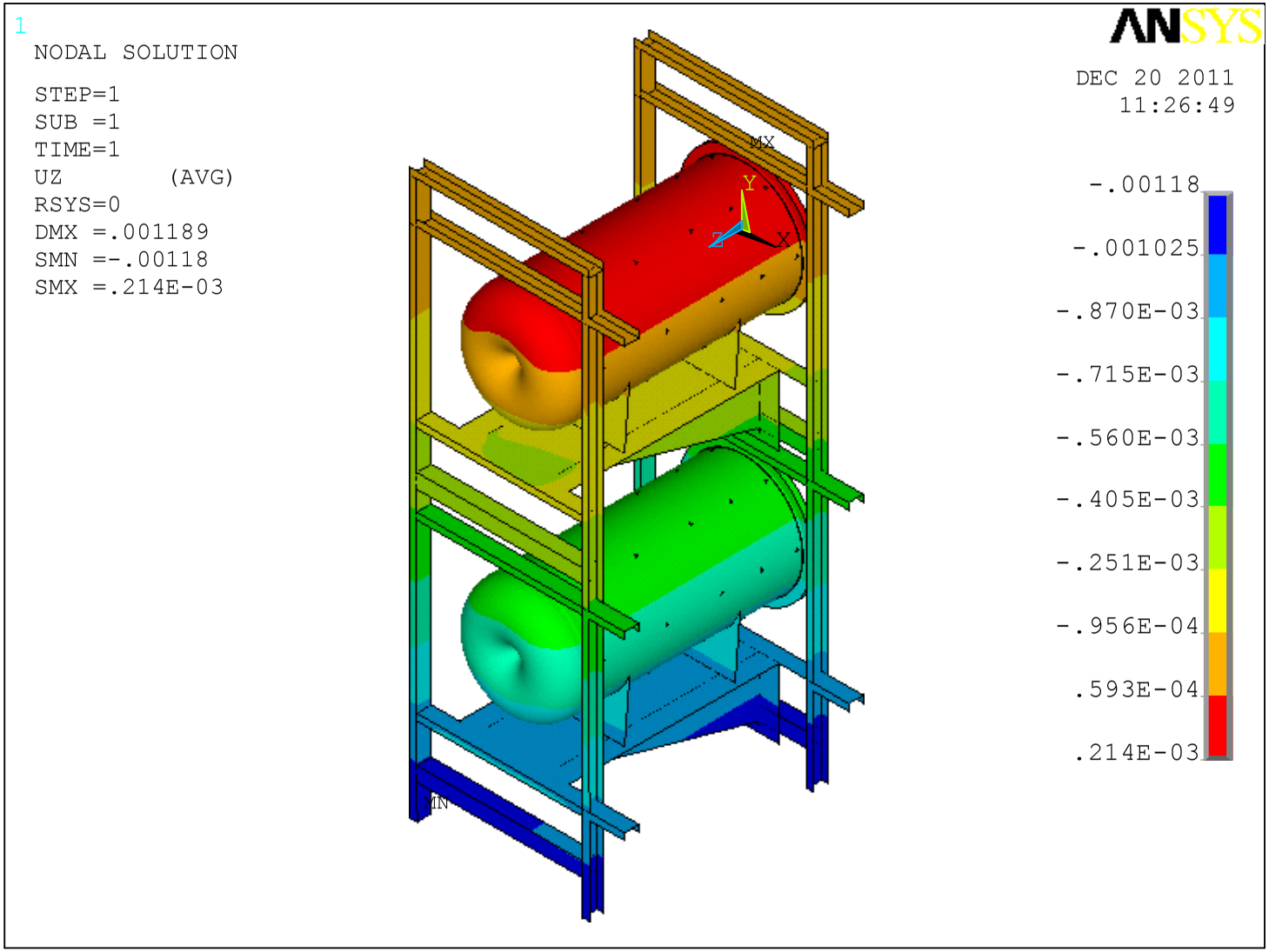

Deformation

Frames supported on the top



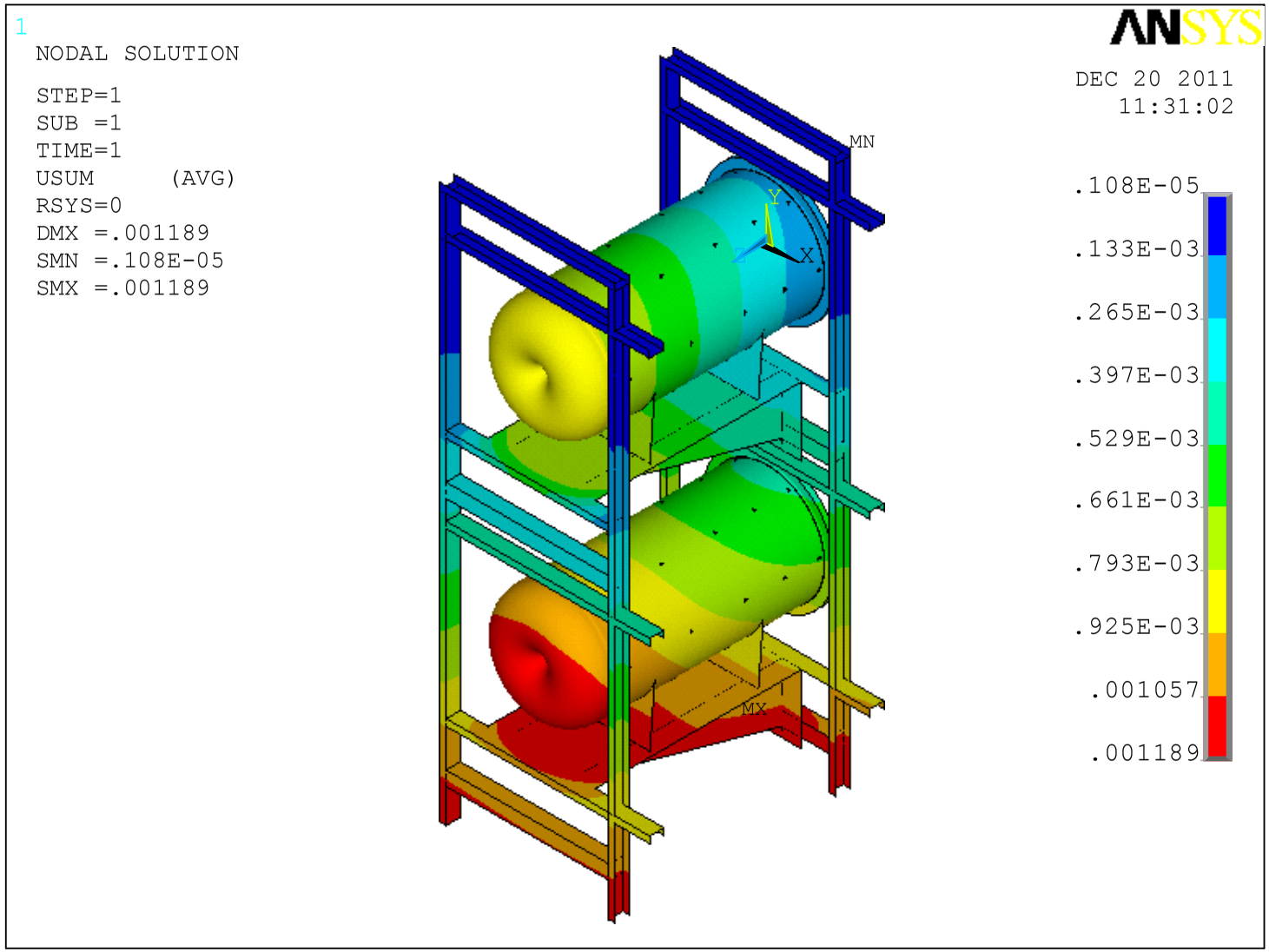

Deflection in *m*

## Frames supported on the top



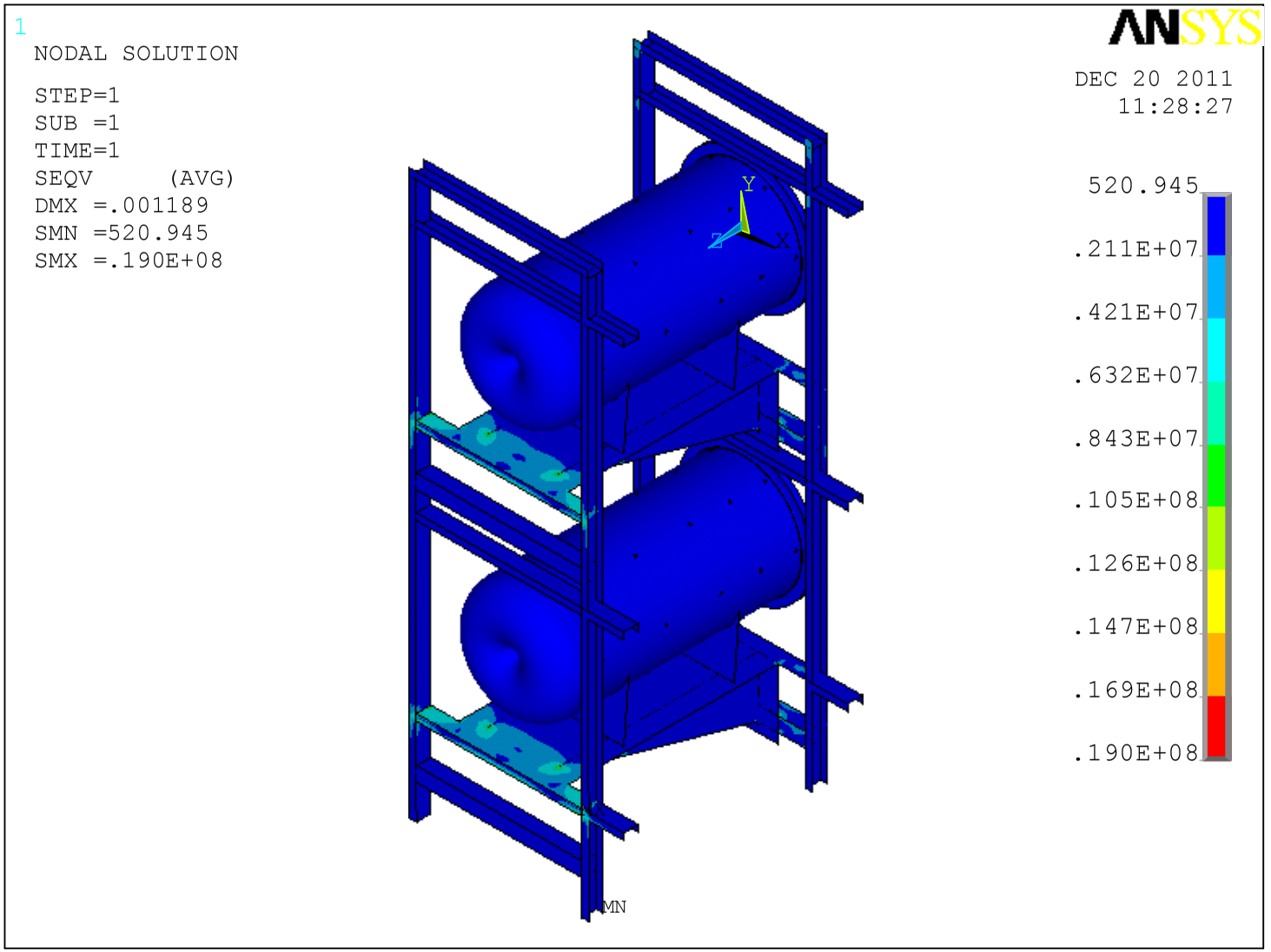

Deflection in *m*

Frames supported on the top



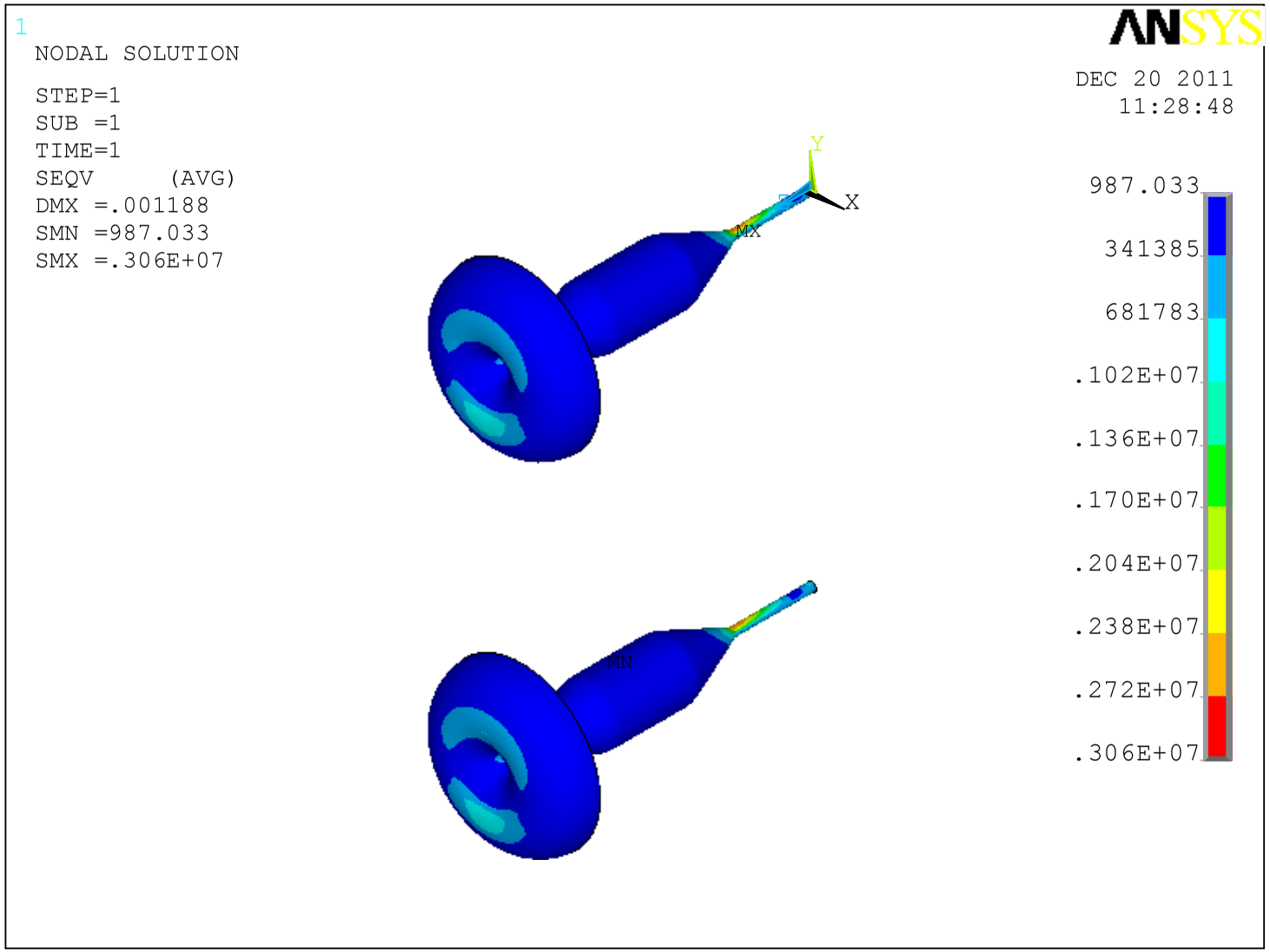

Deflection in *m*

Frames supported on the top



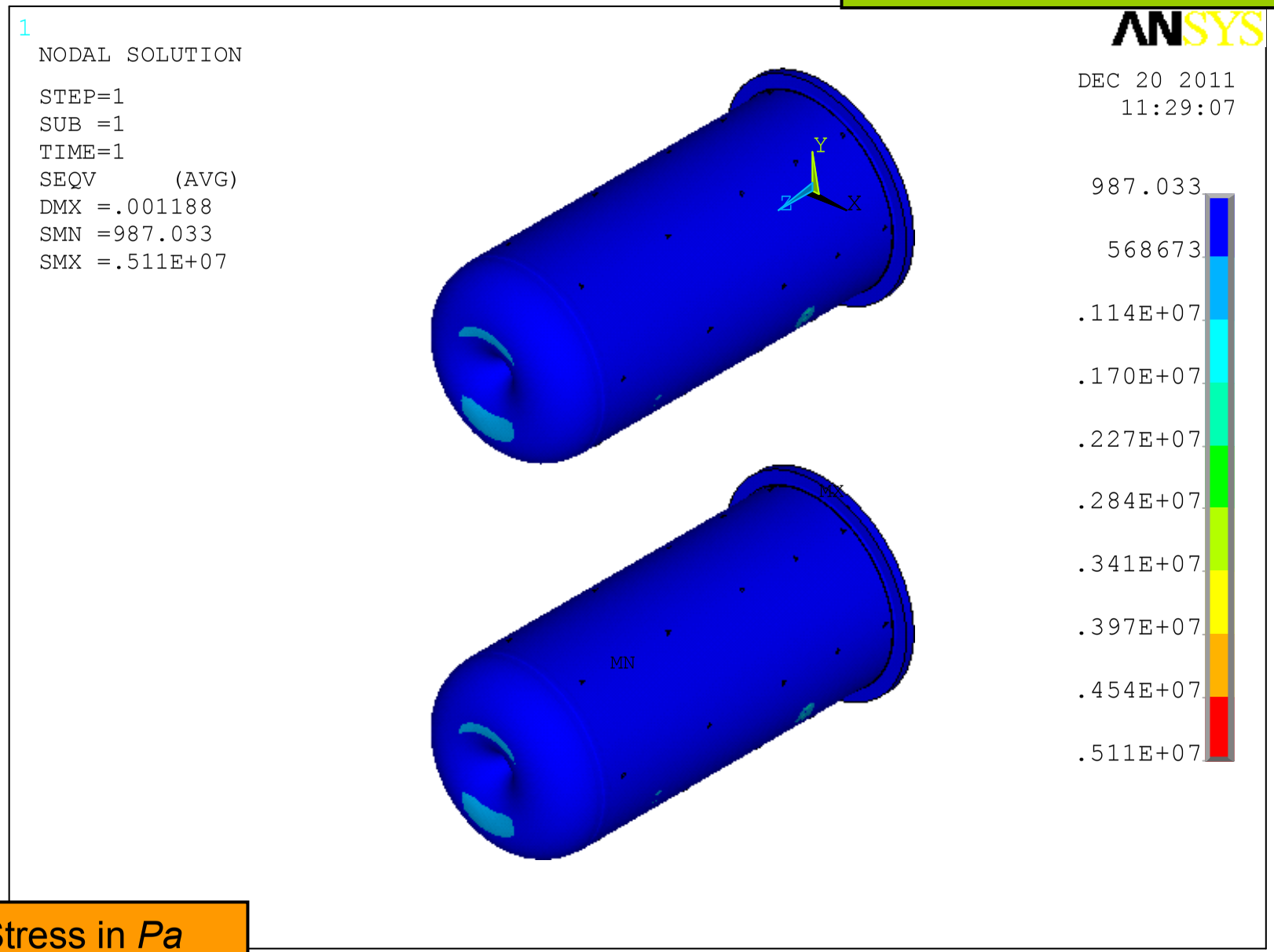

Stress in *Pa*

Frames supported on the top

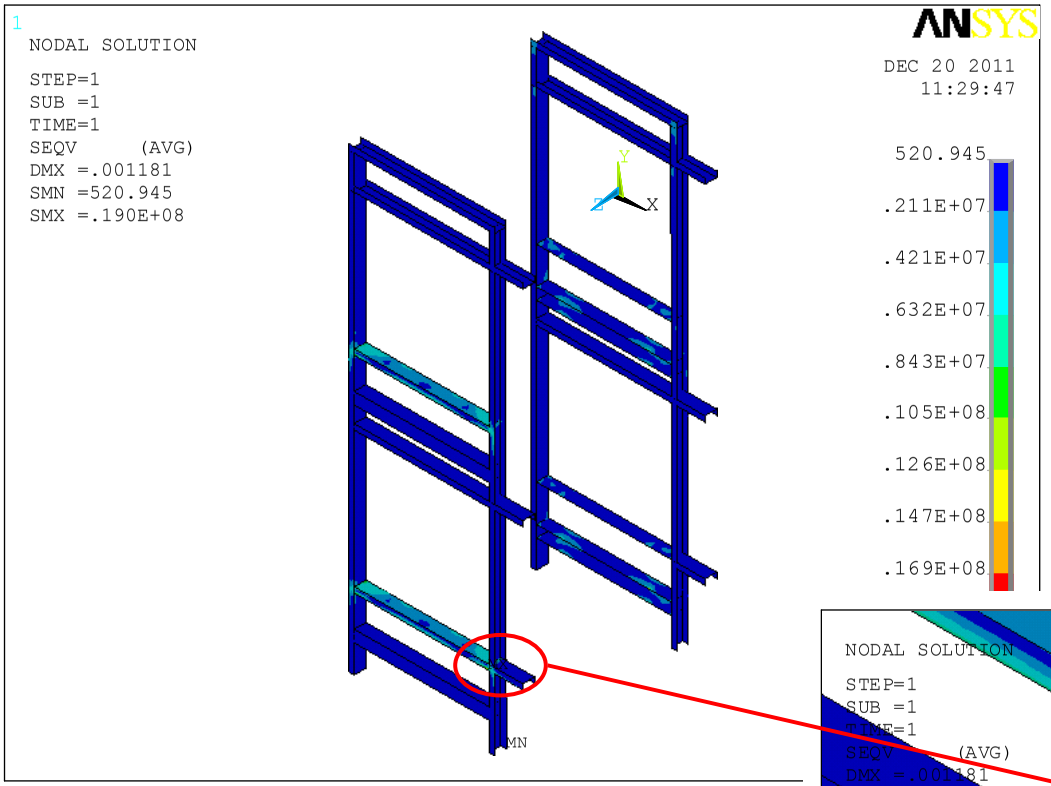



Stress in *Pa*

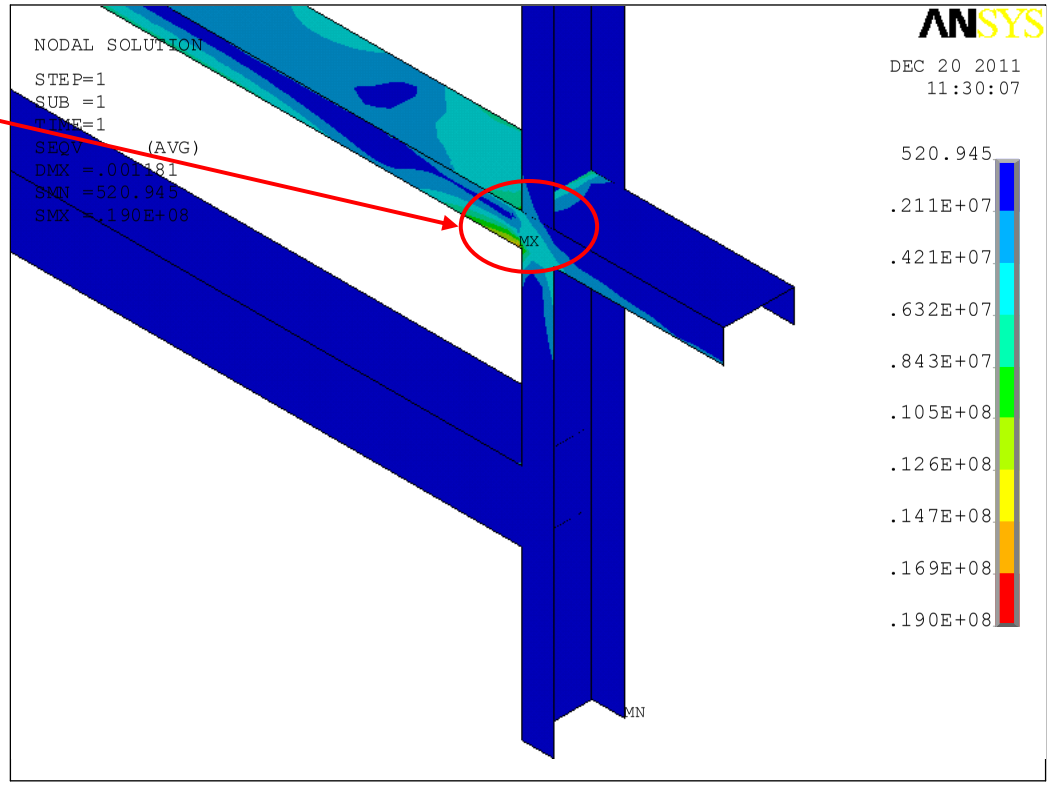
# Frames supported on the top




Stress in *Pa*




Frames supported on the top



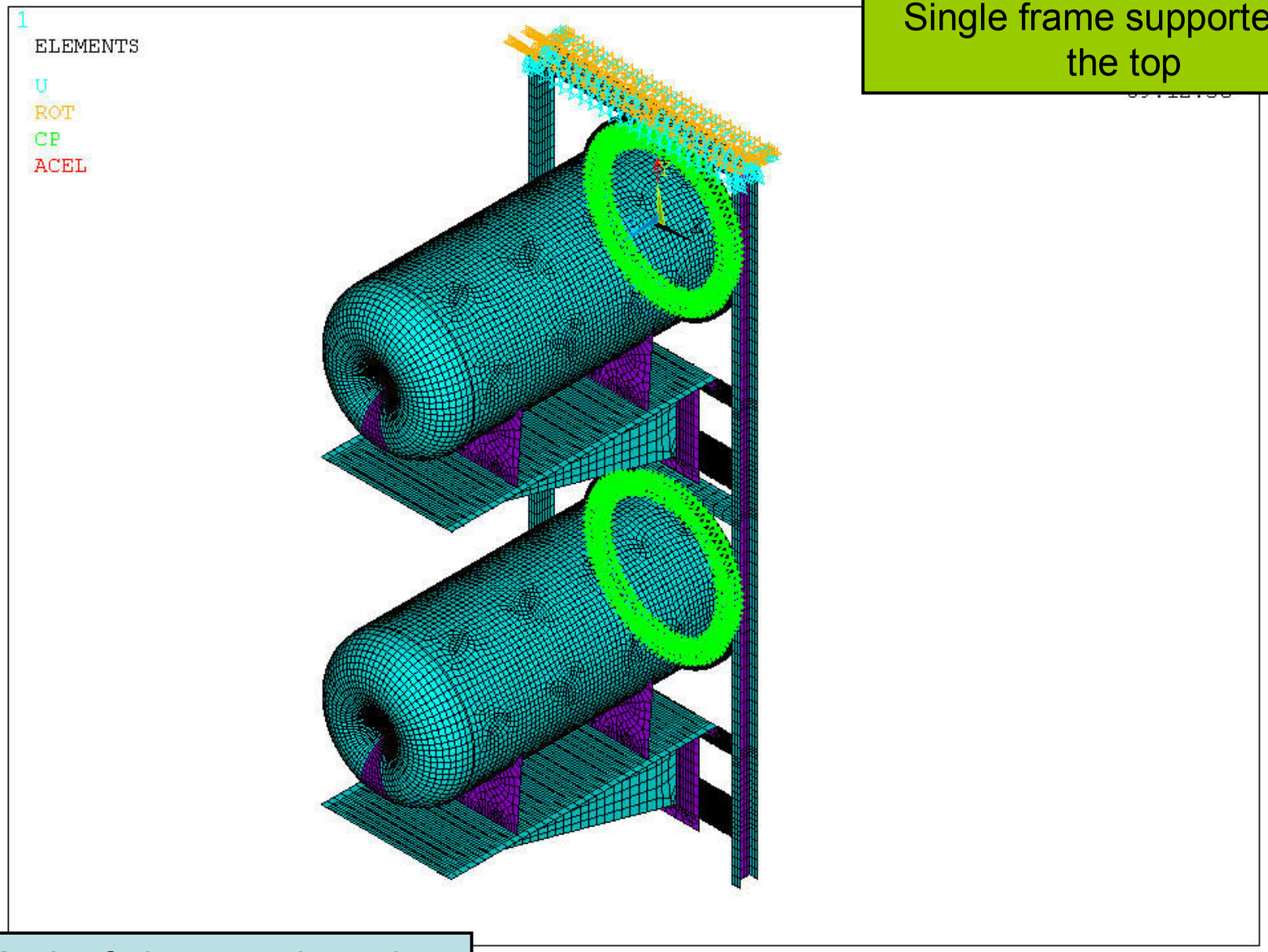

Stress in *Pa*

Four horns supported in two frames – summary of static results for ½ of the structure

| Supports location | $\|u_y\|_{max}$ *mm* | $\|u_z\|_{max}$ *mm* | $U_{sum,max}$ *mm* | $\sigma_{eqv,\ max}$ *MPa* | Remarks |
|---|---|---|---|---|---|
| Bottom | 0.90 | 1.38 | - | 20.5 | Max. Stress in frame |
| Top | 0.91 | 1.18 | 1.19 | 19.0 | Max. Stress in frame |

One side frame support for two horns – frame supported on the top,

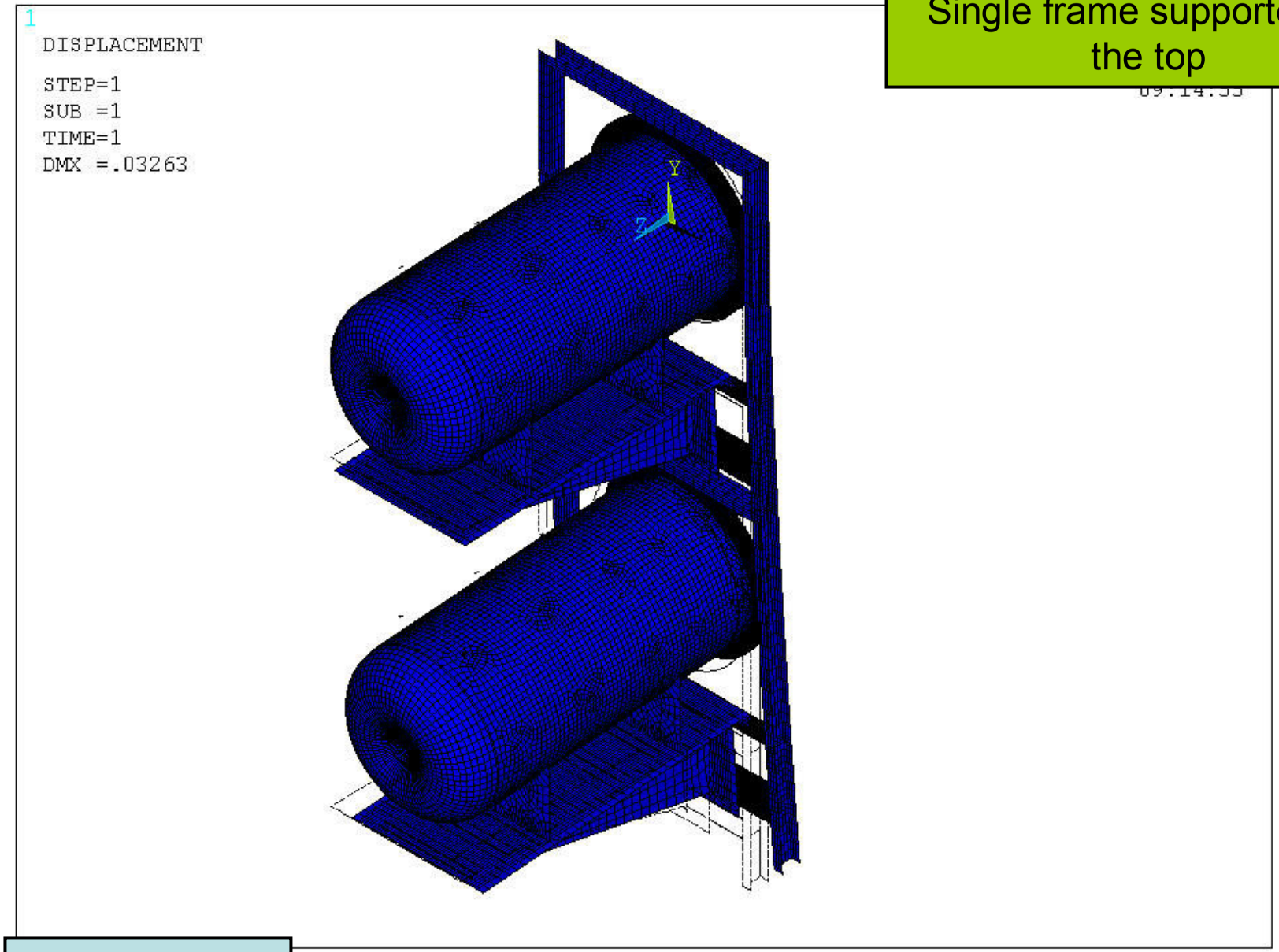
slides: 49-57




Single frame supported on the top

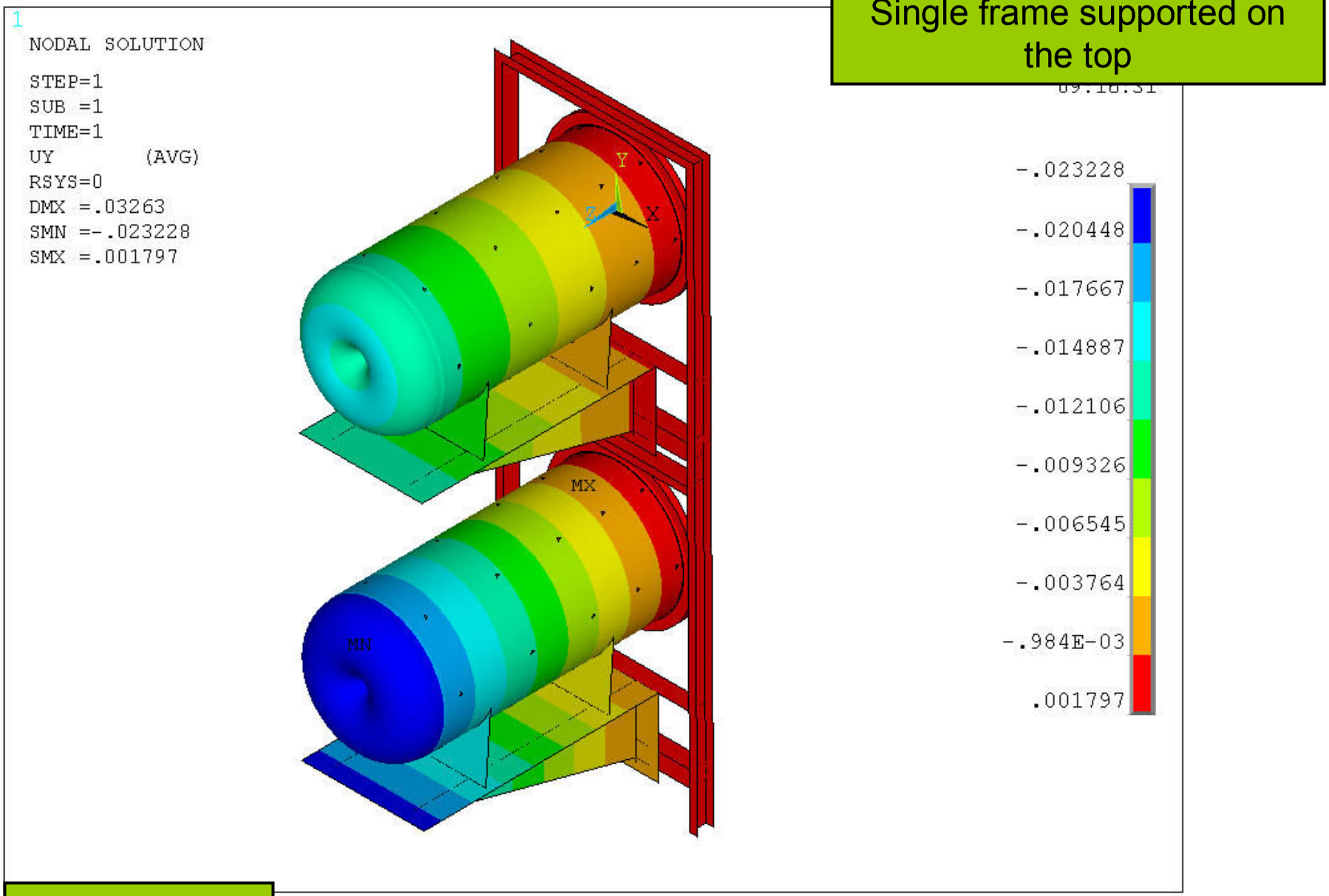
Mesh of elements, boundary conditions

Single frame supported on the top



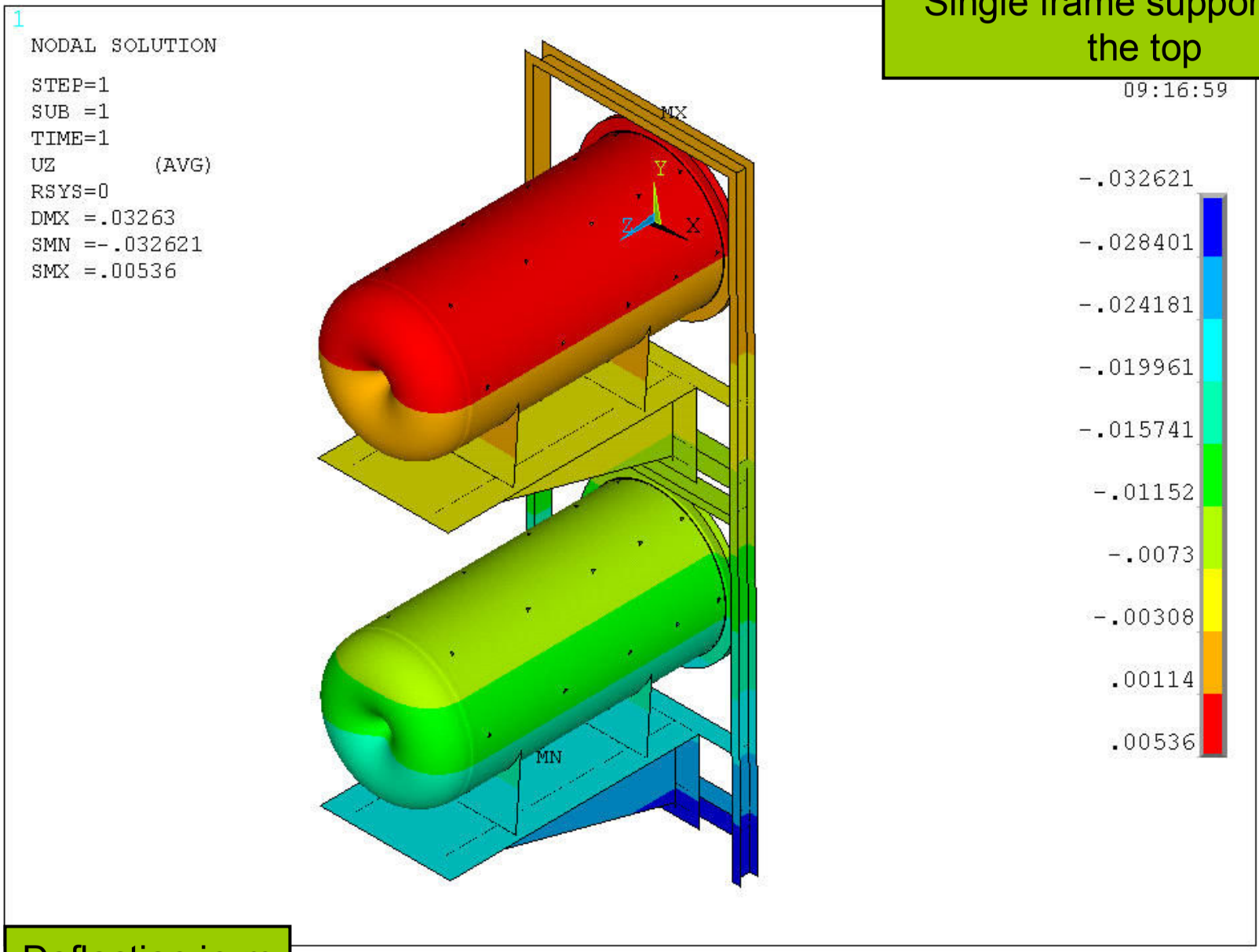

Deformation

# Single frame supported on the top



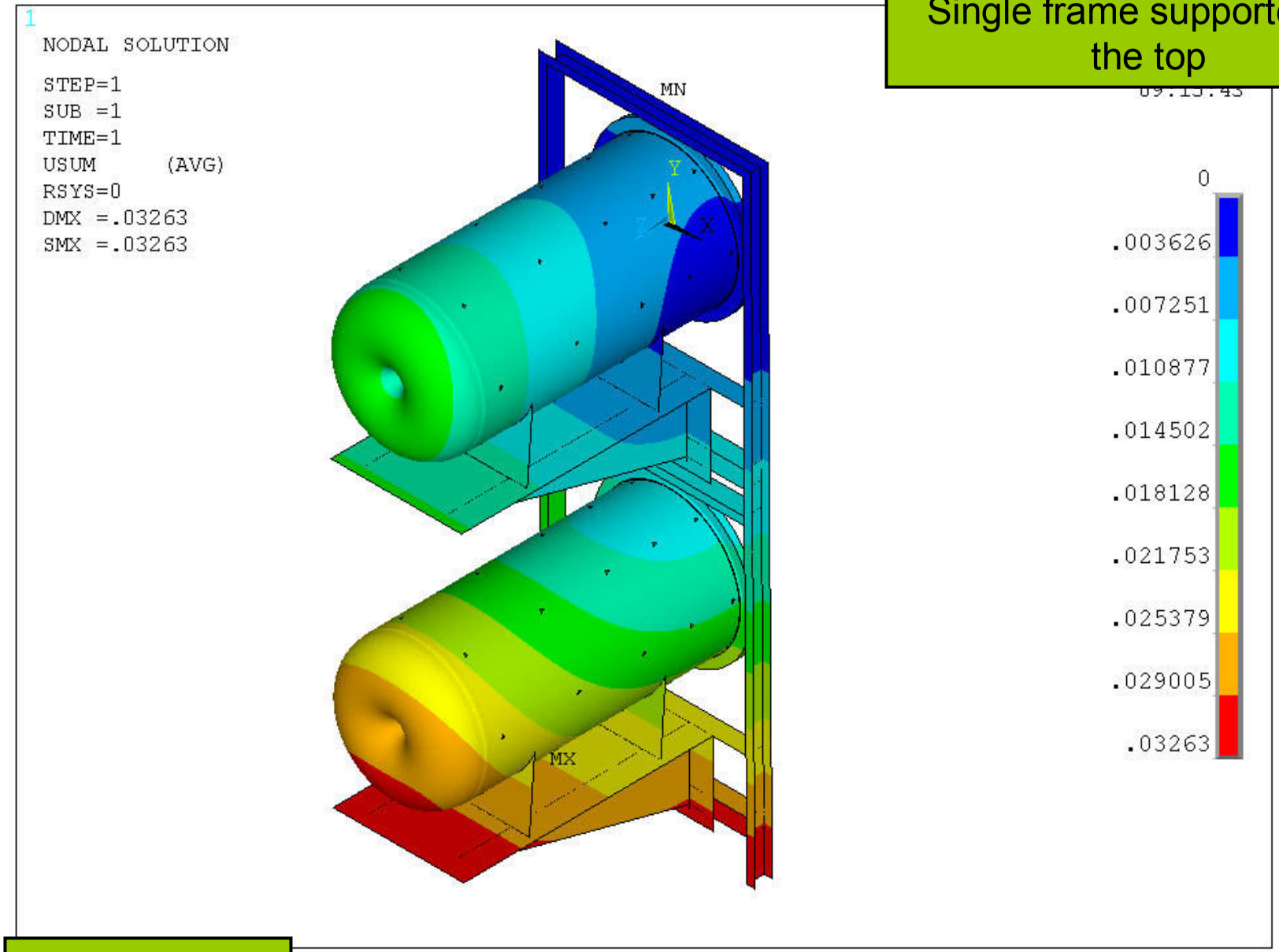

Deflection in *m*

# Single frame supported on the top



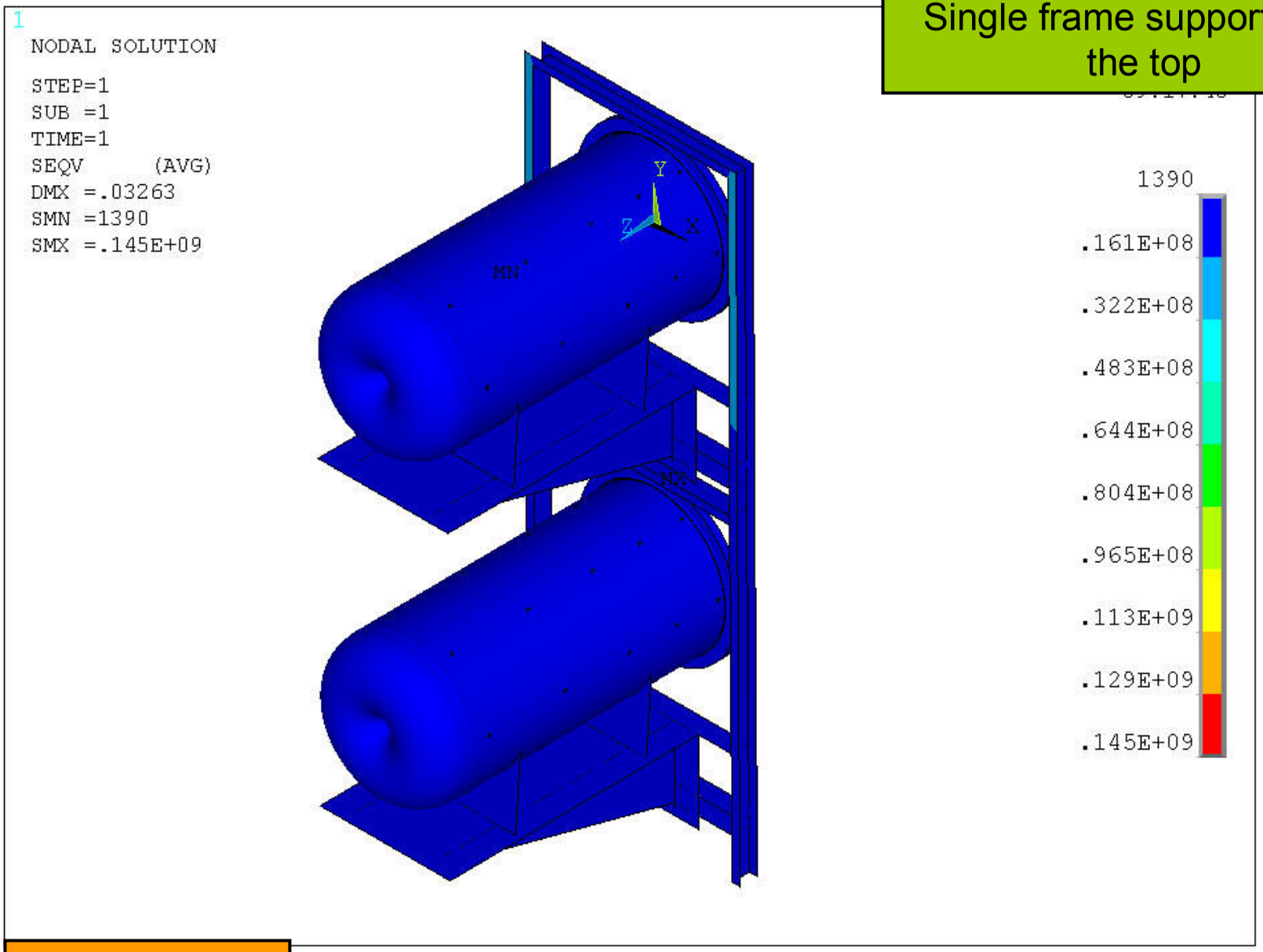

Deflection in *m*

Single frame supported on the top

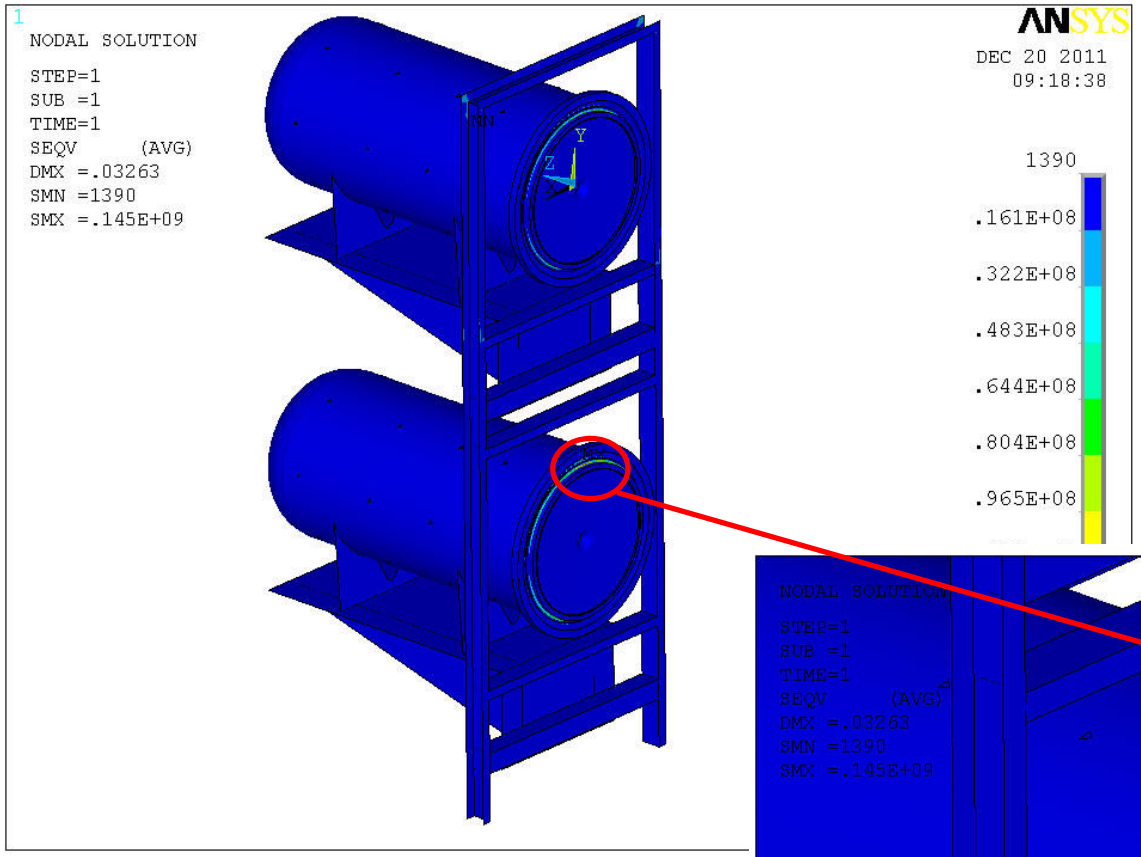



Deflection in *m*

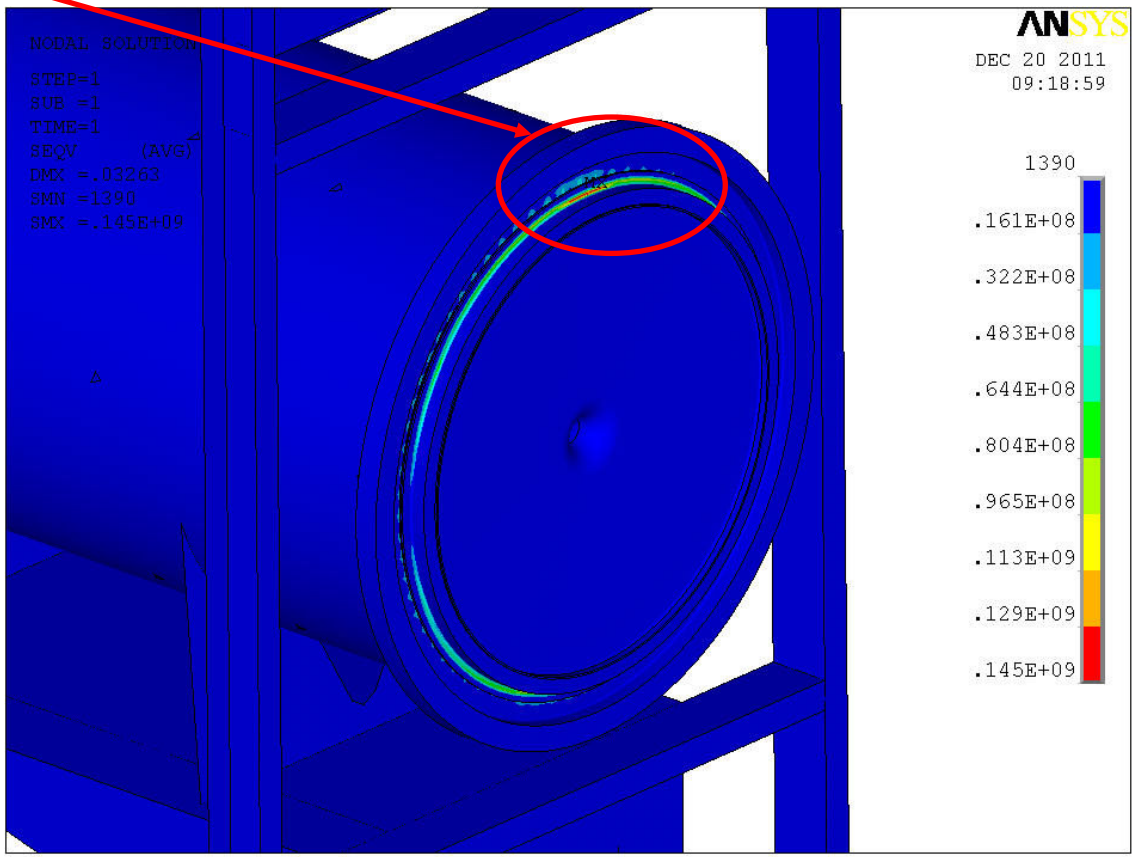
# Single frame supported on the top




Stress in *Pa*

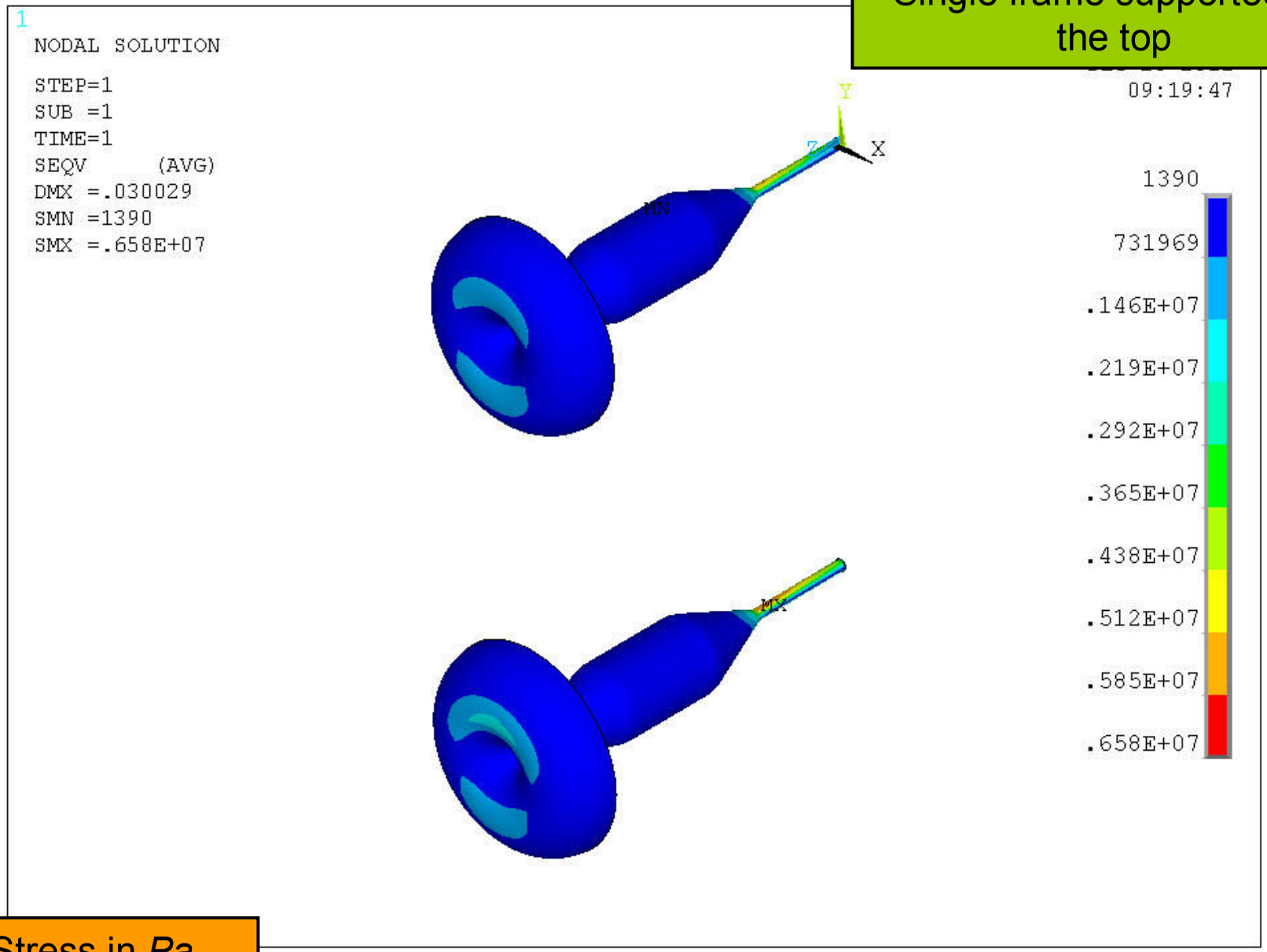



Single frame supported on the top



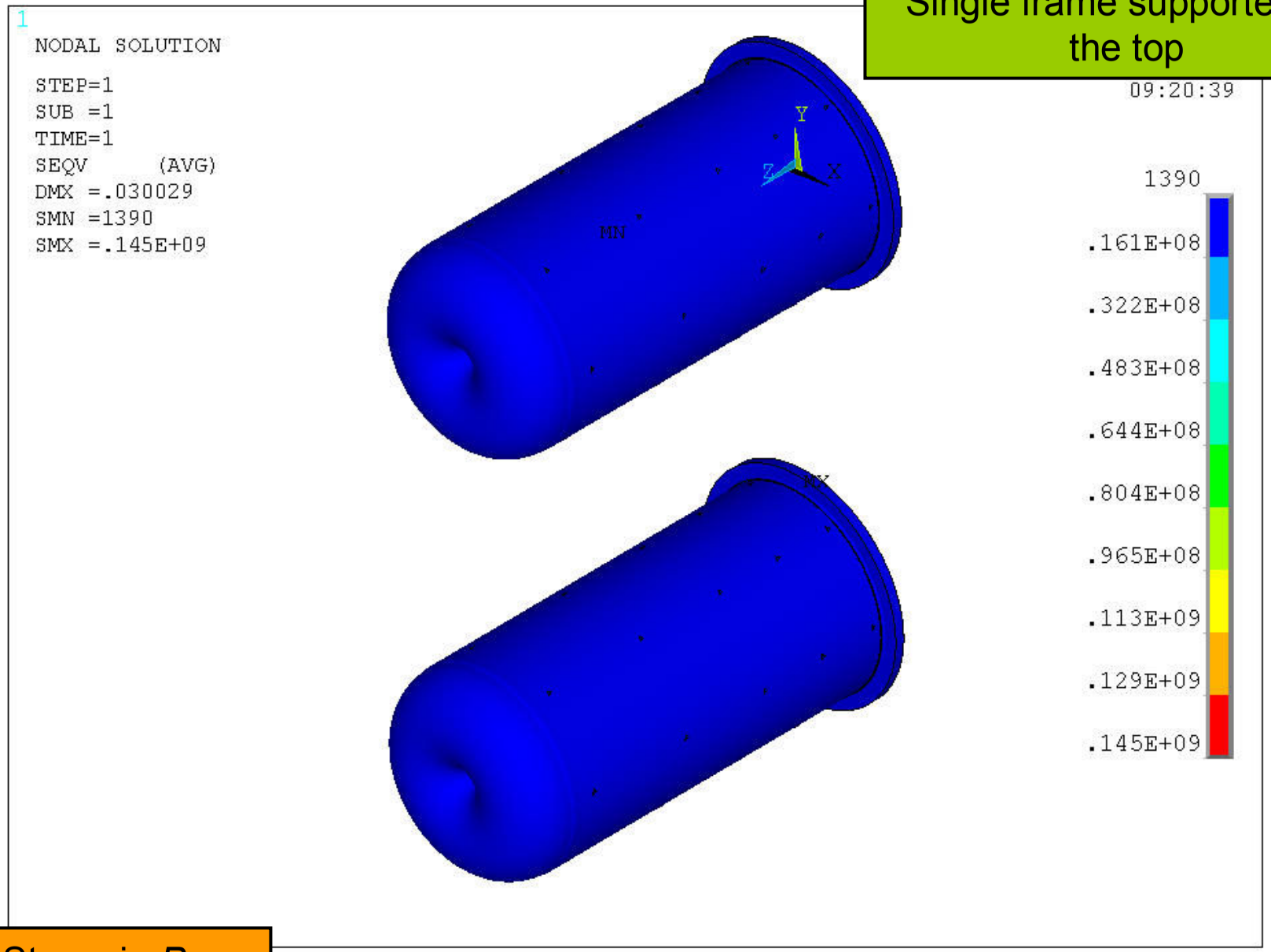

Stress in *Pa*

Single frame supported on the top




Stress in *Pa*

Single frame supported on the top




Stress in *Pa*

Two horns supported in one frame – summary of static results

| Supports location | $\|u_y\|_{max}$ *mm* | $\|u_z\|_{max}$ *mm* | $U_{sum,max}$ *mm* | $\sigma_{eqv,\ max}$ *MPa* | Remarks |
|---|---|---|---|---|---|
| Bottom | 15.5 | - | 27.1 | 102.0 | Max. Stress in front plate of top horn |
| Top | 23.2 | 32.6 | 32.6 | 145.0 | Max. Stress in front plate of bottom horn |

## Two horns supported at the bottom – static results

| Number of frames | $\|u_y\|_{max}$ *mm* | $\|u_z\|_{max}$ *mm* | $U_{sum,max}$ *mm* | $\sigma_{eqv,\ max}$ *MPa* | Remarks |
|---|---|---|---|---|---|
| One frame | 15.5 | - | 27.1 | 102.0 | Max. Stress in front plate of top horn (Table in slide 58) |
| Two frames | 0.90 | 1.38 | 1.45 | 20.2 | Max. Stress in frame (see slide 23) |

## Two horns supported on the top – static results

| Supports location | $\|u_y\|_{max}$ *mm* | $\|u_z\|_{max}$ *mm* | $U_{sum,max}$ *mm* | $\sigma_{eqv,\ max}$ *MPa* | Remarks |
|---|---|---|---|---|---|
| One frame | 23.2 | 32.6 | 32.6 | 145.0 | Max. Stress in front plate of bottom horn (Table in slide 58) |
| Two frames | 0.93 | 1.18 | 1.20 | 18.1 | Max. Stress in frame (see slide 12) |

Thank you for your attention