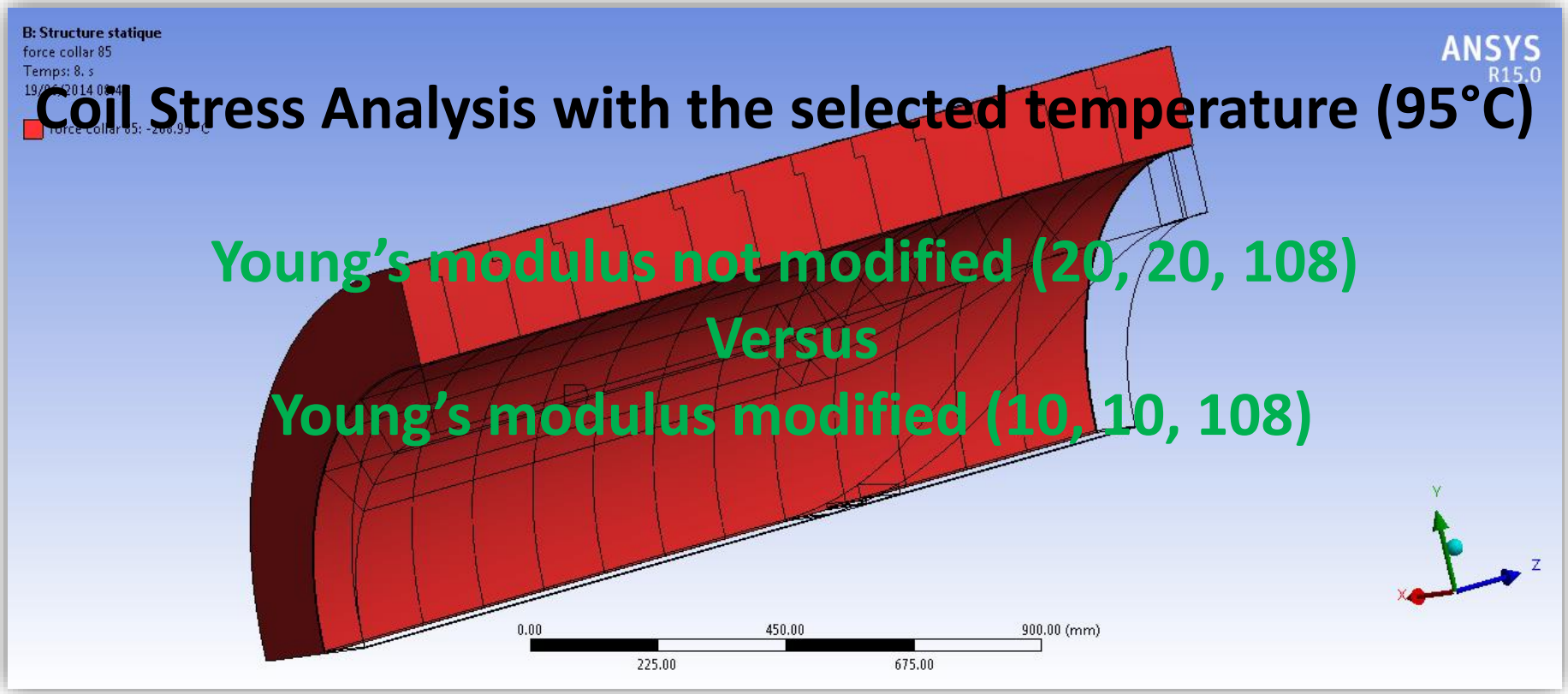
3D ANSYS Model



Coil Stress Analysis with the selected temperature (95°C)

Young's modulus not modified (20, 20, 108)

Versus

Young's modulus modified (10, 10, 108)

2015-05-06_317111_JLAB_Coil Stress Analysis

Revision and Abstract

Description	Revision	Date
Creation	A	2015-05-06 - SA
Update with a shear stress and pressure view, Normal stress add simulation without cooldown and forces (@20°)	B	2015-05-11 - SA

ABSTRACT

This report presents calculation made by Sigmaphi on the dipole coil.

It compares simulation results for the following Young's modulus at room temperature:

- Not modified (measured at UBS): azimuthal = 20 GPa, Radial = 20 GPa, Axial = 108 GPa
- Modified (measured with the prototype collar on the dipole coil): azimuthal = 10 GPa, Radial = 10 GPa, Axial = 108 Gpa

There is no significant difference of stress and contact pressures as a function of these Young's modulus. Consequently the collaring interference temperature at 95°C is still pertinent.

2015-05-06_317111_JLAB_Coil Stress Analysis

Young Modulus modified

All material properties are the same of the report:
2014-12-22-JLAB-Ansys-317111-ansys-collar temperature+Coil v37-95-100

Young Modulus not modified

Température (K)	Module de Young - Direction X (Pa)	Module de Young - Direction Y (Pa)	Module de Young - Direction Z (Pa)	Coefficient de Poisson - XY	Coefficient de Poisson YZ	Coefficient de Poisson XZ	Module de cisaillement - XY (Pa)	Module de cisaillement - YZ (Pa)	Module de cisaillement - XZ (Pa)
4	2,90E+10	2,90E+10	1,25E+11	0,113	0,304	0,0832	8,90E+09	1,14E+10	2,16E+10
295,15	2,00E+10	2,00E+10	1,08E+11	0,17	0,2993	0,0646	6,65E+09	8,45E+09	1,77E+10

Young modulus modified

Température (K)	Module de Young - Direction X (Pa)	Module de Young - Direction Y (Pa)	Module de Young - Direction Z (Pa)	Coefficient de Poisson - XY	Coefficient de Poisson YZ	Coefficient de Poisson XZ	Module de cisaillement - XY (Pa)	Module de cisaillement - YZ (Pa)	Module de cisaillement - XZ (Pa)
4	1,45E+10	1,45E+10	1,25E+11	0,113	0,304	0,0832	8,90E+09	1,14E+10	2,16E+10
295,15	1,00E+10	1,00E+10	1,08E+11	0,17	0,28	0,0646	6,65E+09	8,45E+09	1,77E+10

2015-05-06_317111_JLAB_Coil Stress Analysis

Comparaison of young modulus modified/original young modulus

	Young modulus not modified (Mpa) *Max/Min*	Young modulus modified (Mpa) *Max/Min*
CONTACT PRESSURE BETWEEN COLLARS AND COIL (with magnetic forces)	39,2 / 0	38,54 / 0
CONTACT PRESSURE BETWEEN SPACERS AND COIL (with magnetic forces)	95,6 / -23,51	88,14 / -25,32
CONTACT PRESSURE BETWEEN COLLARS AND COIL (without magnetic forces)	39,78 / 0	38,35 / 0
CONTACT PRESSURE BETWEEN SPACERS AND COIL (without magnetic forces)	73,70 / -11,97	57,83 / -8,7

2015-05-06_317111_JLAB_Coil Stress Analysis

Comparaison of young modulus modified/original young modulus

	Shear stress Young modulus not modified (Mpa) *Max/Min*	Shear stress Young modulus modified (Mpa) *Max/Min*
Shear Stress coils (Plan XZ) (@20°C without forces)	12,03/-11,64	13,27/-12,90
Shear Stress coils (PlanXY) (@20°C without forces)	8,44/-4,87	10,7/-5,12
Shear Stress coils (Plan YZ) (@20°C without forces)	11,95/-20,16	10,7/-16,46

@ 20°C

2015-05-06_317111_JLAB_Coil Stress Analysis

Comparaison of young modulus modified/original young modulus

	Shear stress Young modulus not modified (Mpa) *Max/Min*	Shear stress Young modulus modified (Mpa) *Max/Min*
Shear Stress coils (Plan XZ) (without forces)	30,85/-28,46	28,02/-19,75
Shear Stress coils (PlanXY) (without forces)	11,28/-13,95	14,45/-9,90
Shear Stress coils (Plan YZ) (without forces)	18,44/-33,69	14,97/-30,92

After cooldown at 4K and without magnetic forces

2015-05-06_317111_JLAB_Coil Stress Analysis

Comparaison of young modulus modified/original young modulus

	Shear stress Young modulus not modified (Mpa) *Max/Min*	Shear stress Young modulus modified (Mpa) *Max/Min*
Shear Stress coils (Plan XZ) (with forces)	30,43/-21,54	26,63/-21,32
Shear Stress coils (PlanXY) (with forces)	16,22/-16,82	19,42/-20,32
Shear Stress coils (Plan YZ) (with forces)	21,10/-35,27	19,17/-34,75

After cooldown at 4K and with magnetic forces

2015-05-06_317111_JLAB_Coil Stress Analysis

Comparaison of young modulus modified/original young modulus

	Normal stress Young modulus not modified (Mpa) *Max/Min*	Normal stress Young modulus modified (Mpa) *Max/Min*
Normal stress X axis (@20°C)	15,03/-16,92	7,97/-16,93
Normal stress Y axis (@20°C)	10,45/-47,31	10,95/-32,41
Normal stress Z axis (@20°c)	61,93/-87,32	56,75/-95,95

@ 20°C

2015-05-06_317111_JLAB_Coil Stress Analysis

Comparaison of young modulus modified/original young modulus

	Normal stress Young modulus not modified (Mpa) *Max/Min*	Normal stress Young modulus modified (Mpa) *Max/Min*
Normal stress X axis (without forces)	29,49/-39,39	15,83/-31,25
Normal stress Y axis (without forces)	26,3/-75,95	19,51/-56,95
Normal stress Z axis (without forces)	101,99/-170,67	95,62/-167,10

After cooldown at 4K and without magnetic forces

2015-05-06_317111_JLAB_Coil Stress Analysis

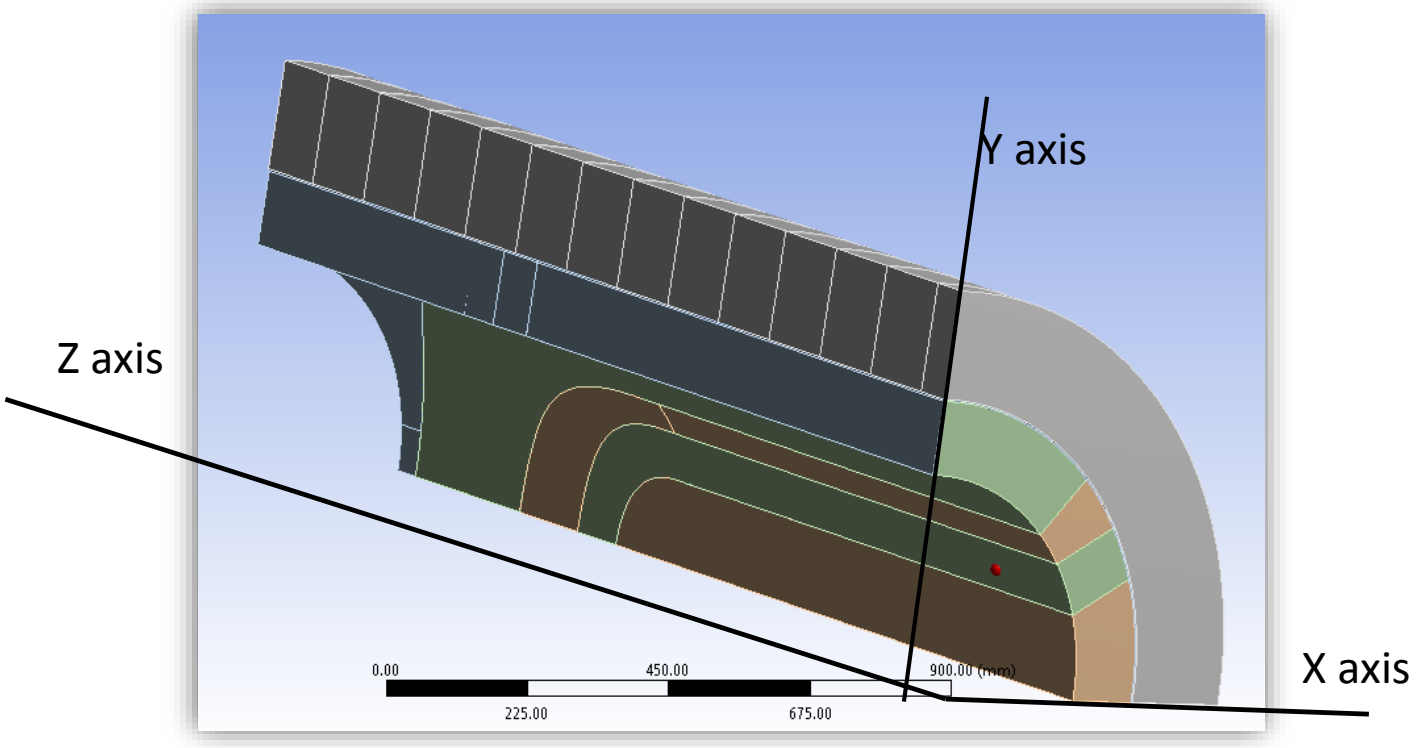
Comparaison of young modulus modified/original young modulus

	Normal stress Young modulus not modified (Mpa) *Max/Min*	Normal stress Young modulus modified (Mpa) *Max/Min*
Normal stress X axis (with forces)	52,69/-46,58	51,46/-40,42
Normal stress Y axis (with forces)	21,63/-96,7	28,07/-88,02
Normal stress Z axis (with forces)	158,37/-171,3	177,66/-179,07

After cooldown at 4K and with magnetic forces

2015-05-06_317111_JLAB_Coil Stress Analysis

Orientation: global axes

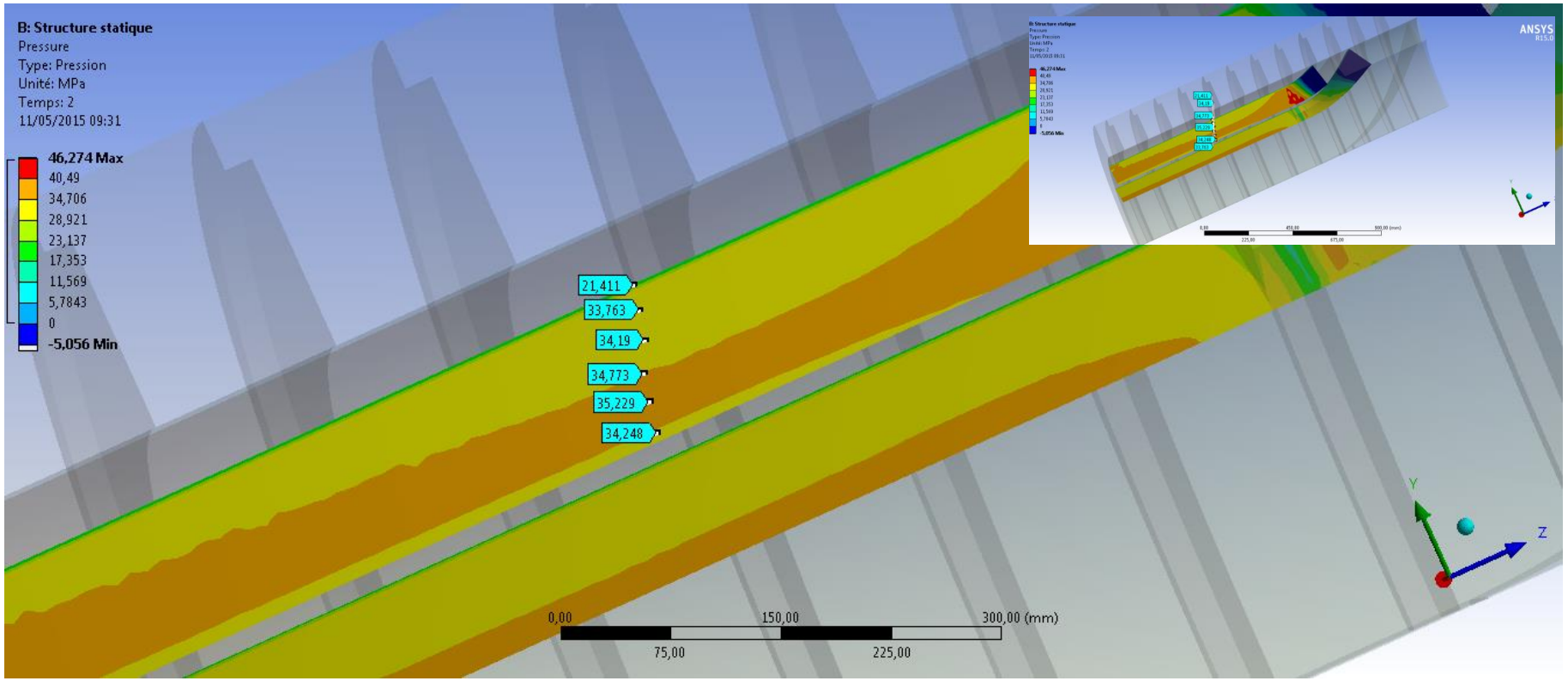


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

– CONTACT PRESSURE BETWEEN Central Spacer

With the young modulus not modified @20°

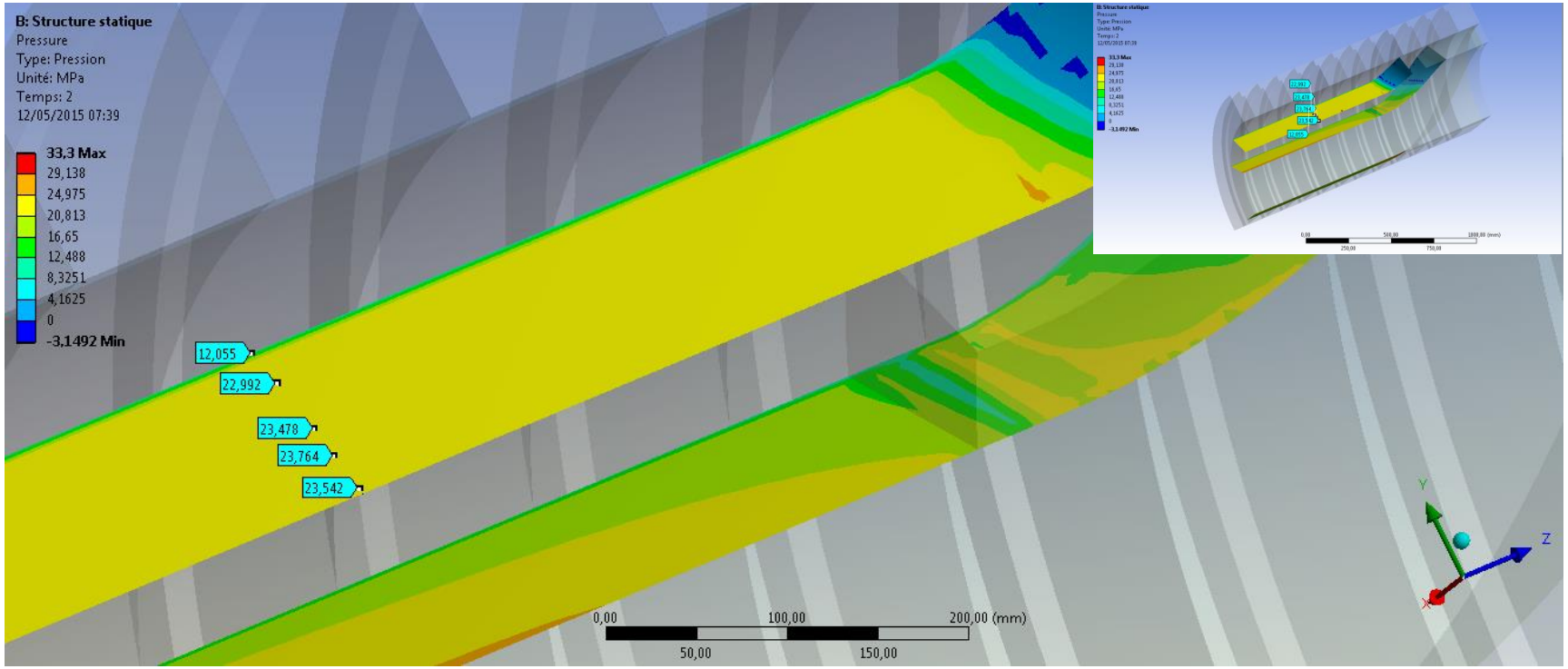


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

– CONTACT PRESSURE BETWEEN Central Spacer

With the young modulus modified @20°

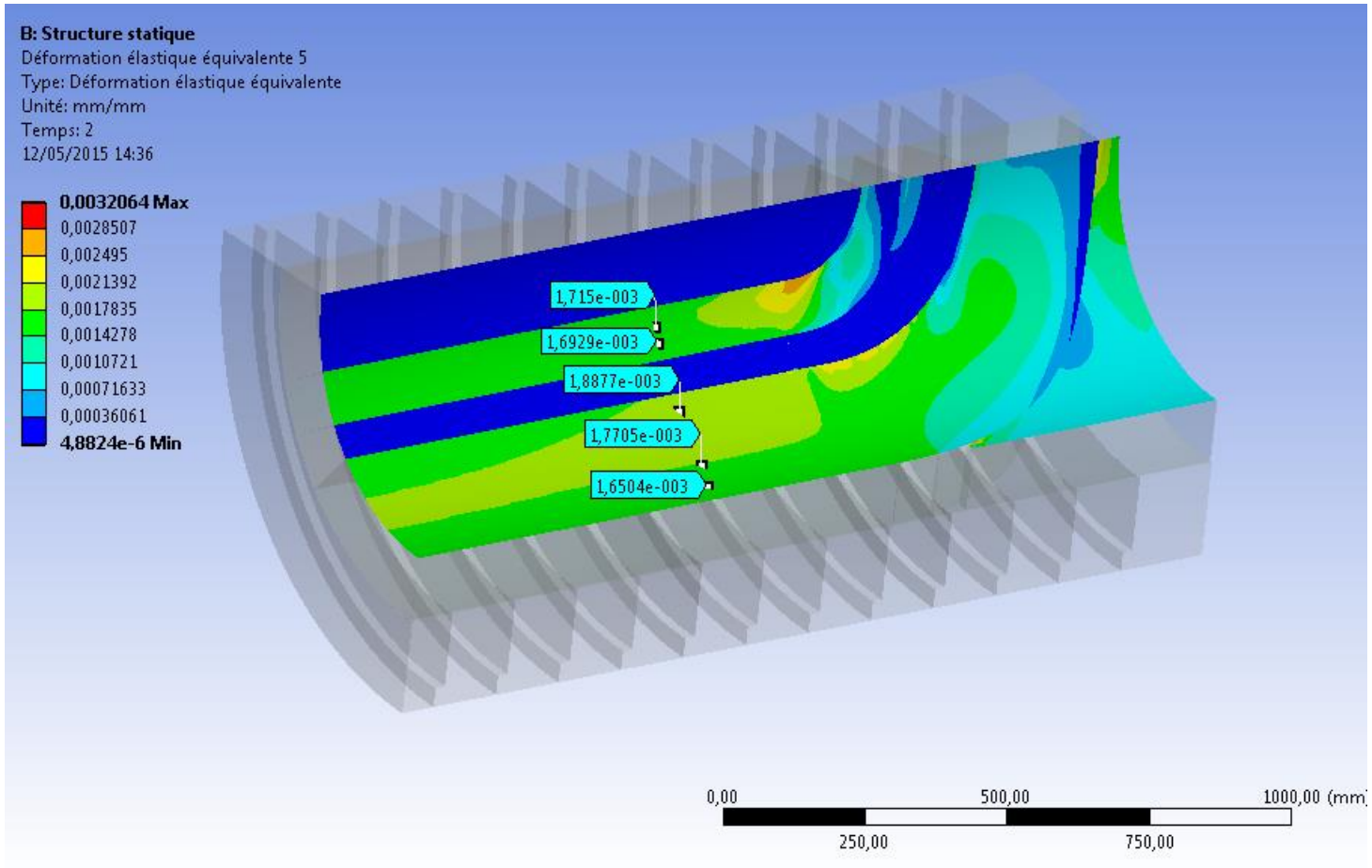


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

– Deformation inner coils

With the young modulus not modified @20°

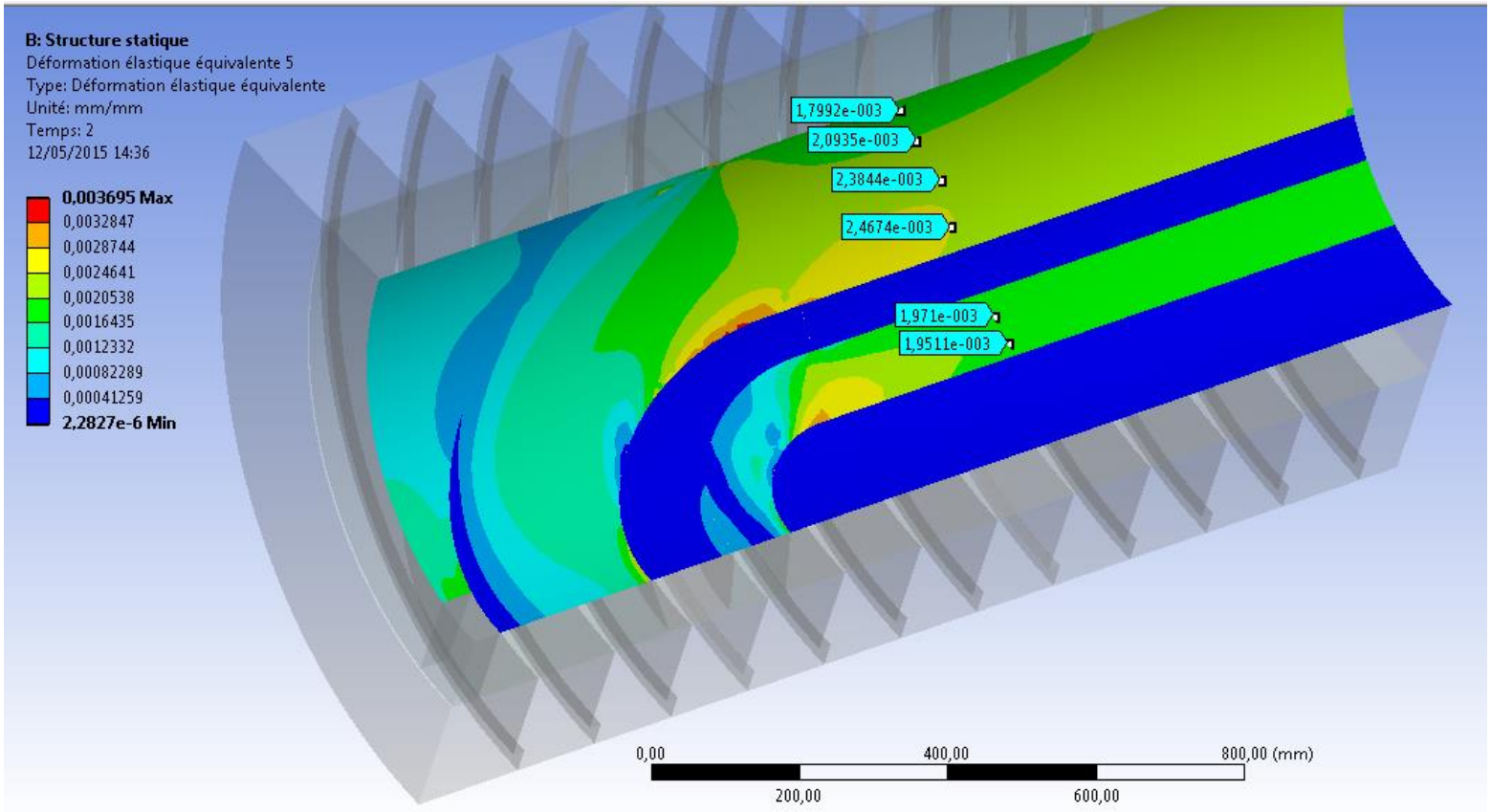


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

– Deformation inner coils

With the young modulus modified @20°

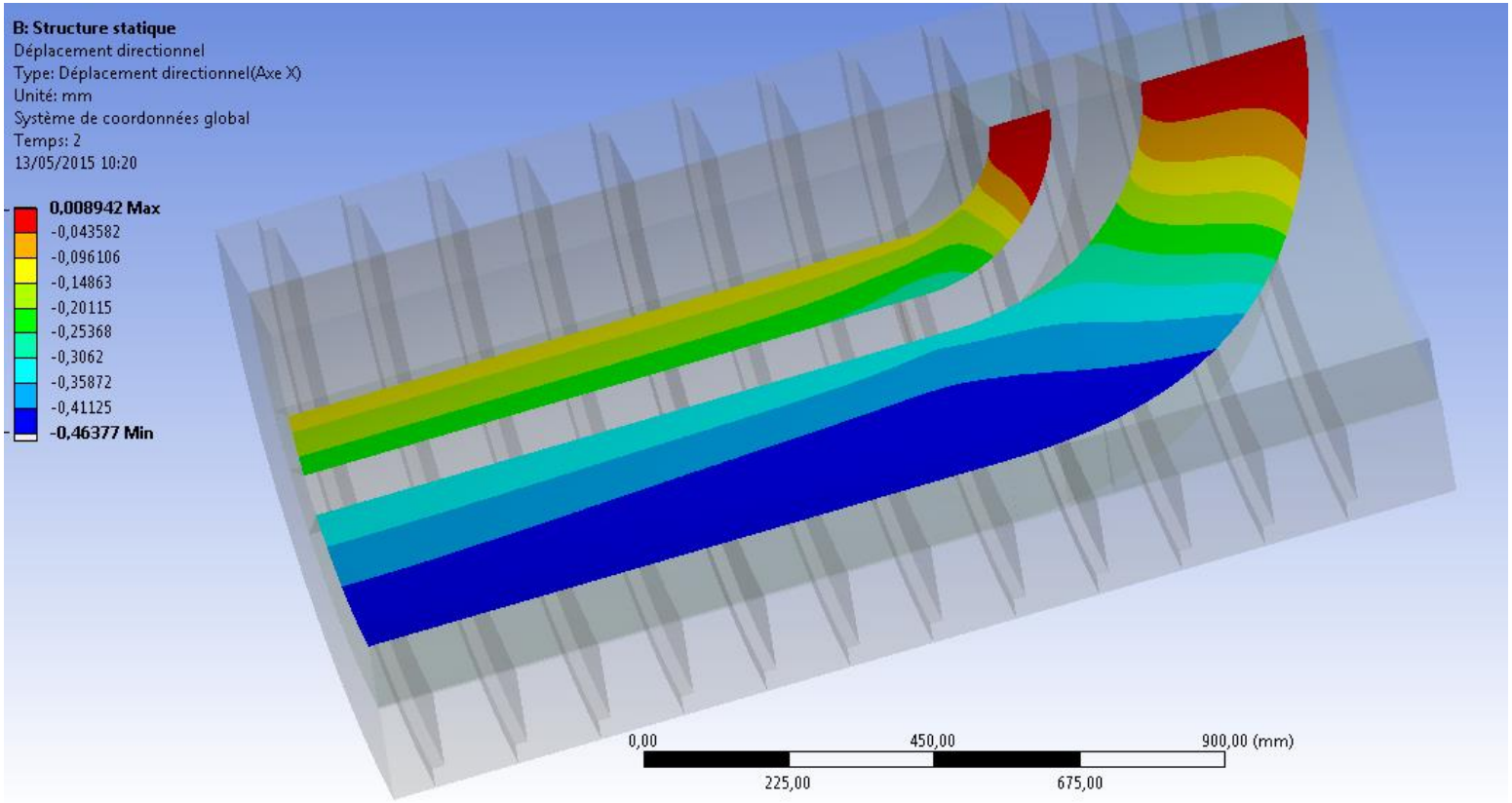


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

– displacement Xaxis inner coils (conductor)

With the young modulus not modified @20°

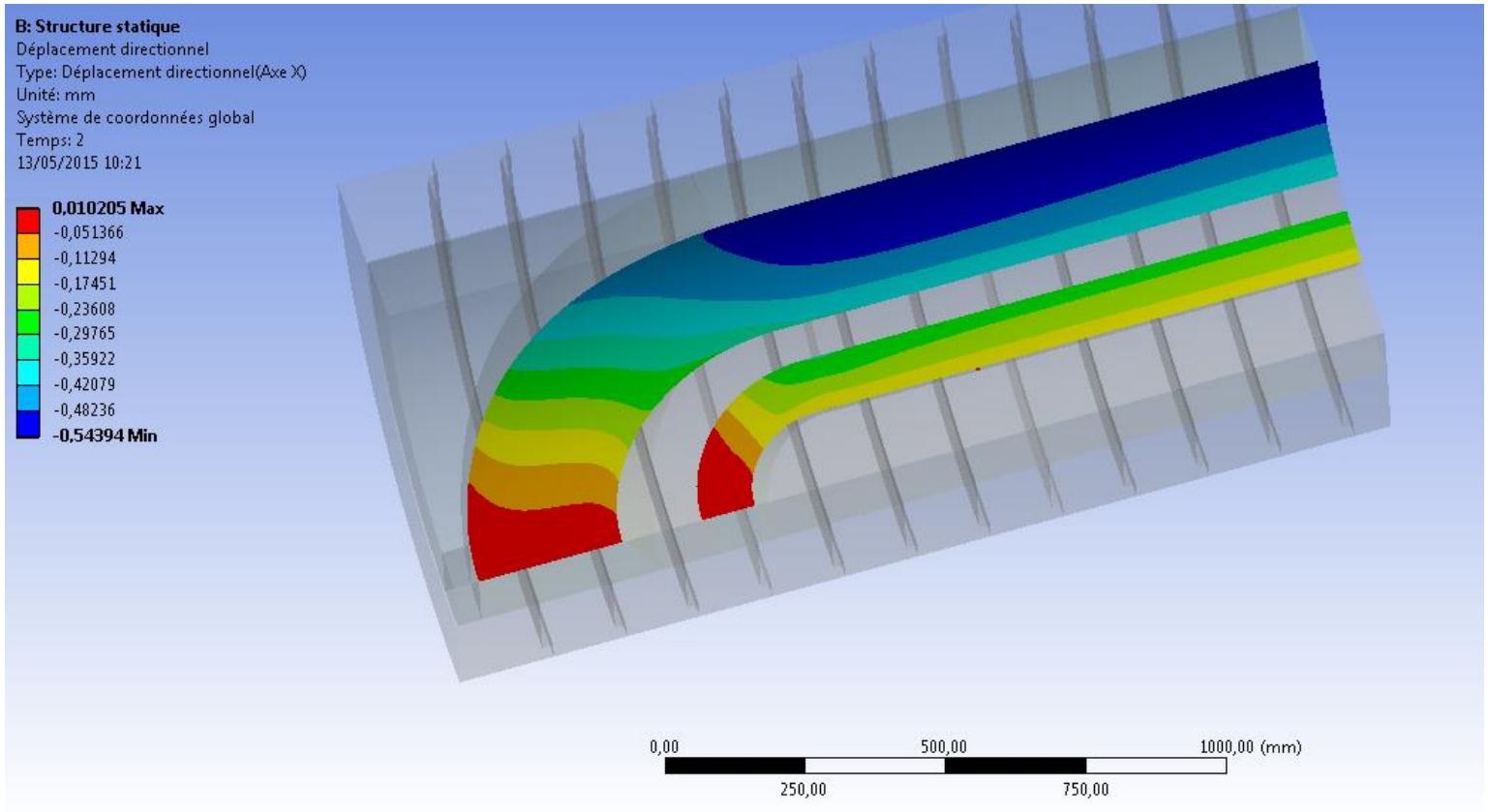


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

– displacement Xaxis inner coils (conductor)

With the young modulus modified @20°

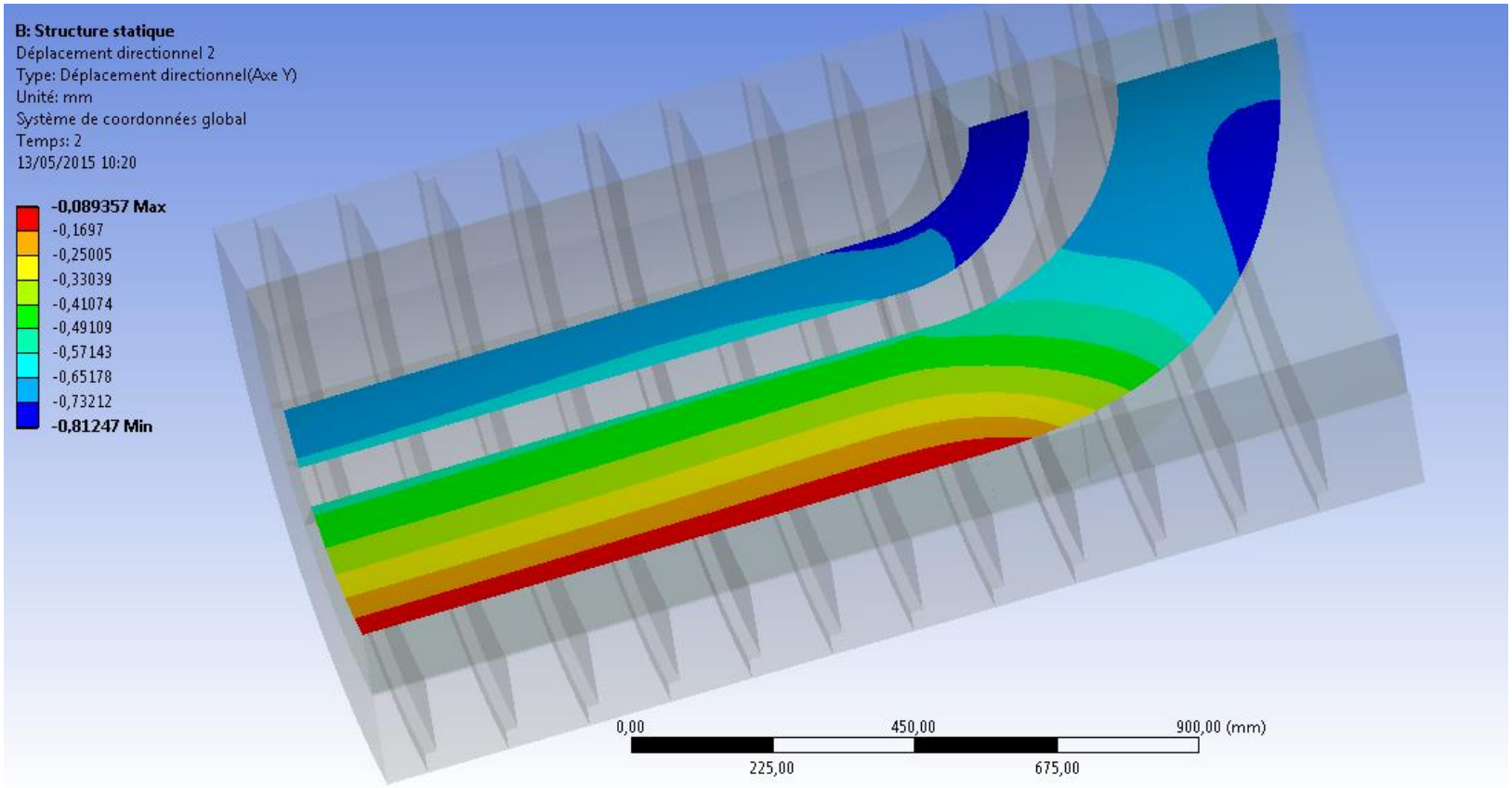


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

– displacement Yaxis inner coils (conductor)

With the young modulus not modified @20°

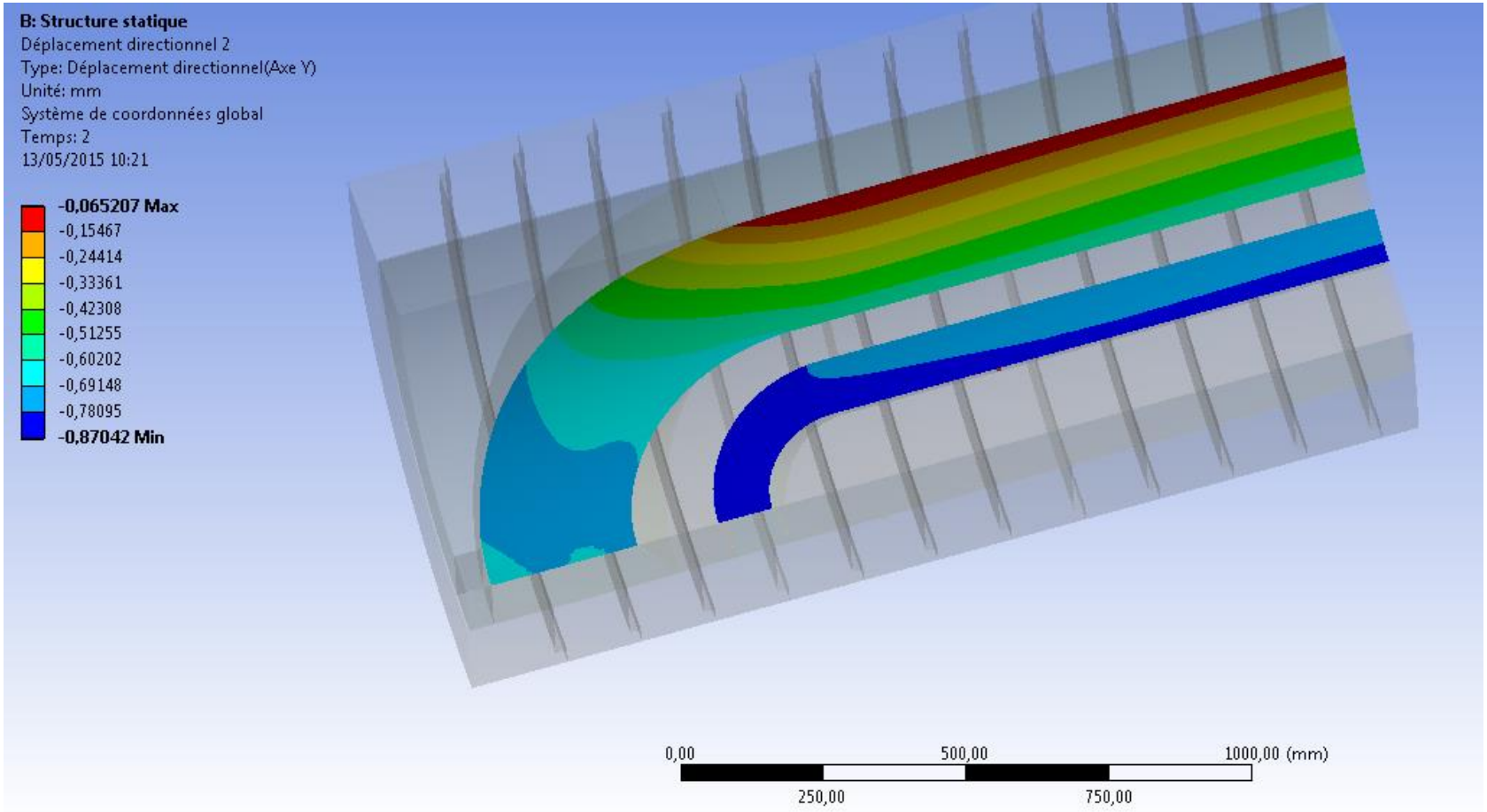


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

– displacement Yaxis inner coils (conductor)

With the young modulus modified @20°

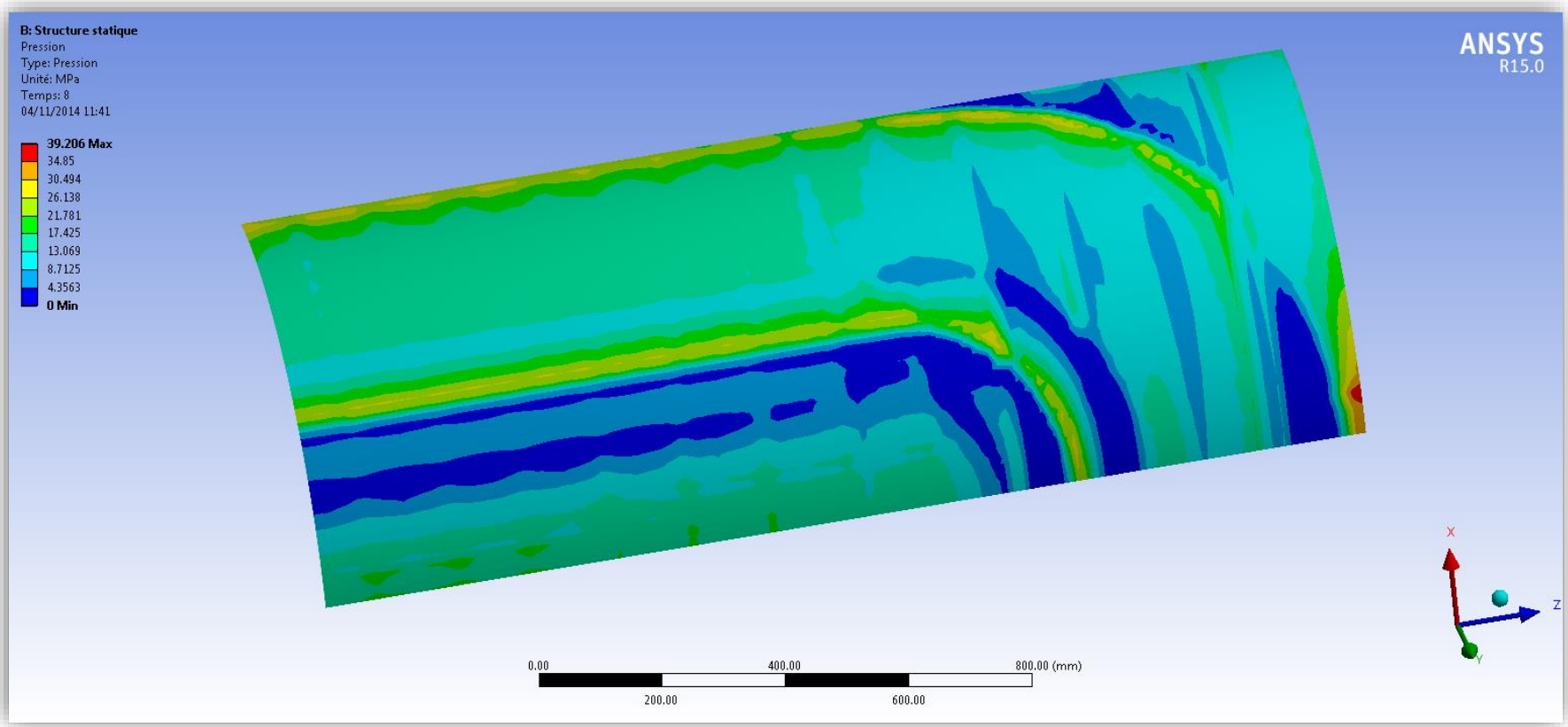


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K and forces– CONTACT PRESSURE BETWEEN COLLARS AND COIL

With the young modulus not modified

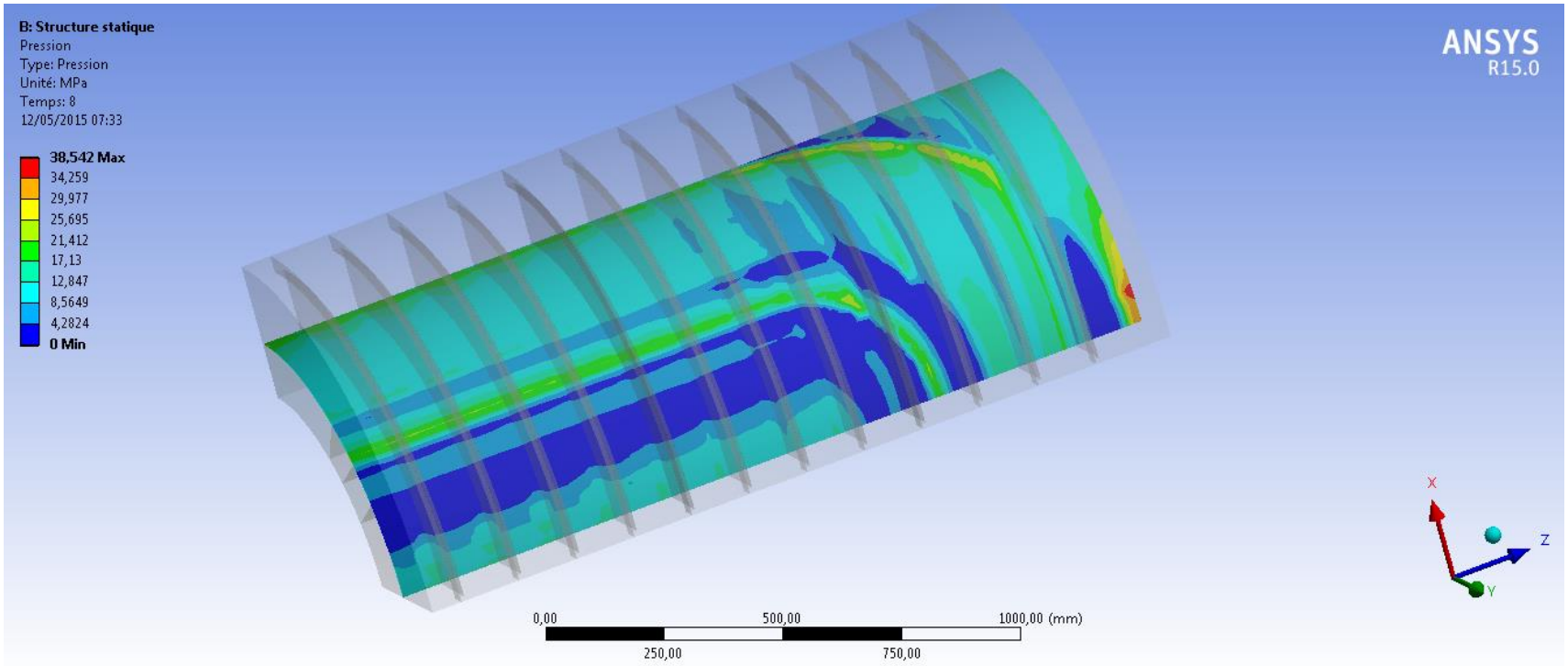


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K and forces– CONTACT PRESSURE BETWEEN COLLARS AND COIL

With the young modulus modified

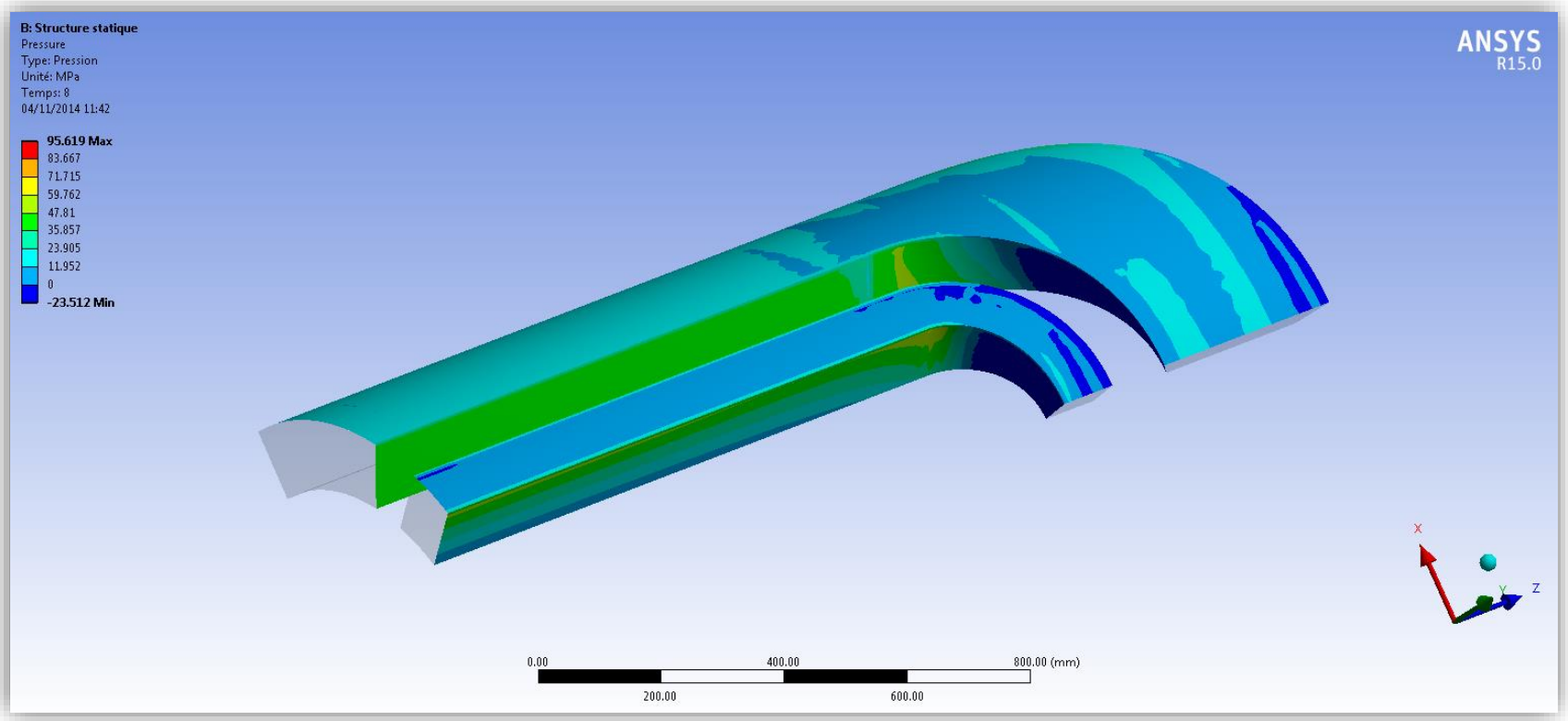


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K and forces– CONTACT PRESSURE BETWEEN SPACERS AND COIL

With the young modulus not modified

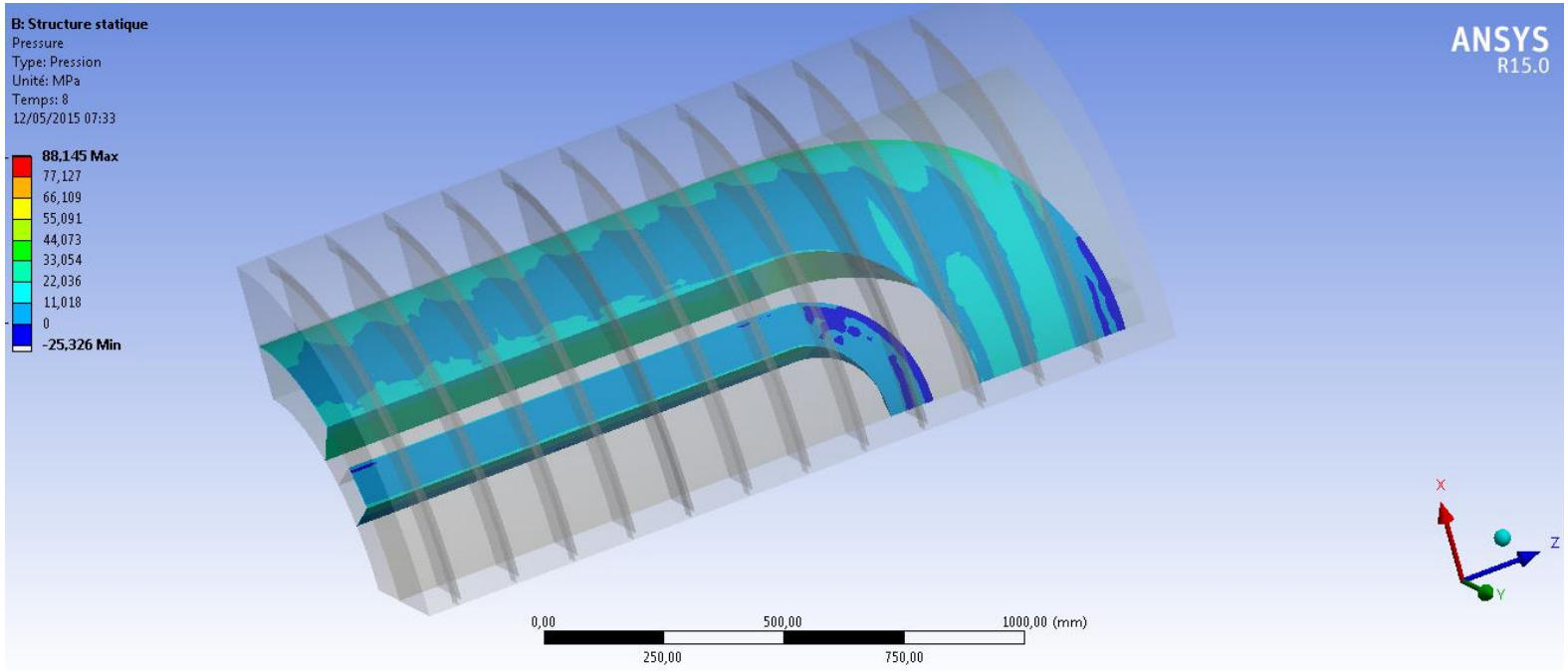


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K and forces– CONTACT PRESSURE BETWEEN SPACERS AND COIL

Version with the young modulus modified

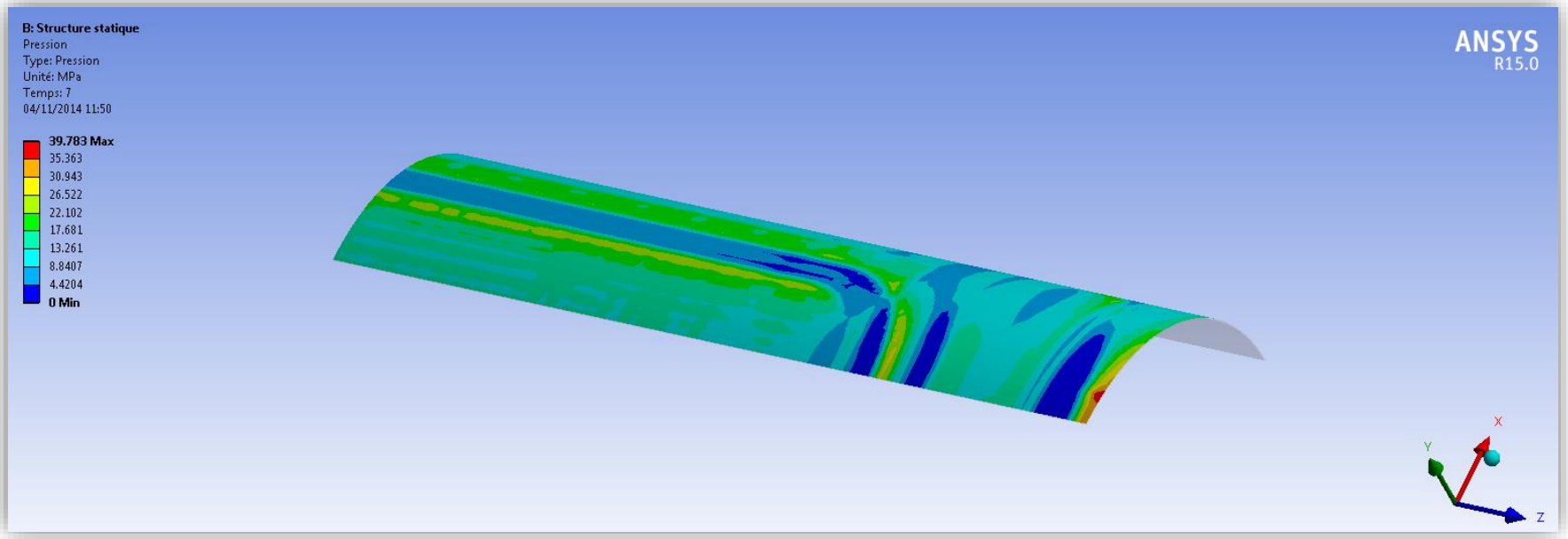


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces-CONTACT PRESSURE BETWEEN COLLARS AND COIL

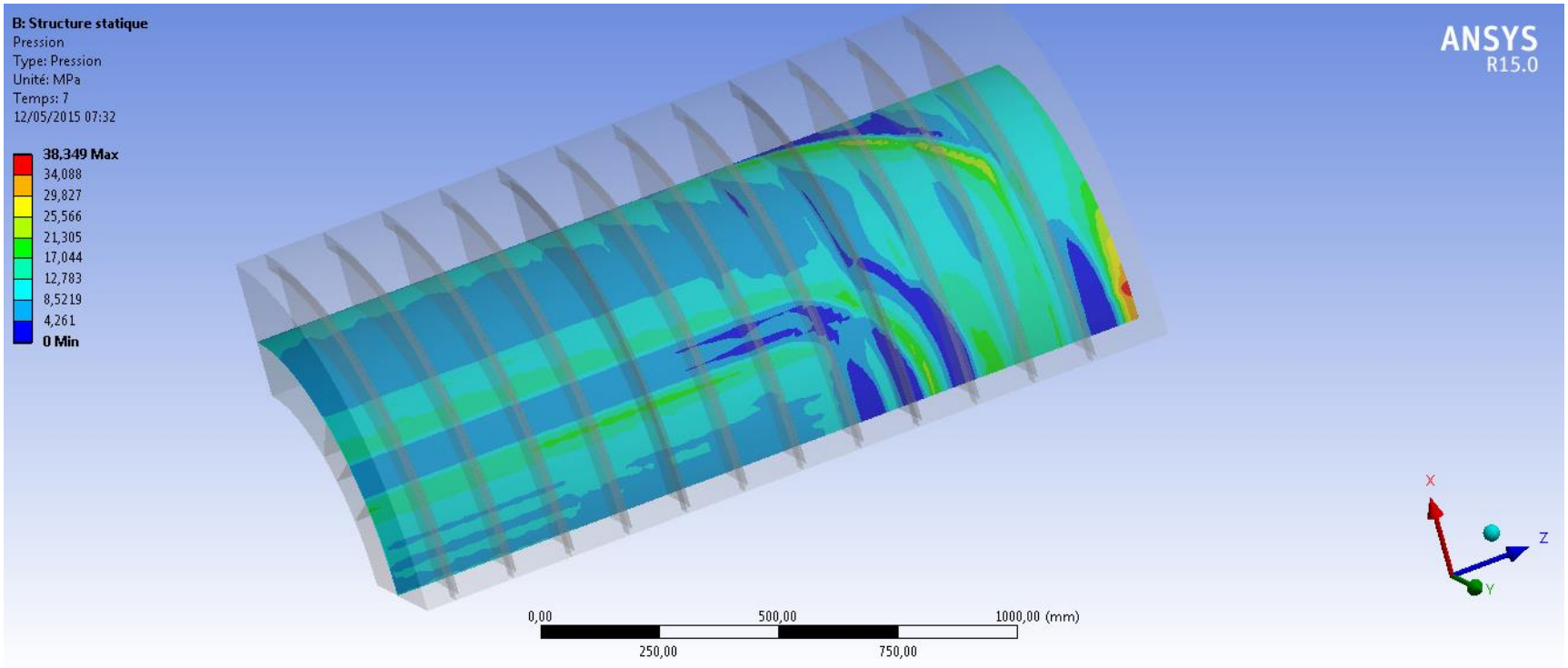
With the young modulus not modified



2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces-CONTACT PRESSURE BETWEEN COLLARS AND COIL With the young modulus modified

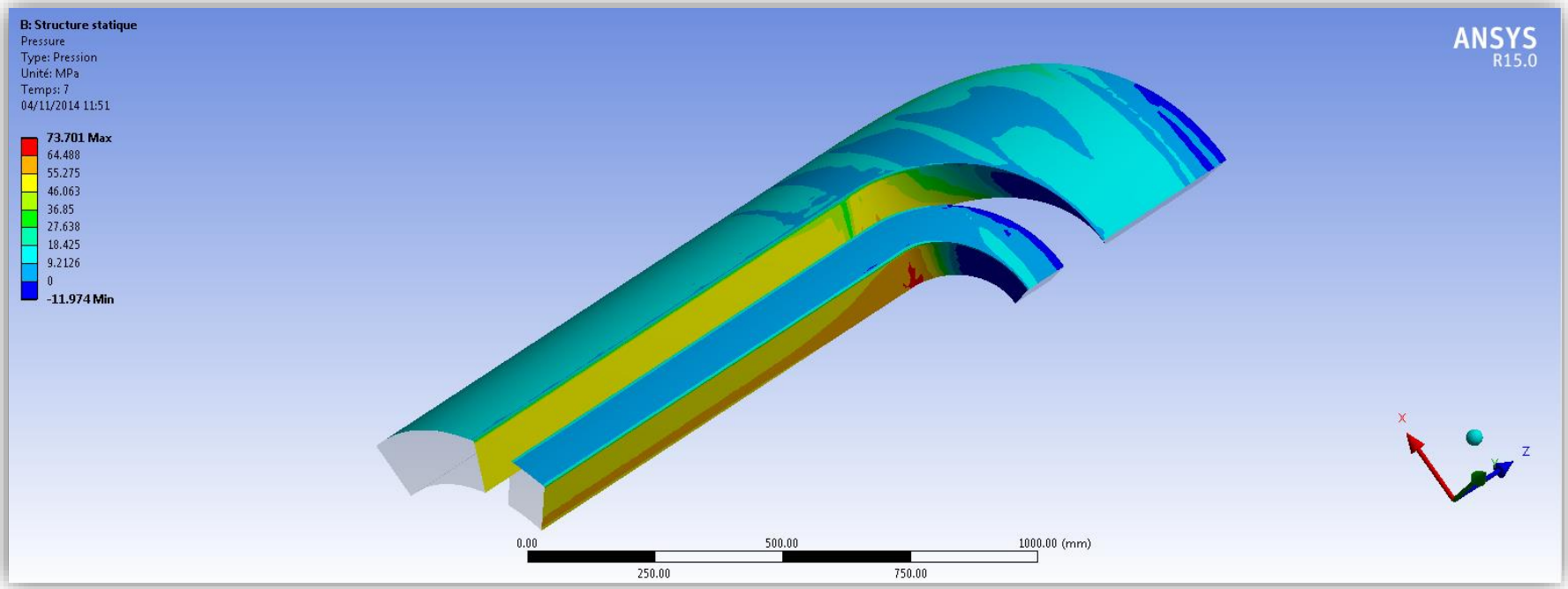


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– CONTACT PRESSURE BETWEEN SPACERS AND COIL

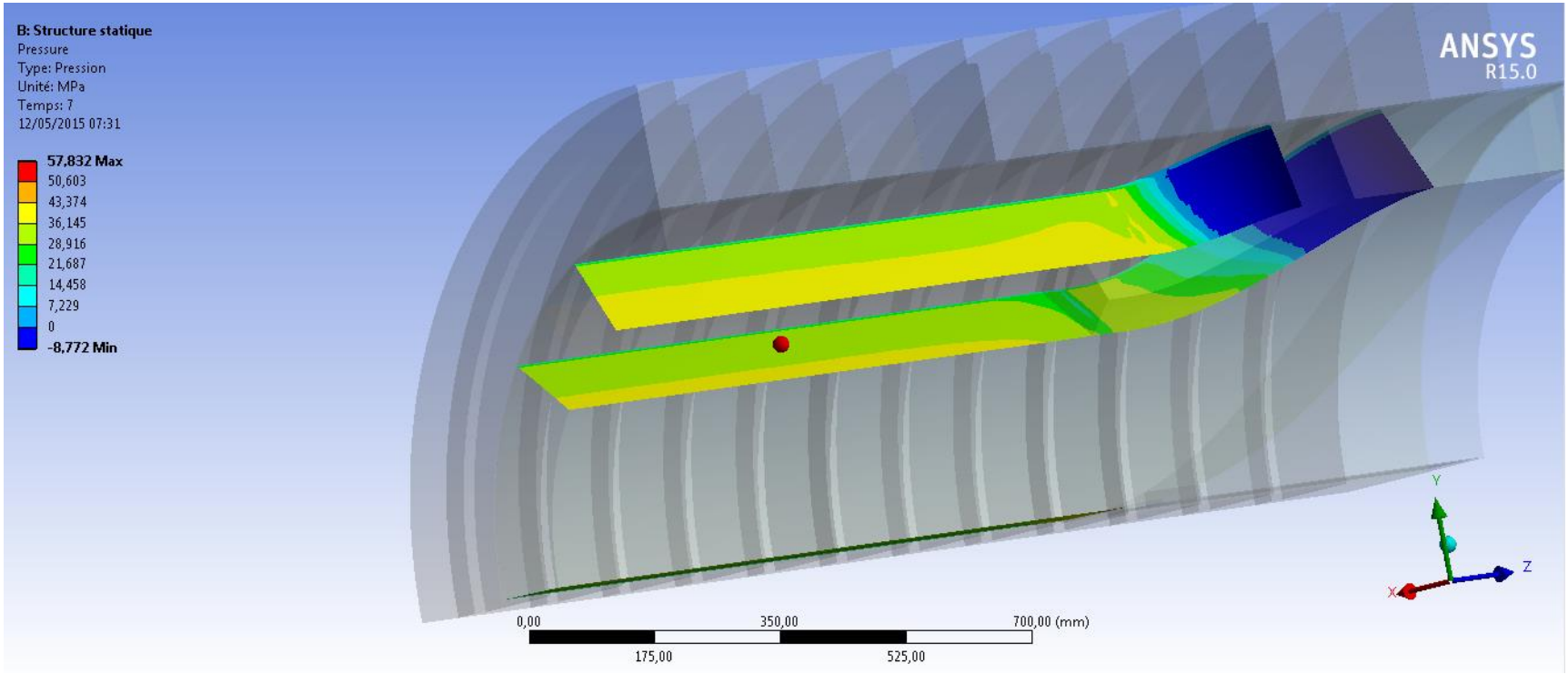
With the young modulus not modified



2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– CONTACT PRESSURE BETWEEN SPACERS AND COIL With the young modulus modified

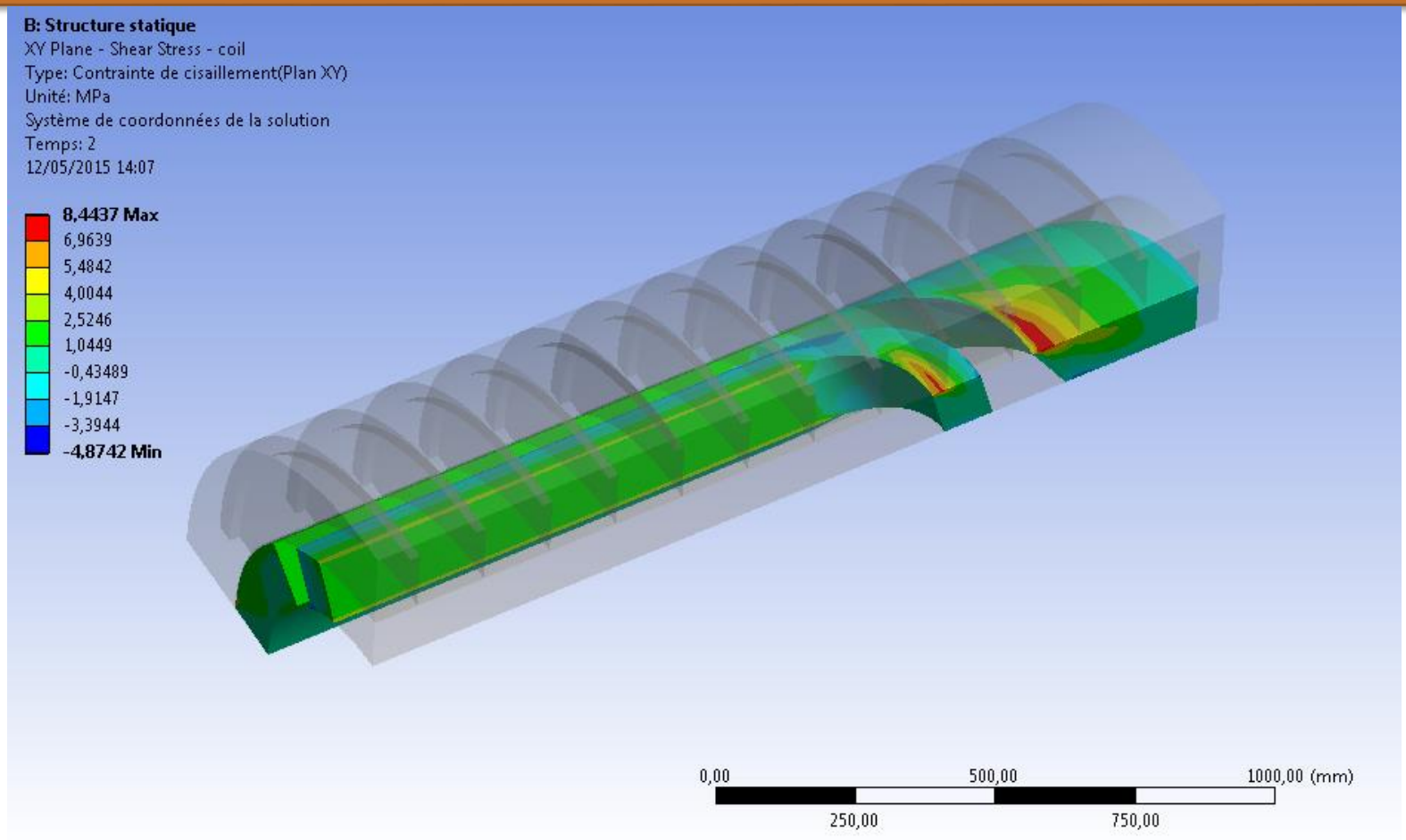


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-@ 20°C without forces– Shear stress XY Plane

With the young modulus not modified

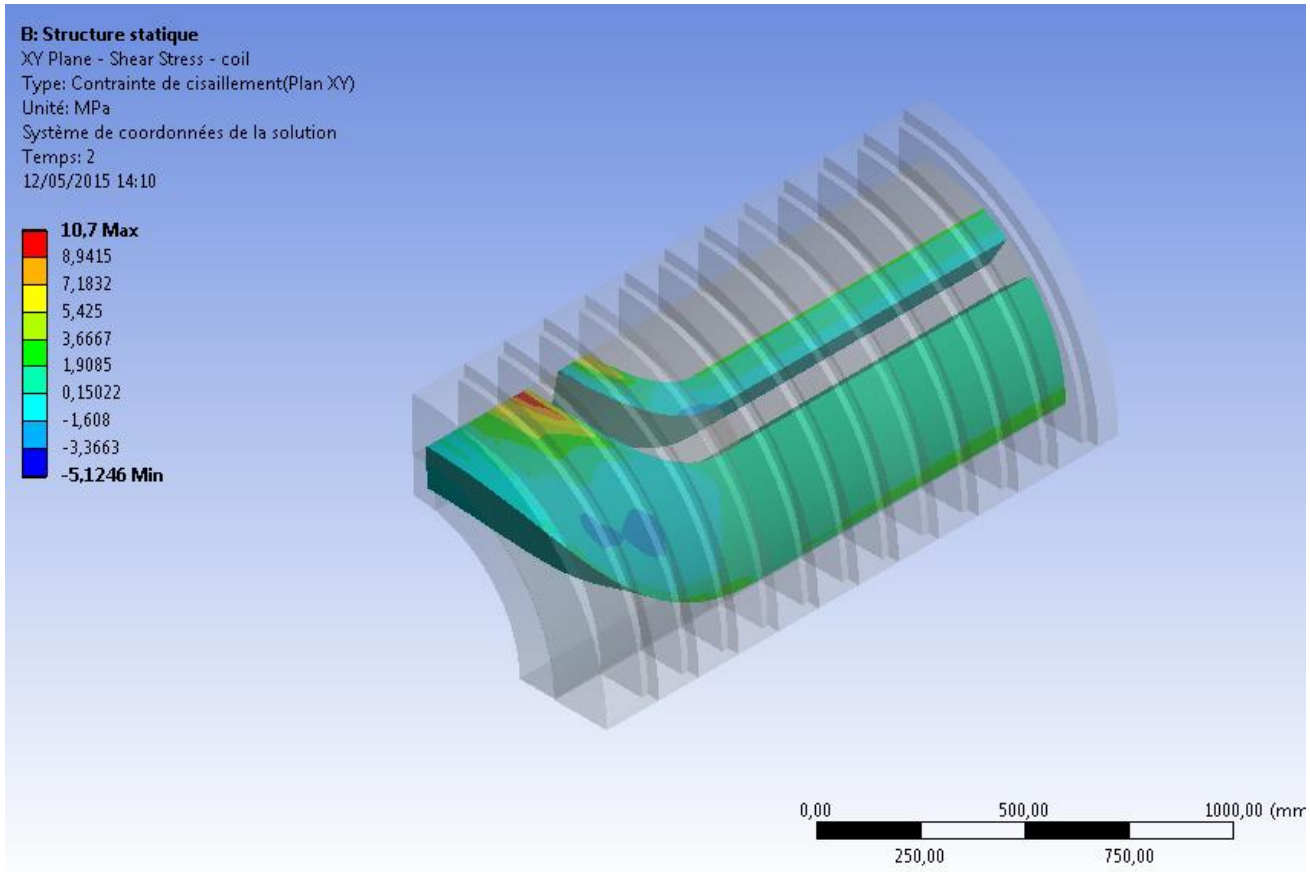


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-@ 20°C without forces– Shear stress XY Plane

With the young modulus modified

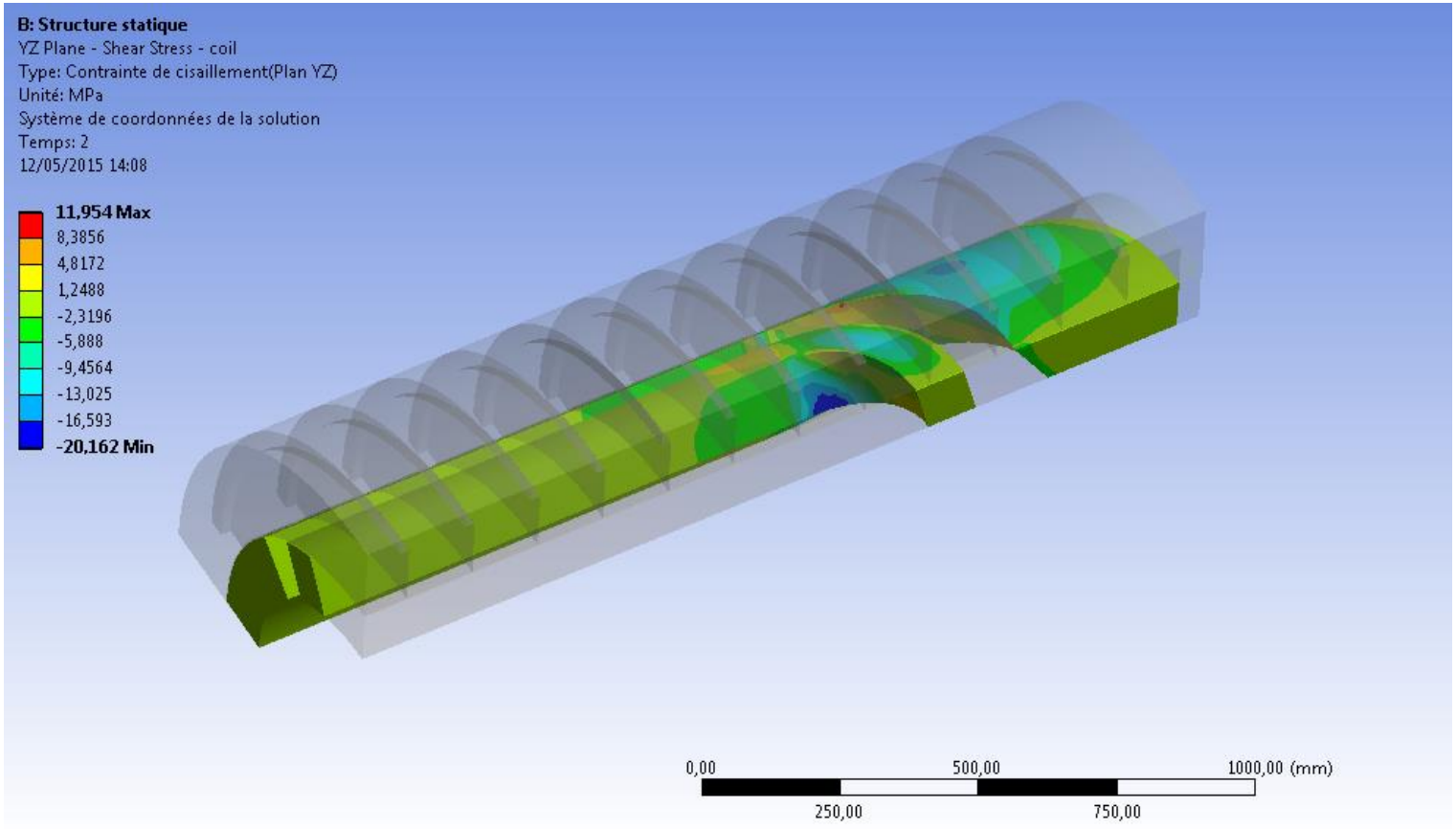


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-@ 20°C without forces– Shear stress YZ Plane

With the young modulus not modified

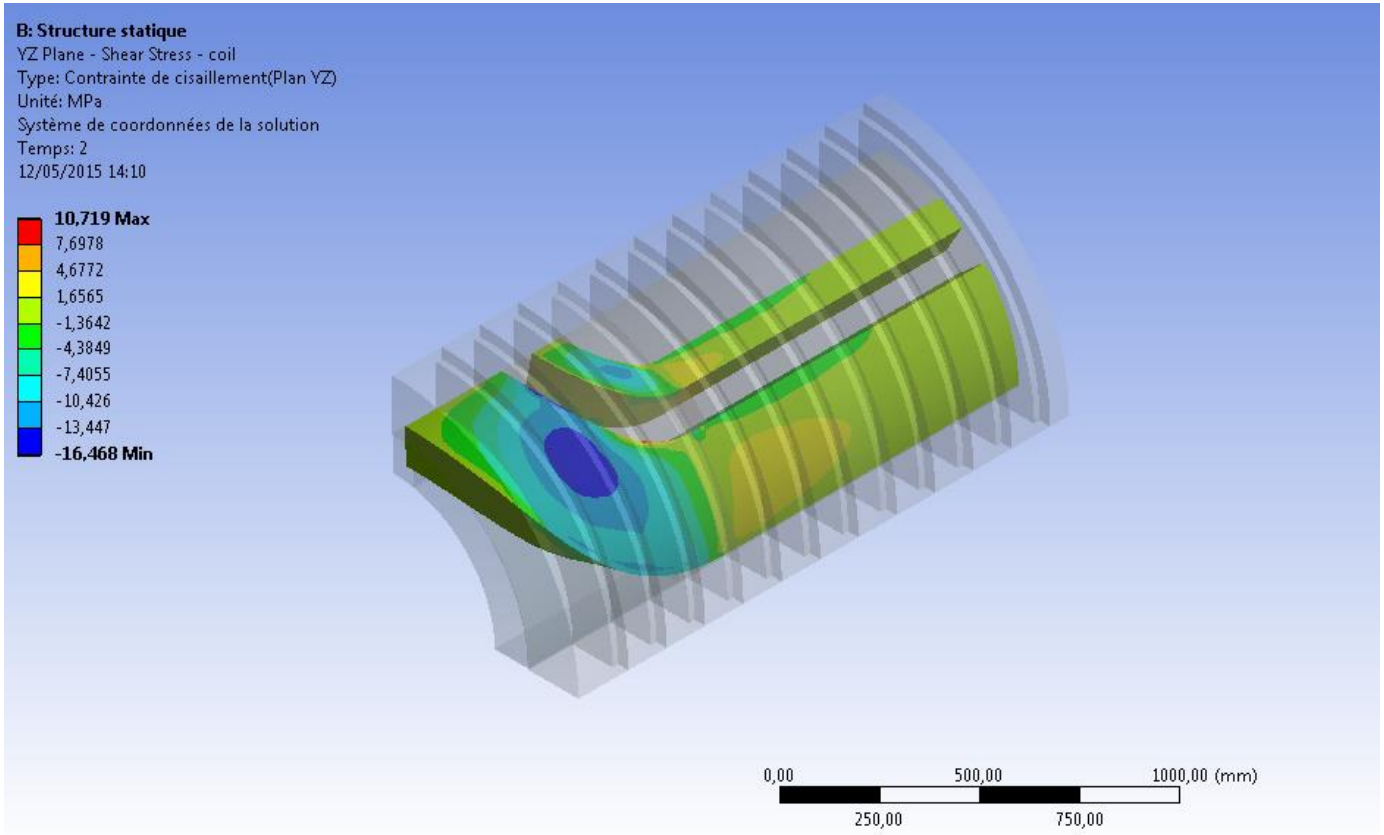


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-@ 20°C without forces– Shear stress YZPlane

With the young modulus modified

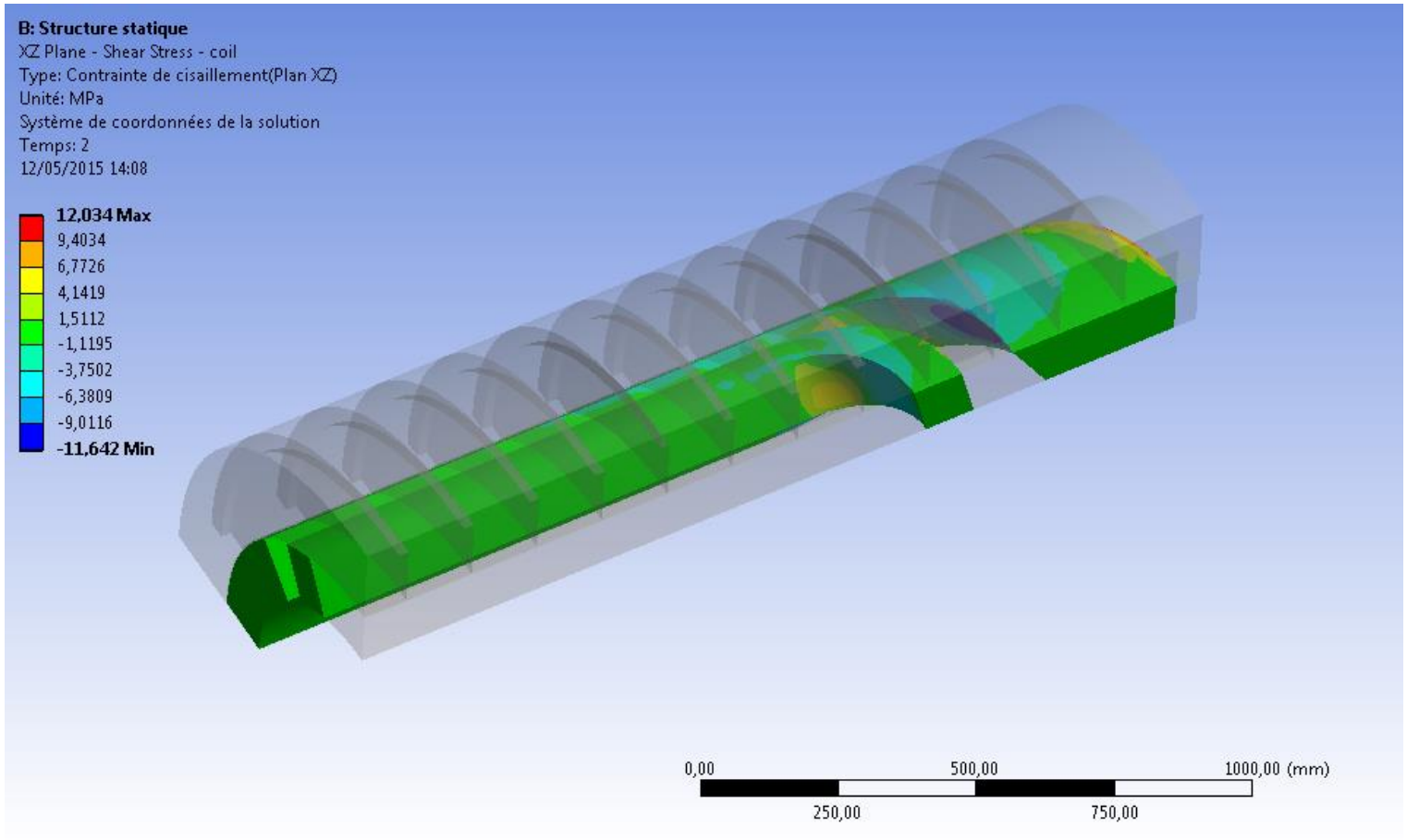


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-@ 20°C without forces– Shear stress XZ Plane

With the young modulus not modified

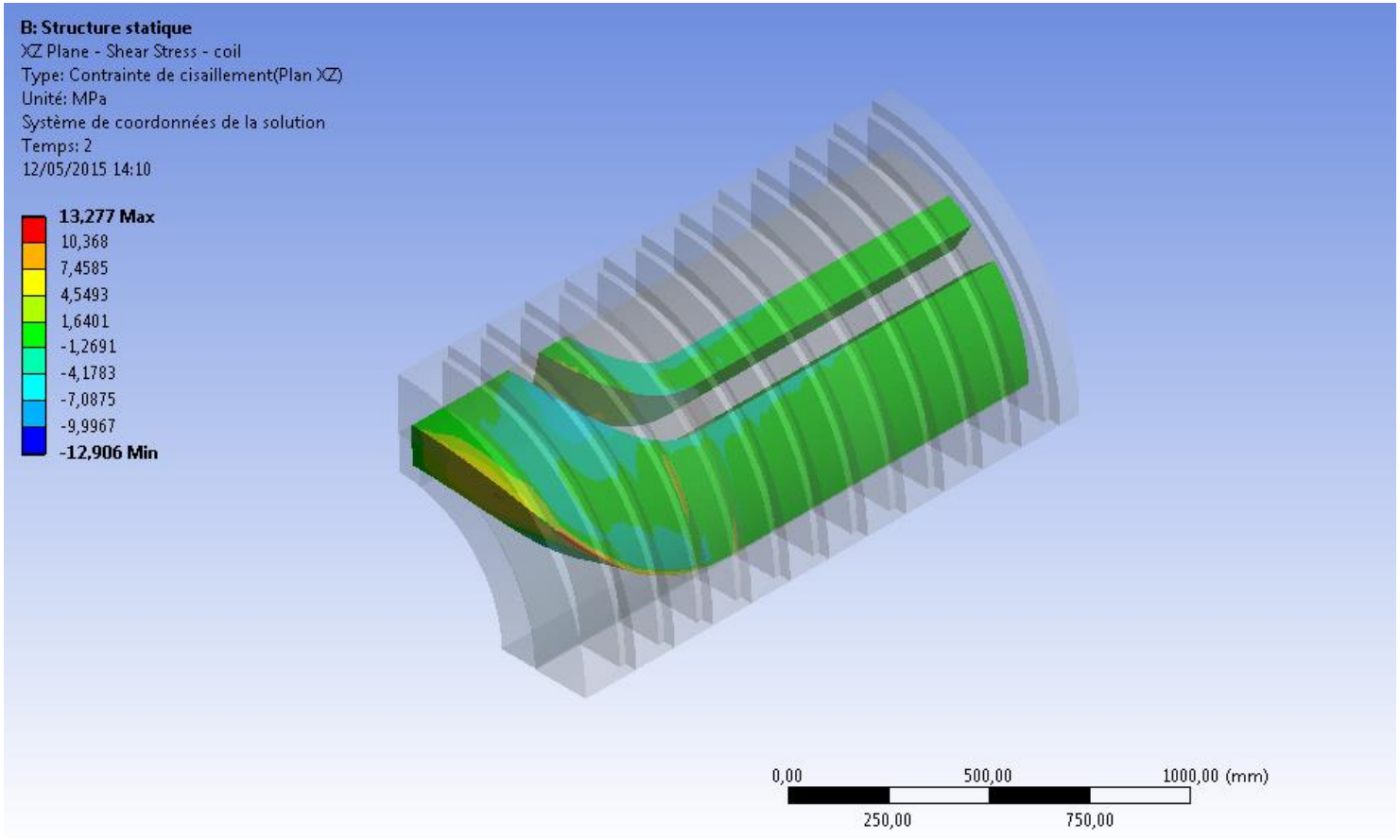


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-@ 20°C without forces– Shear stress XZ Plane

With the young modulus modified

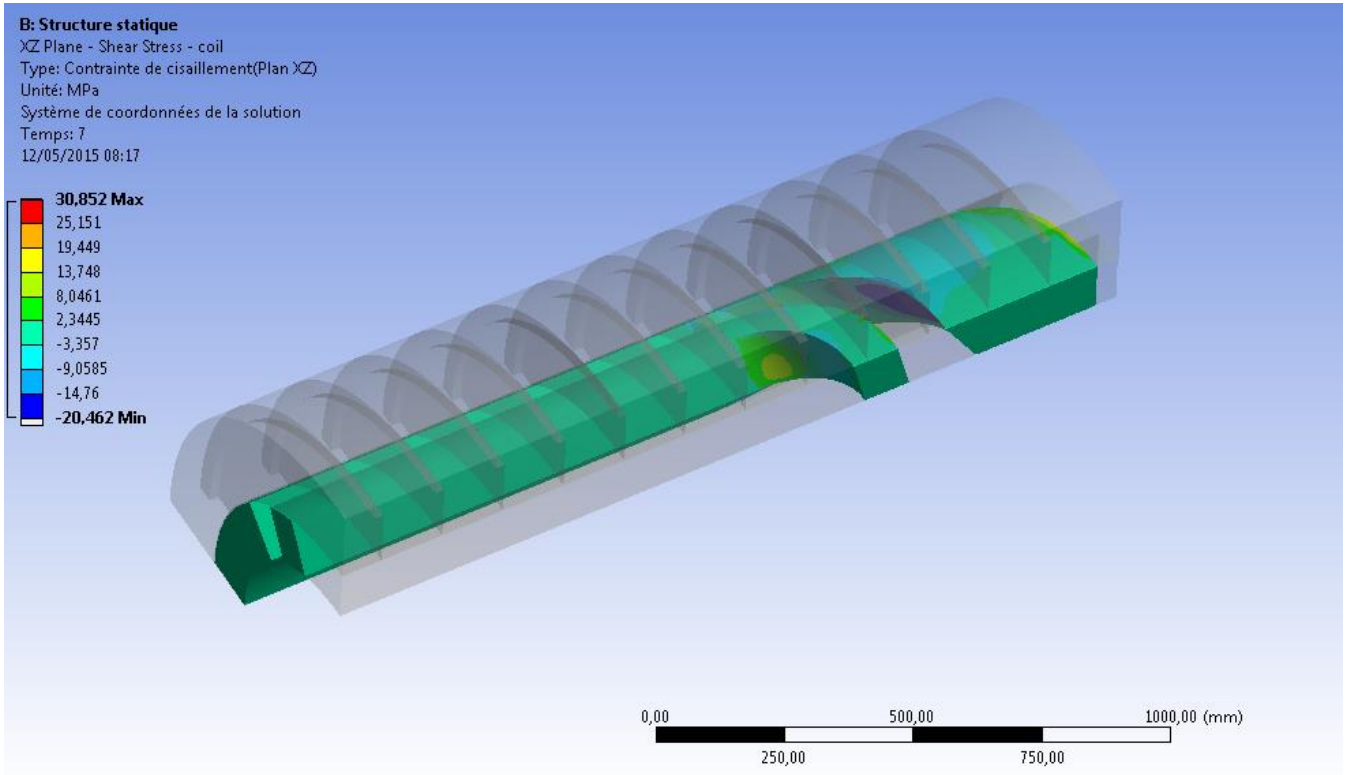


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– Shear stress XZ Plane

With the young modulus not modified

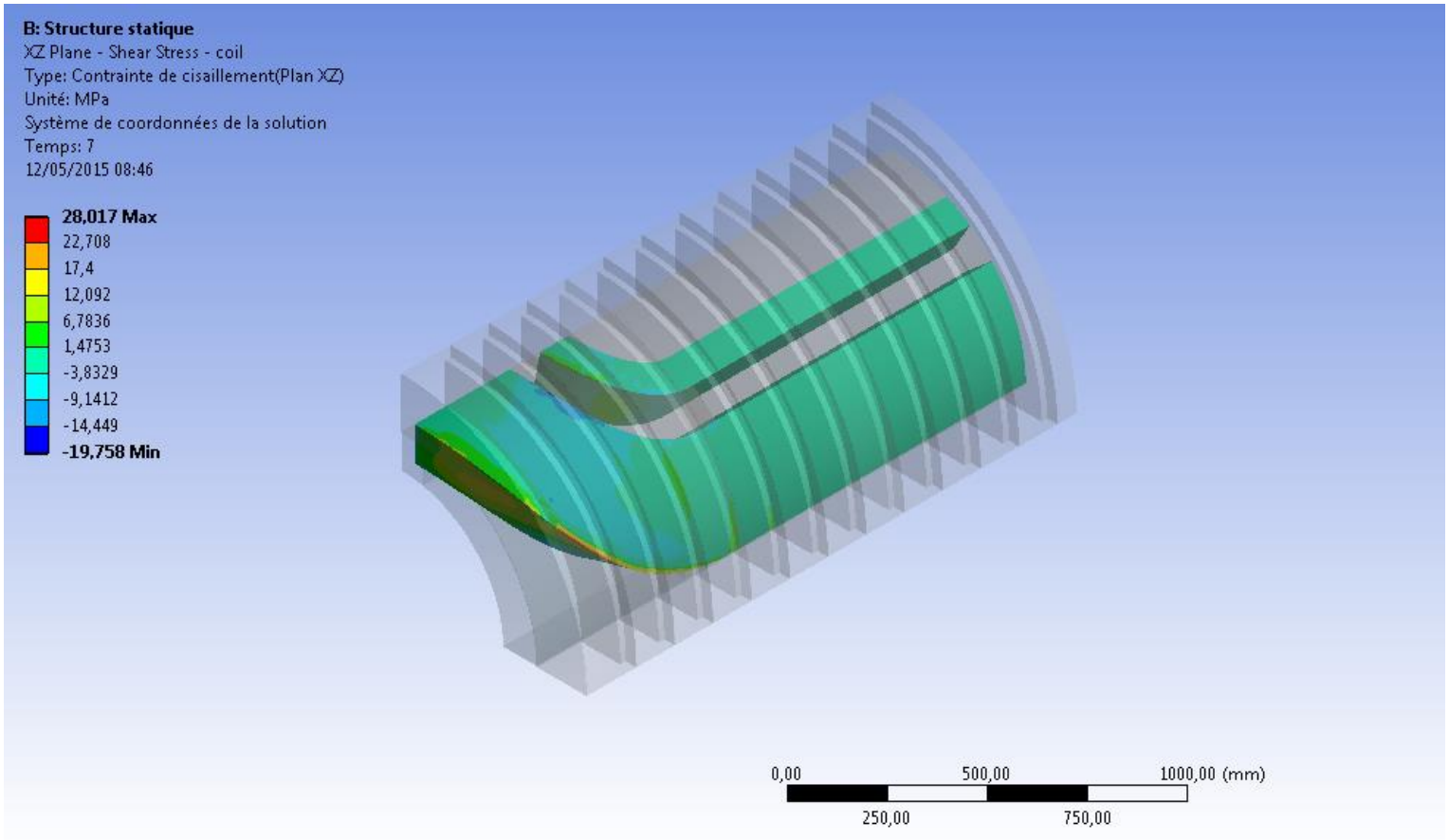


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– Shear stress XZ Plane

With the young modulus modified

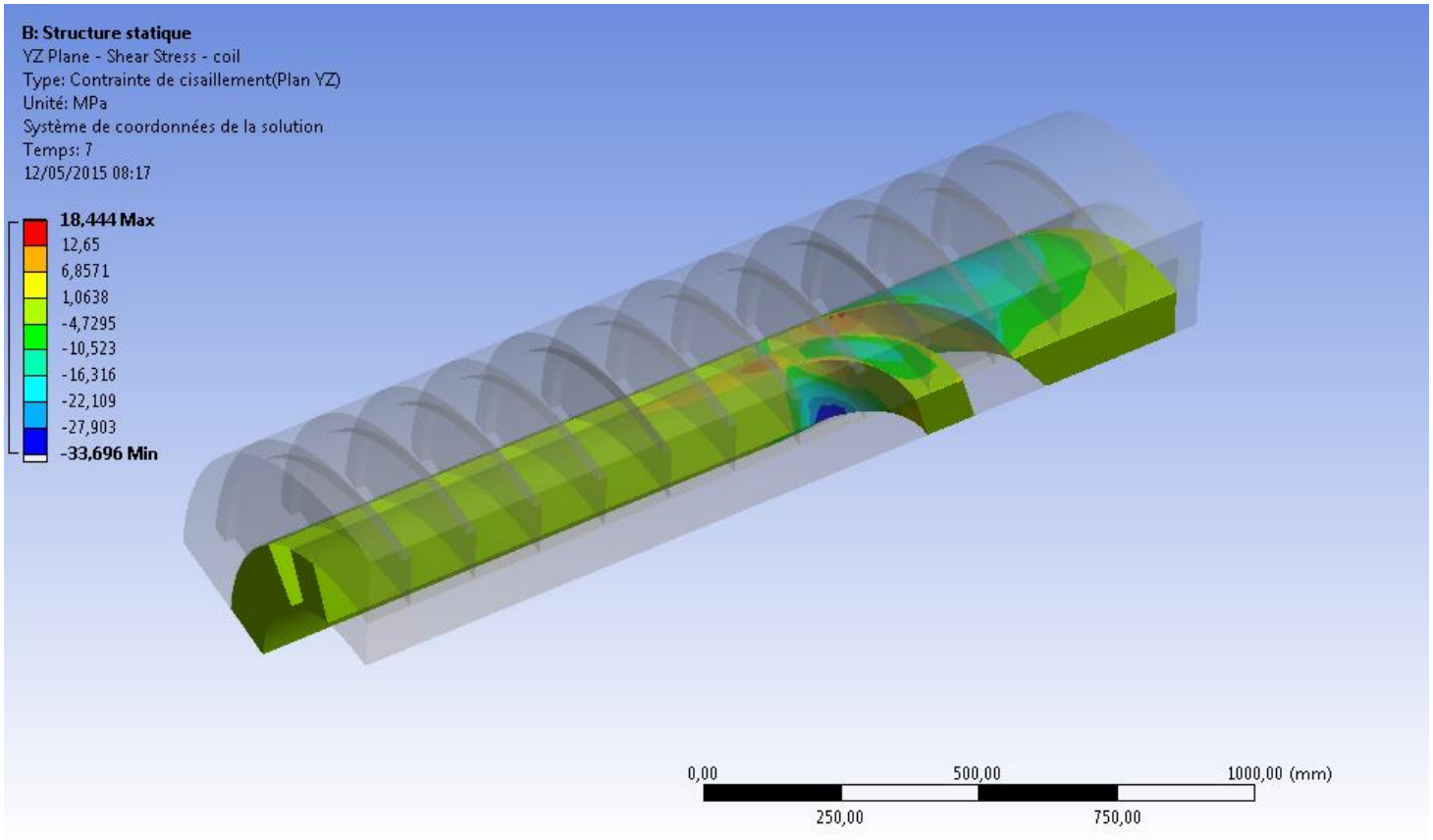


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– Shear stress YZ Plane

With the young modulus not modified

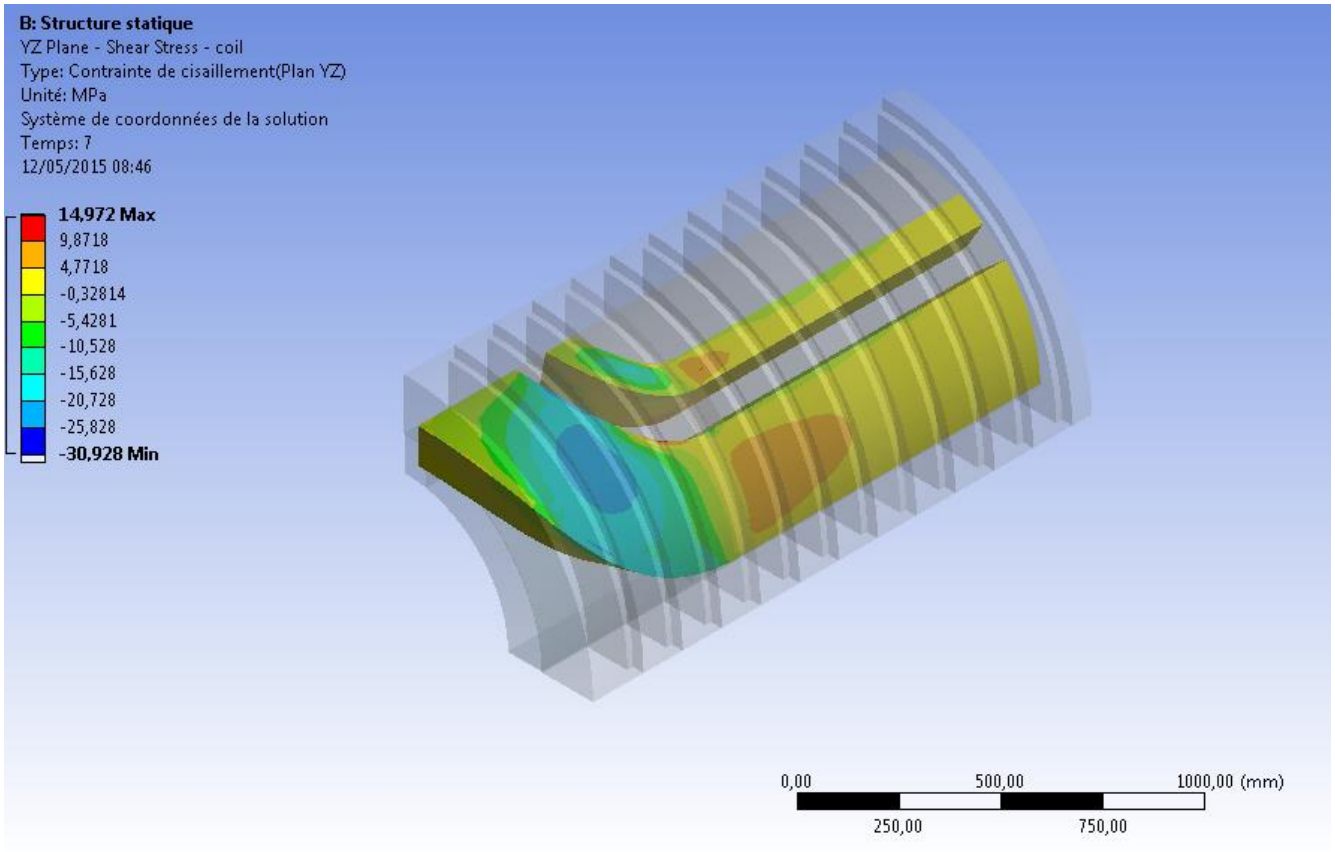


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– Shear stress YZ Plane

With the young modulus modified

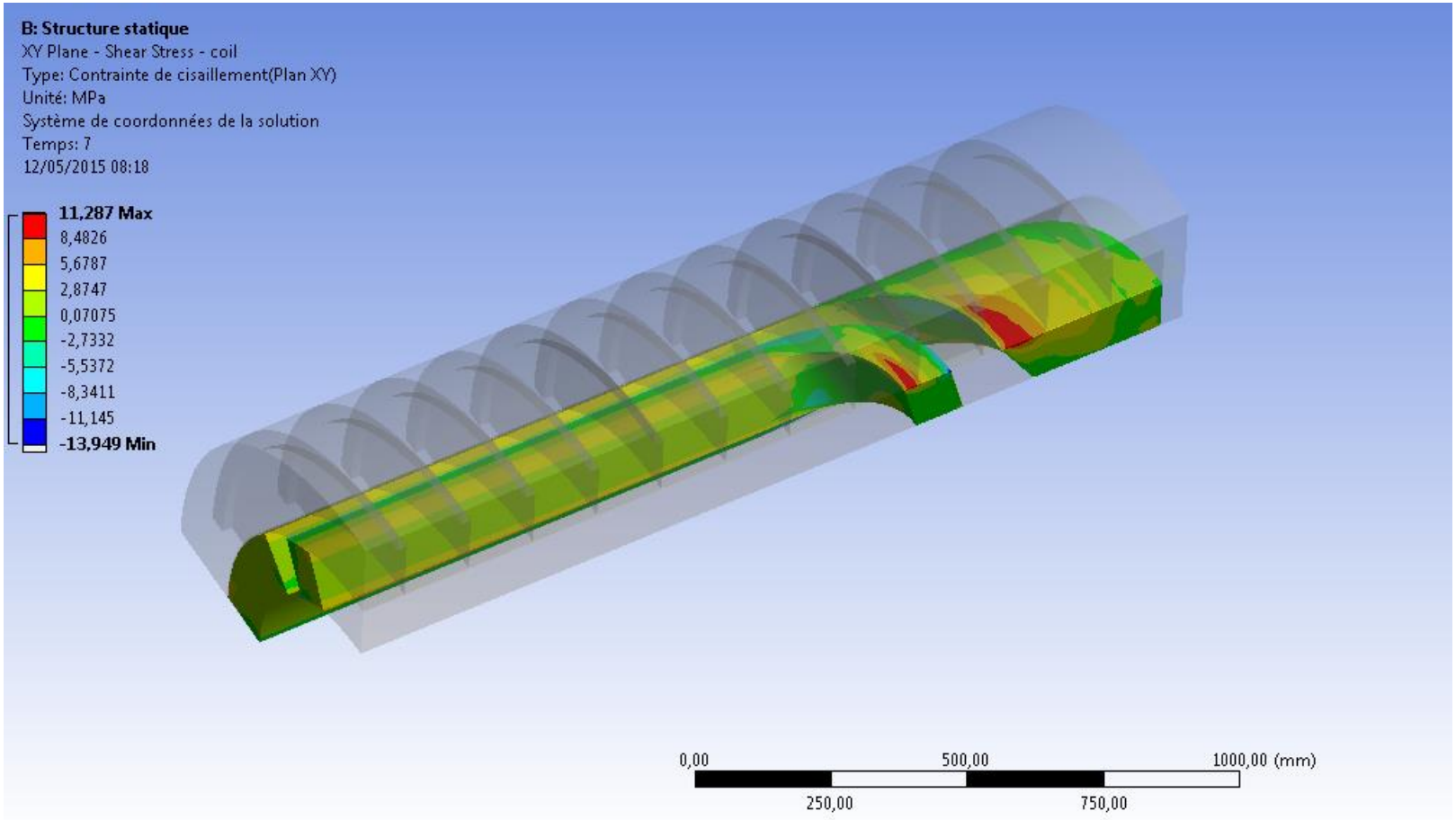


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– Shear stress XY Plane

With the young modulus not modified

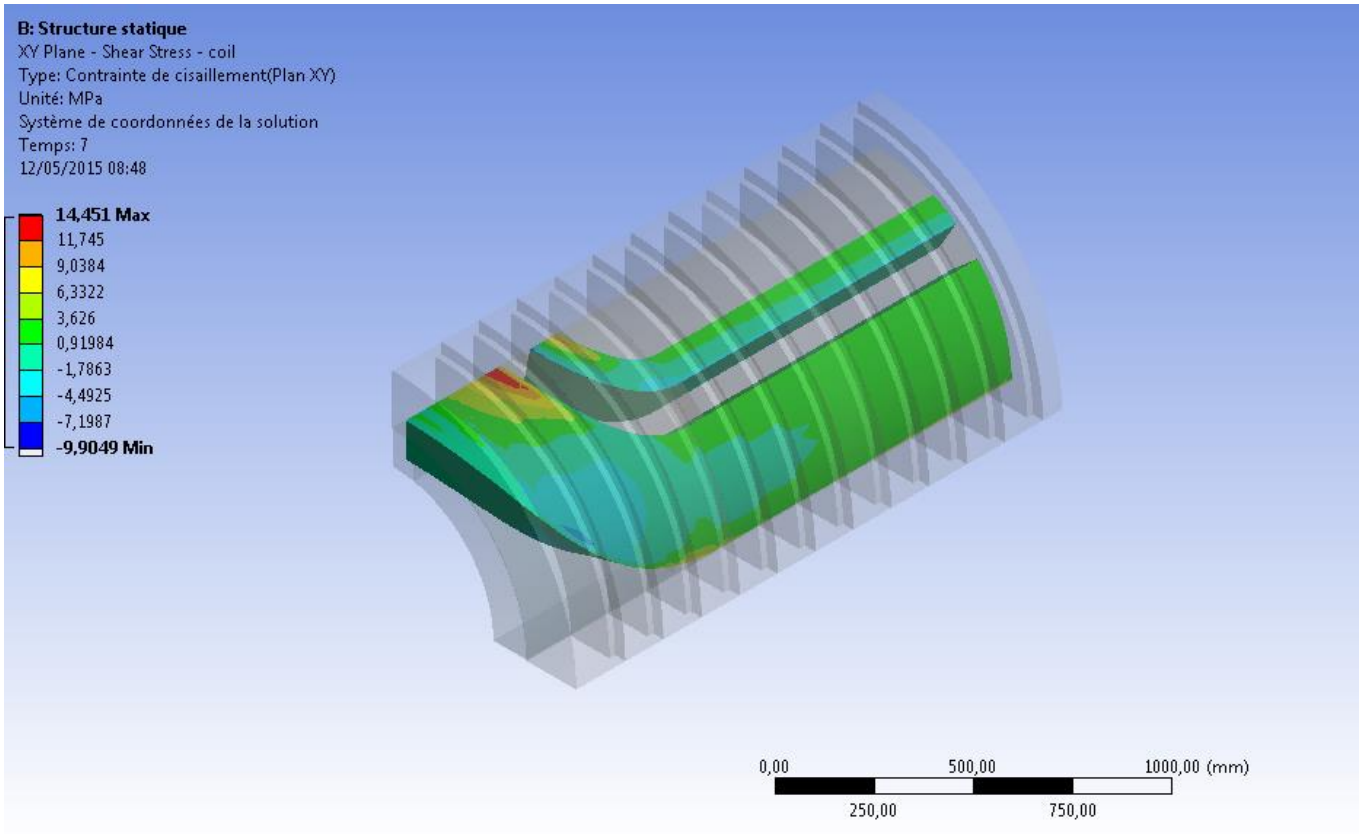


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– Shear stress XY Plane

With the young modulus modified

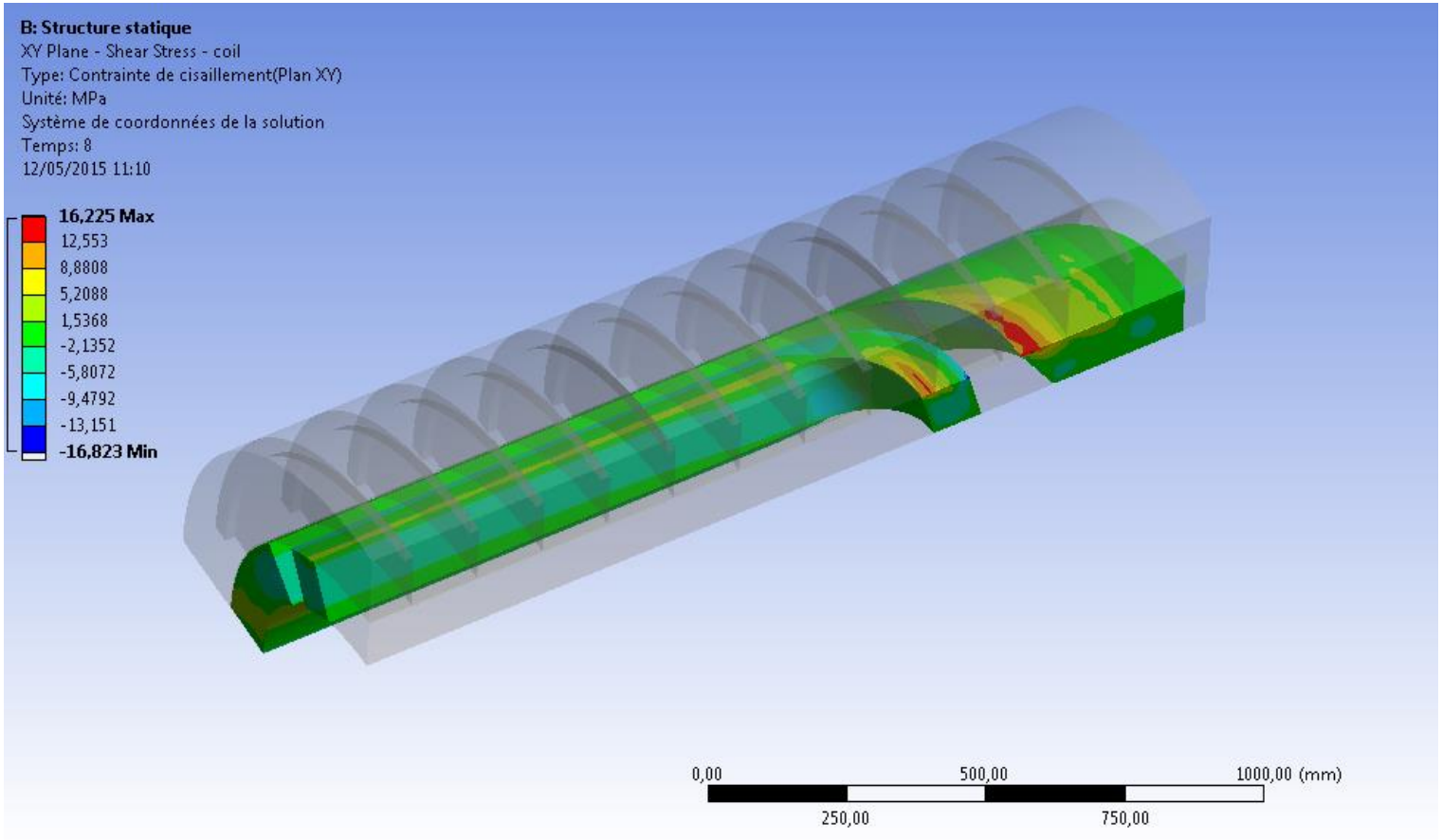


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K with forces– Shear stress XZ Plane

With the young modulus not modified

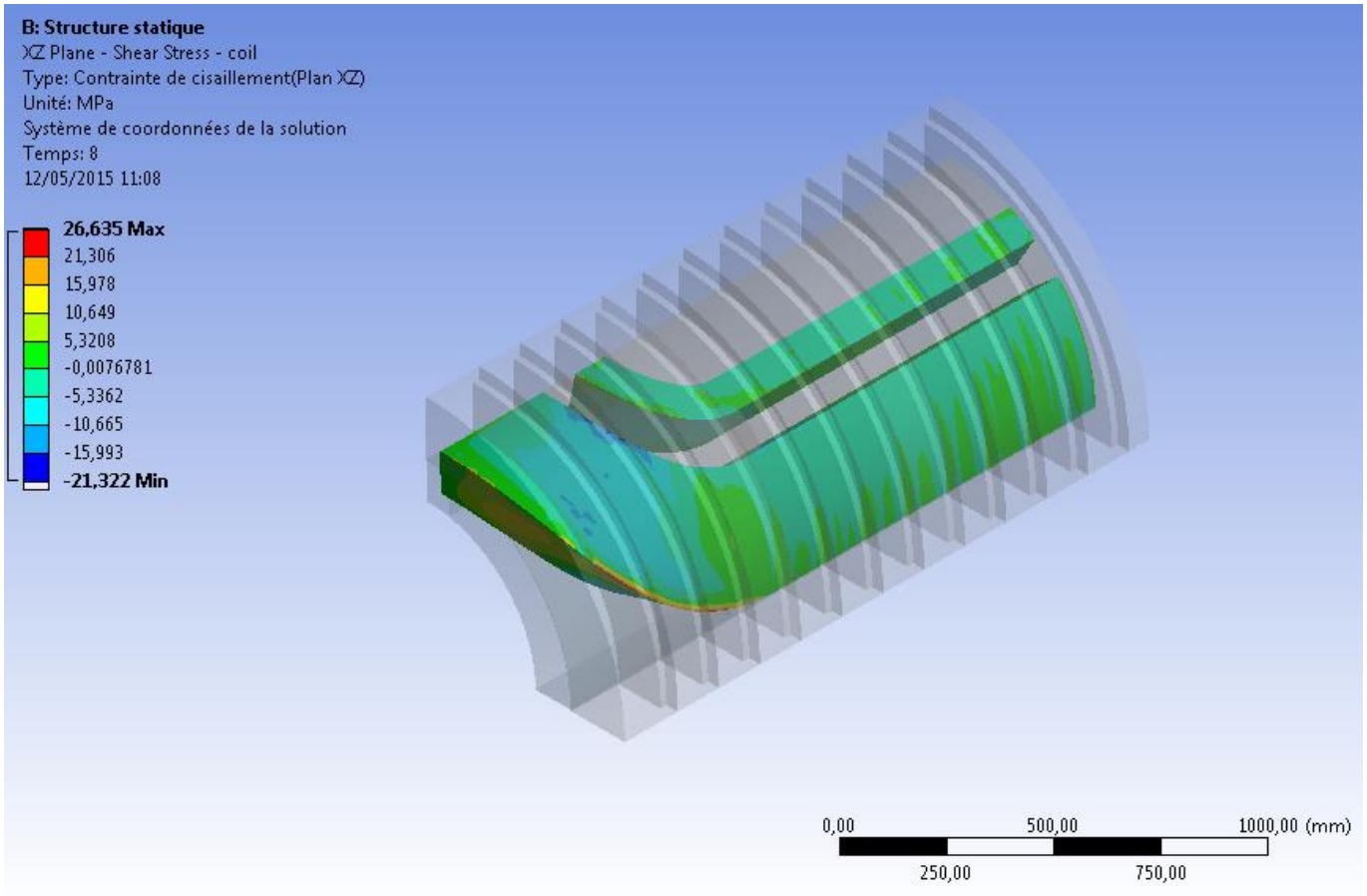


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K with forces– Shear stress XZ Plane

With the young modulus modified

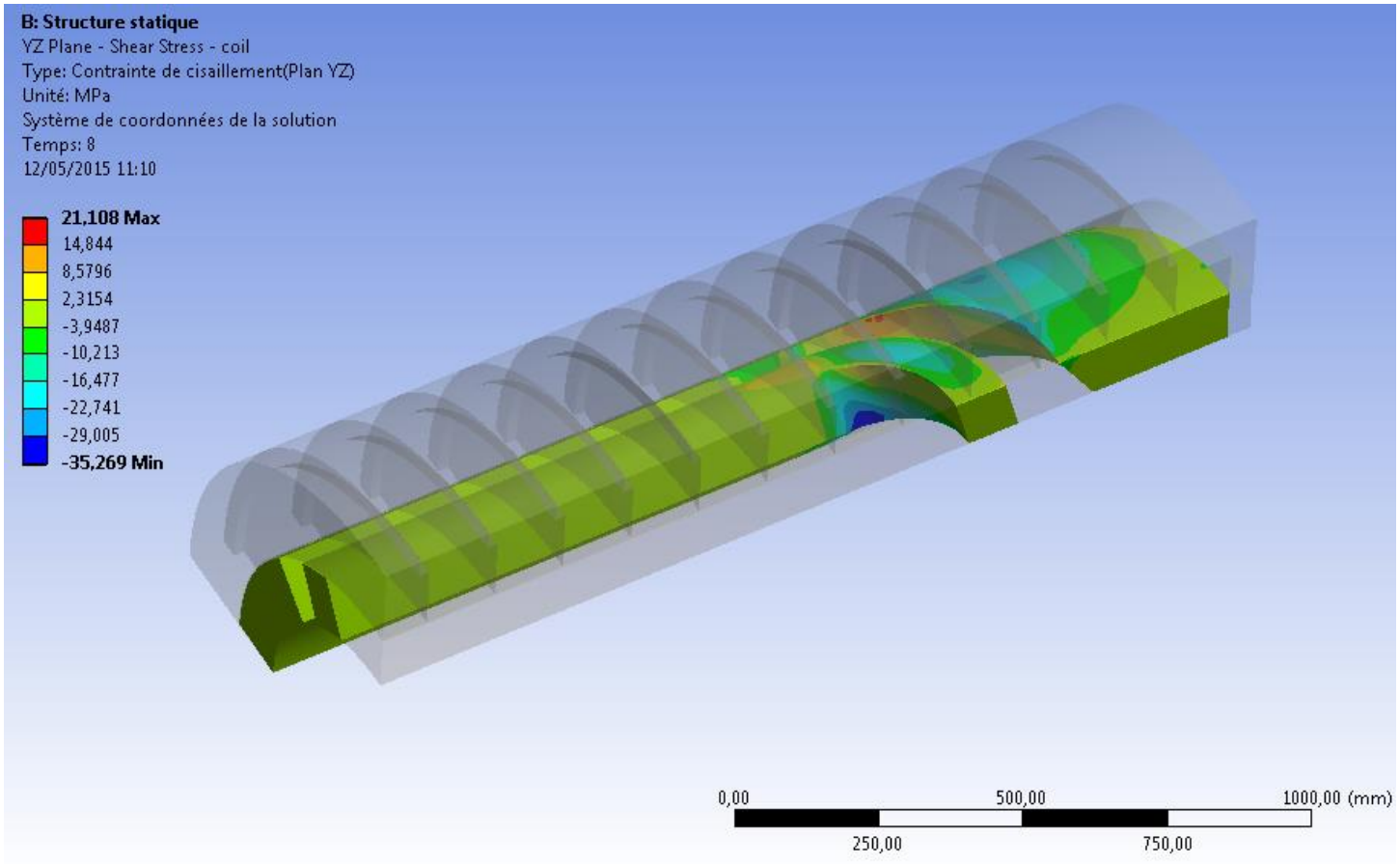


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K with forces– Shear stress YZ Plane

With the young modulus not modified

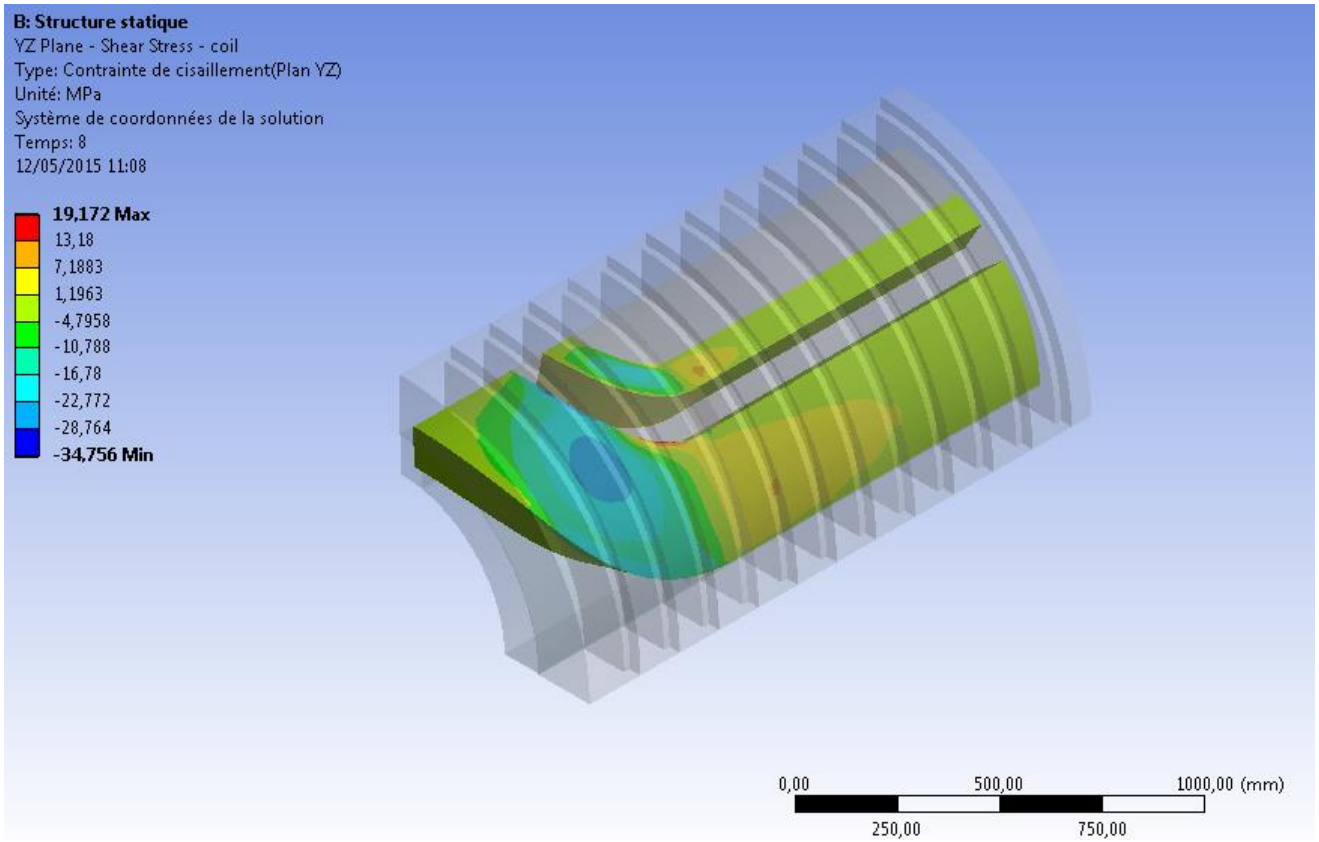


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K with forces– Shear stress YZ Plane

With the young modulus modified

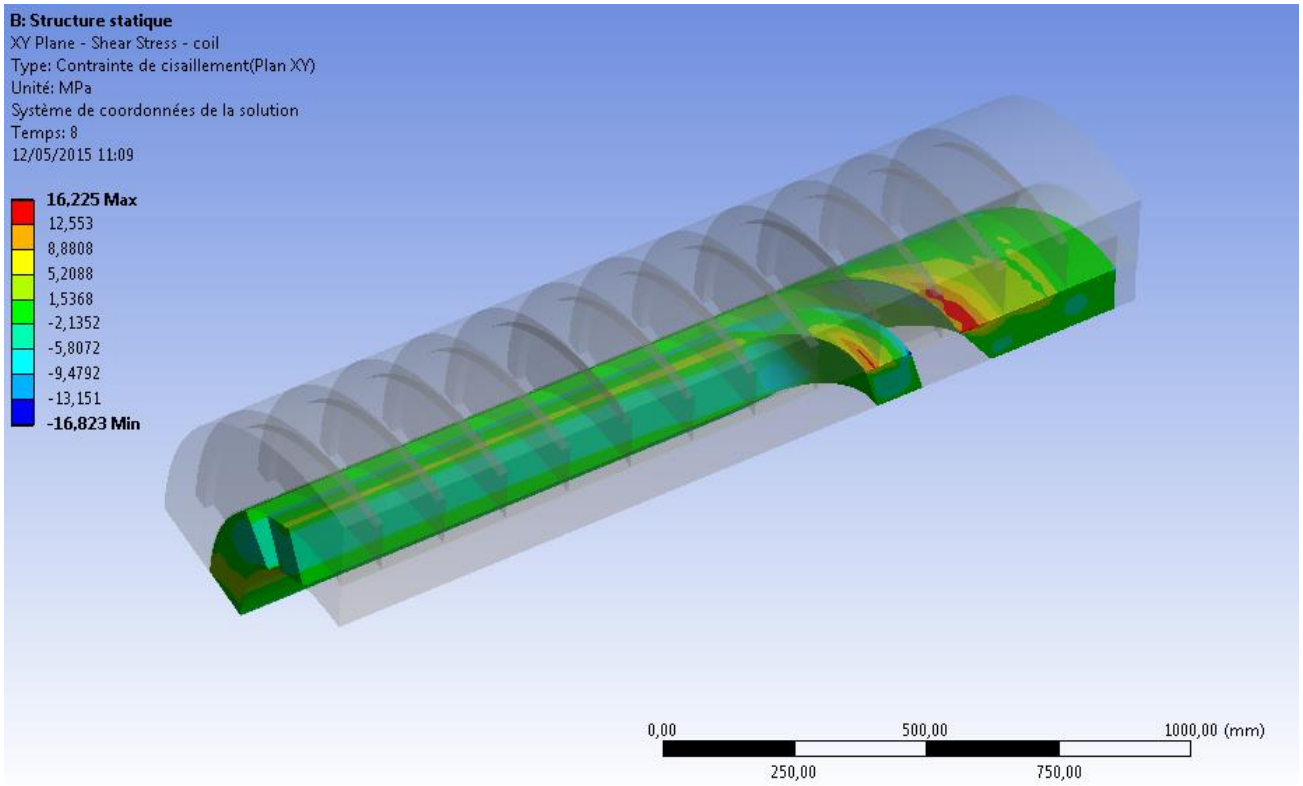


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K with forces– Shear stress XY Plane

With the young modulus not modified

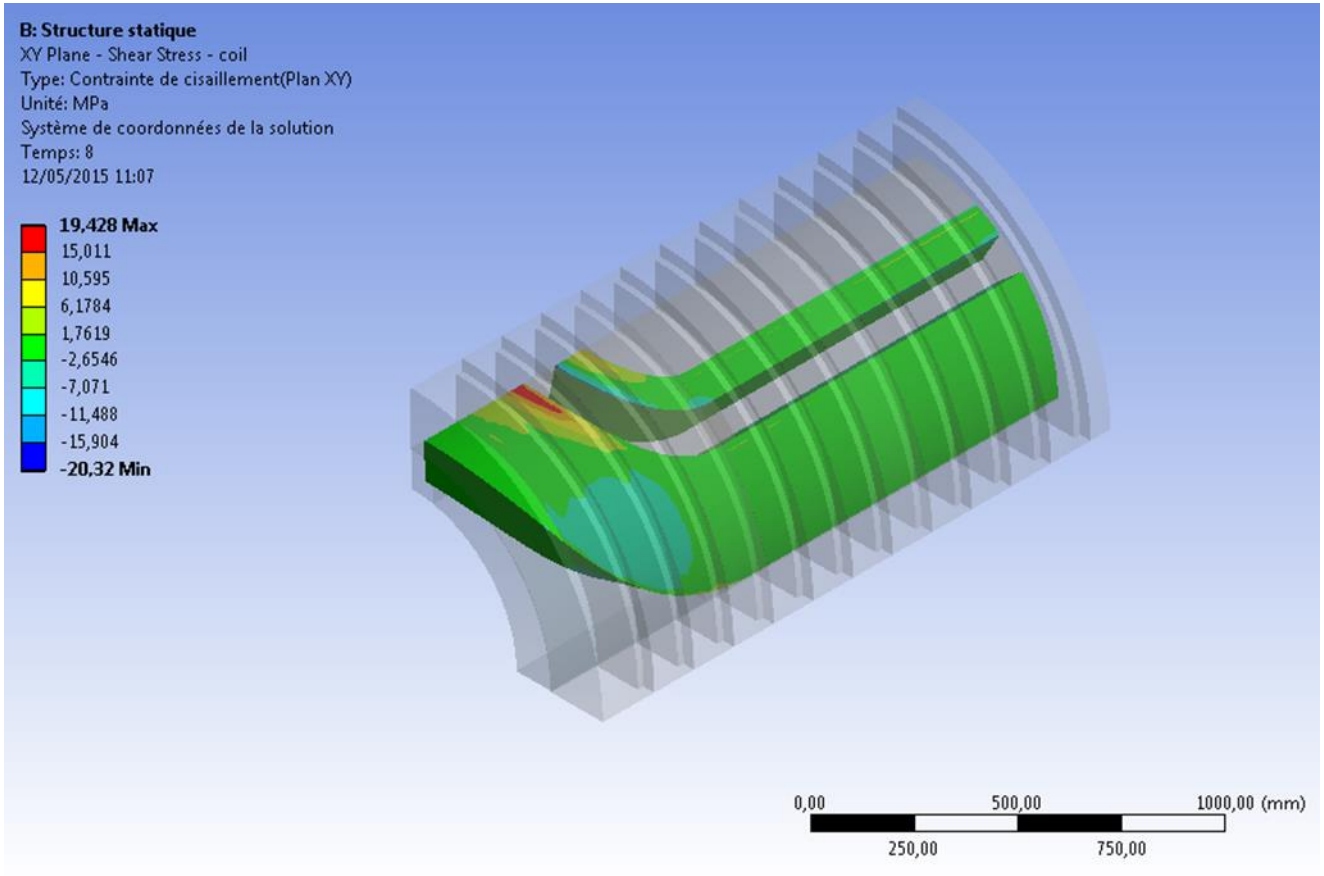


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K with forces– Shear stress XY Plane

With the young modulus modified

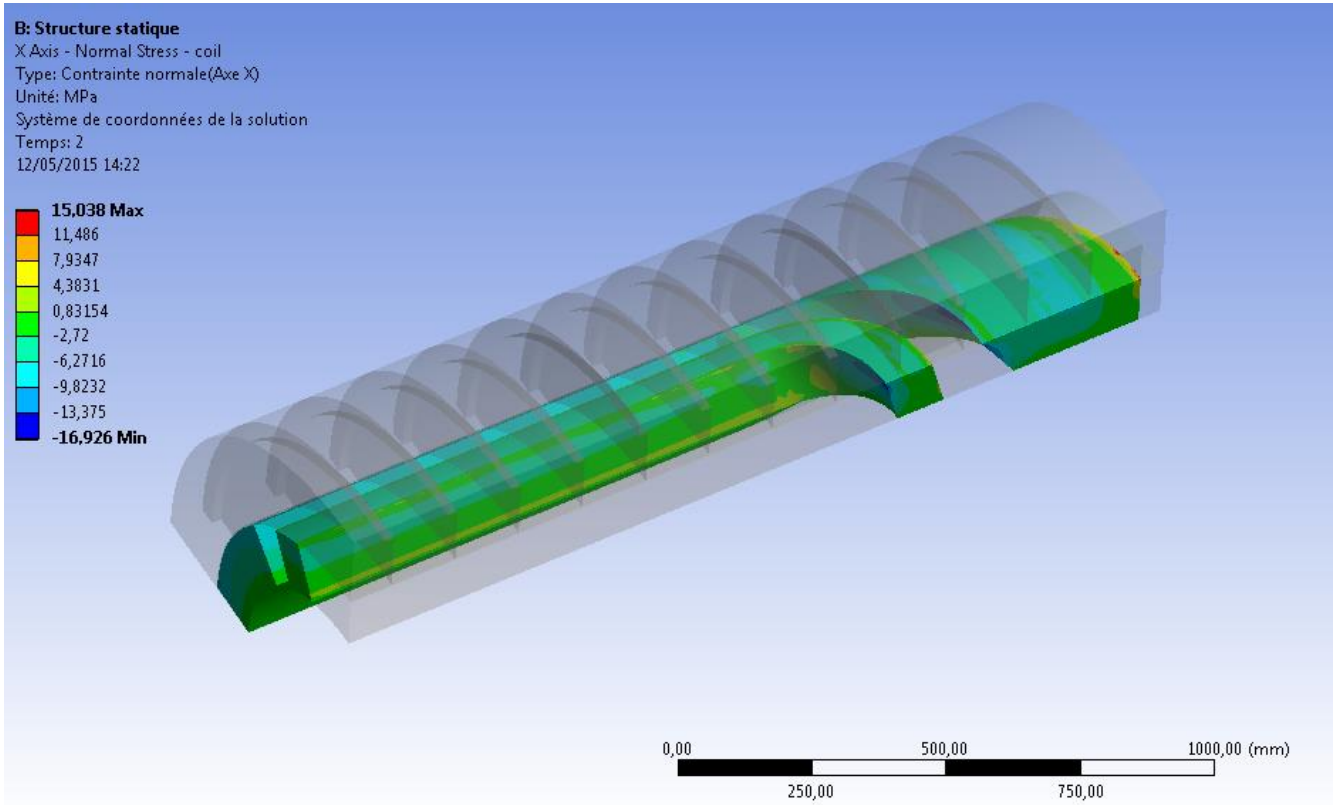


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-@20°C– Normal stress X Axis

With the young modulus not modified

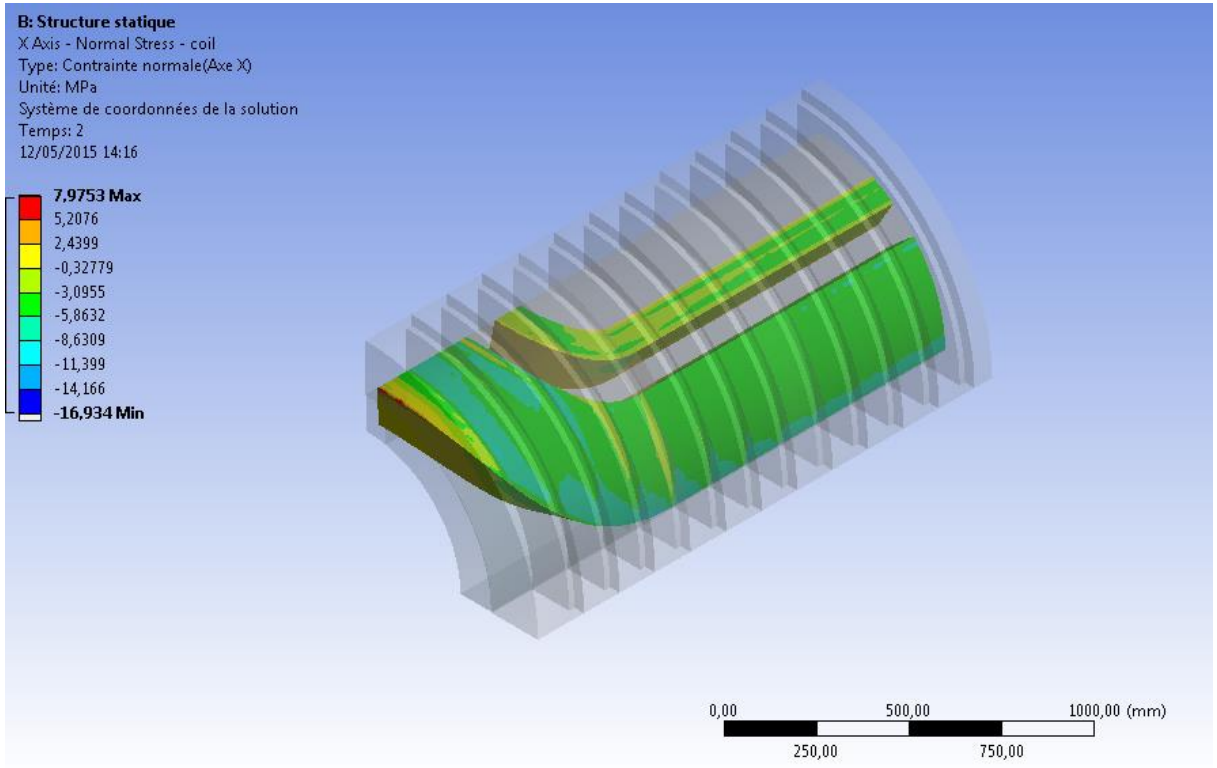


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-@20°C– Normal stress X Axis

With the young modulus modified

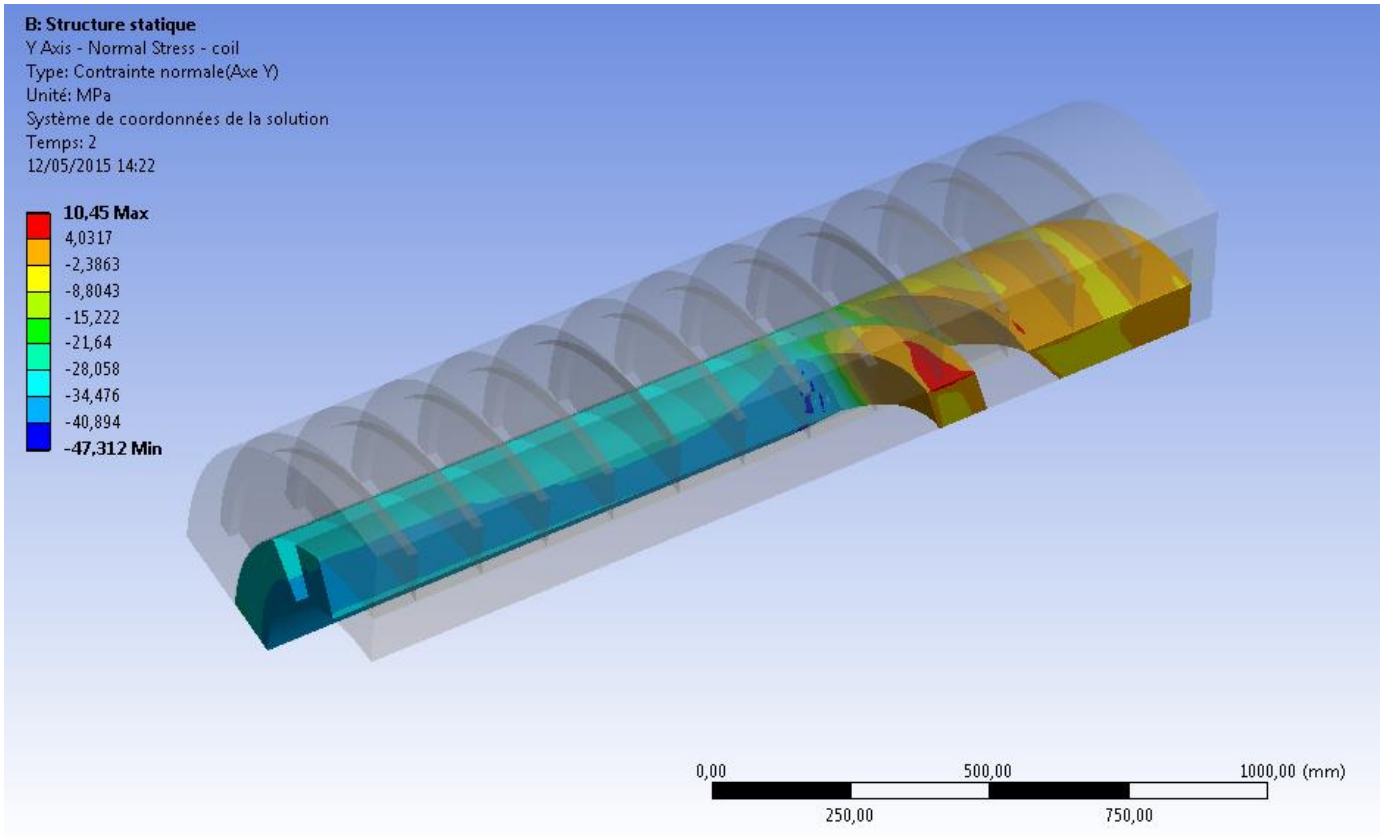


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-@20°C– Normal stress Y Axis

With the young modulus not modified

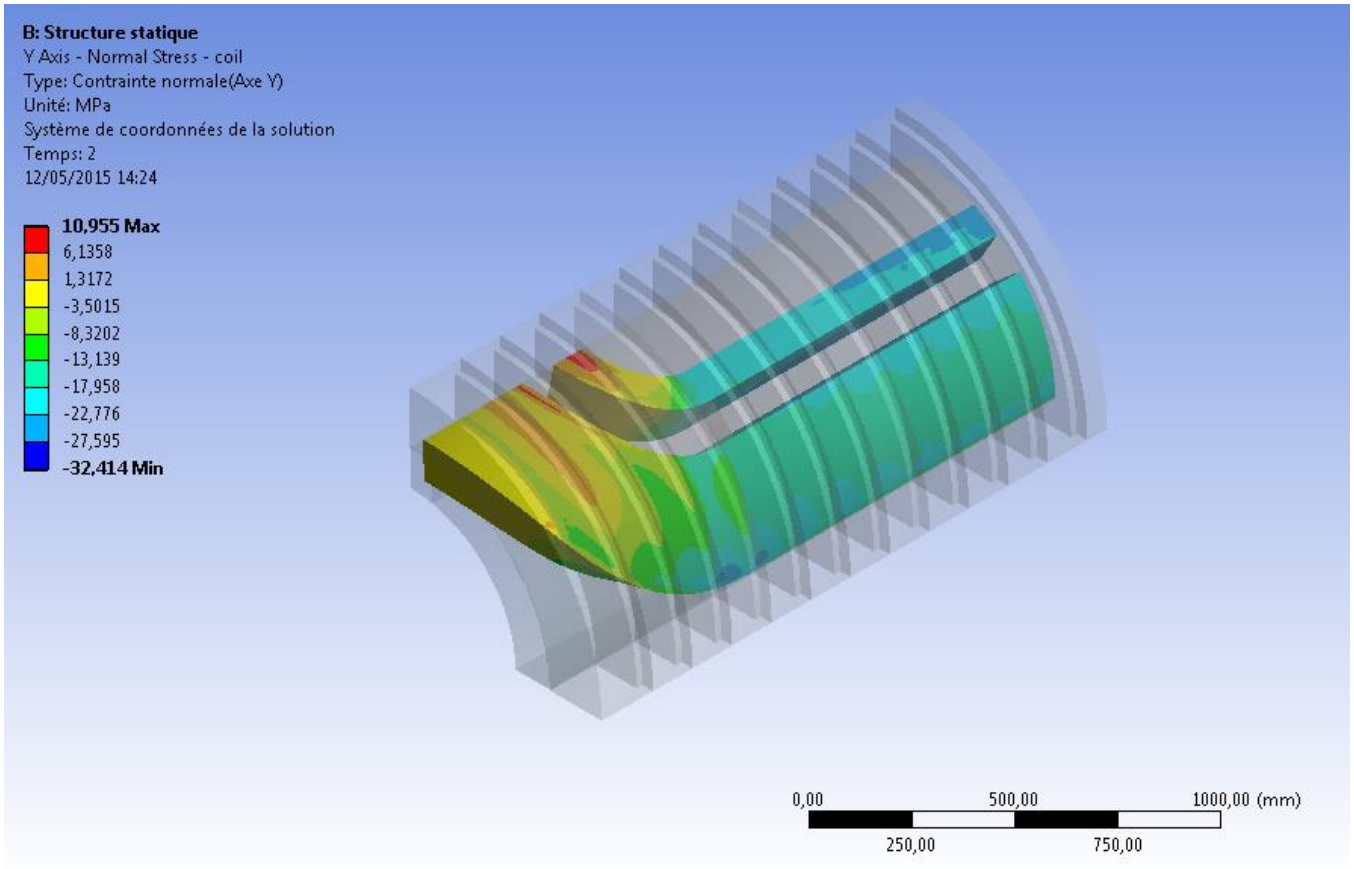


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-20°C– Normal stress Y Axis

With the young modulus modified

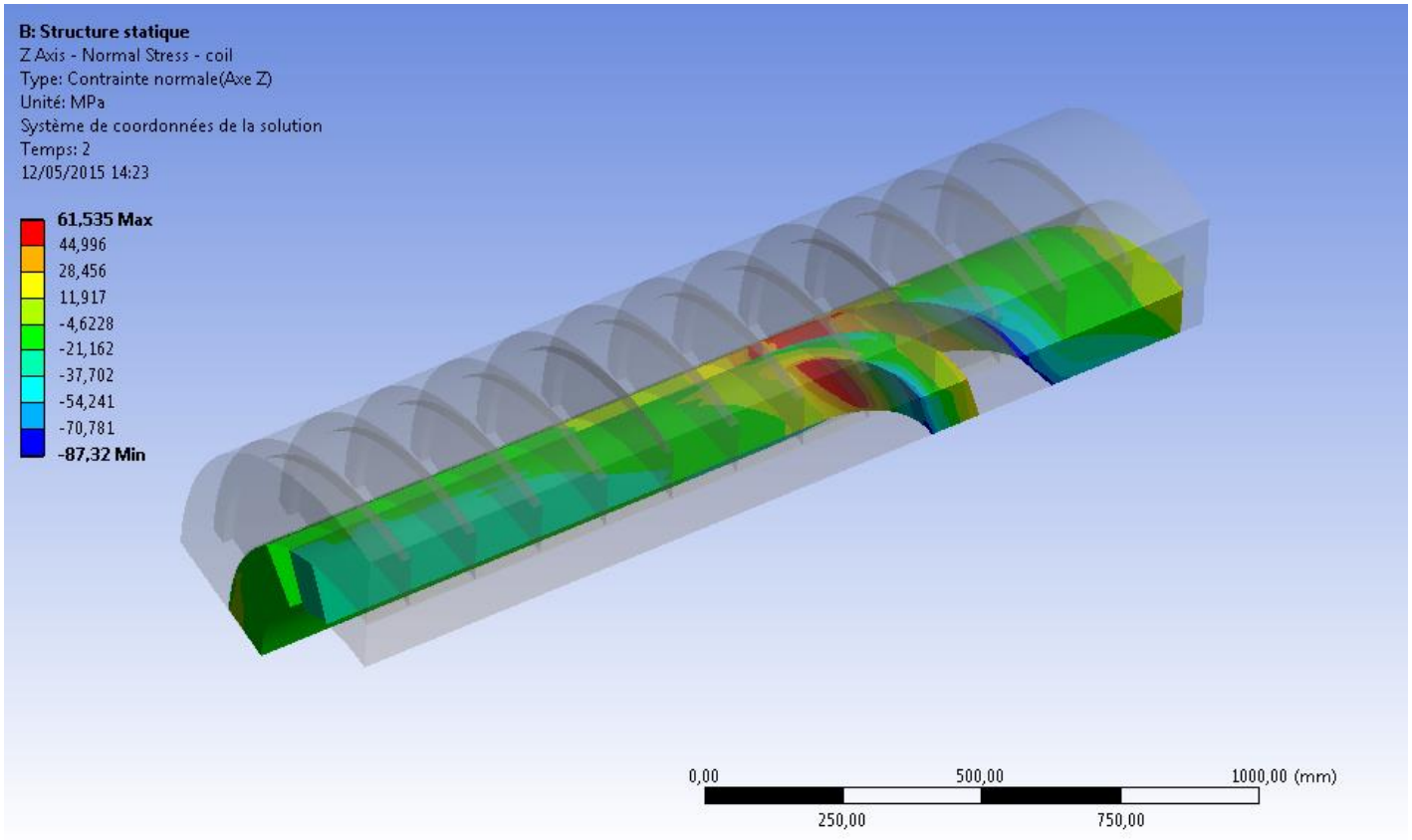


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-@20°C– Normal stress ZAxis

With the young modulus not modified

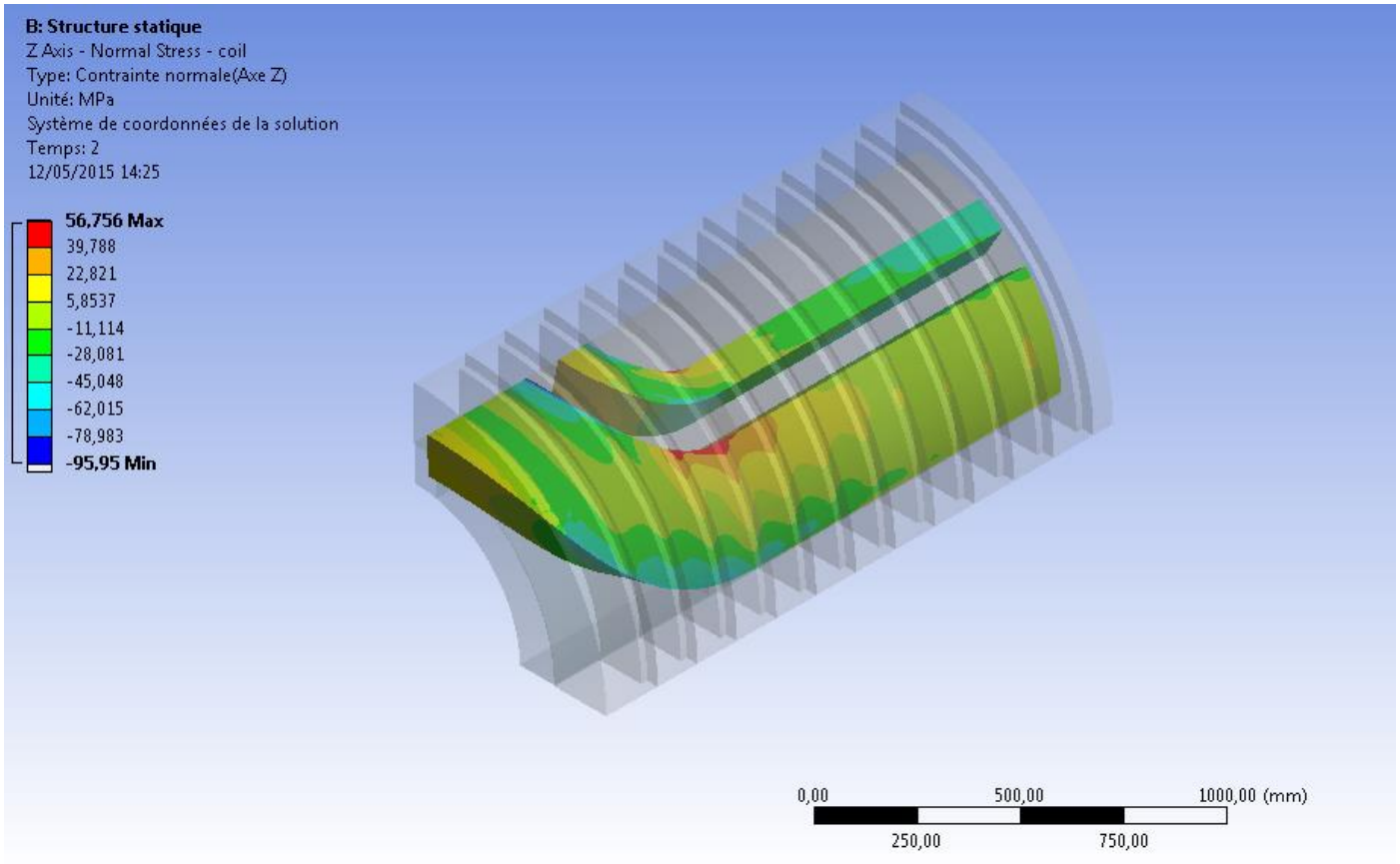


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-@20°C– Normal stress Z Axis

With the young modulus modified

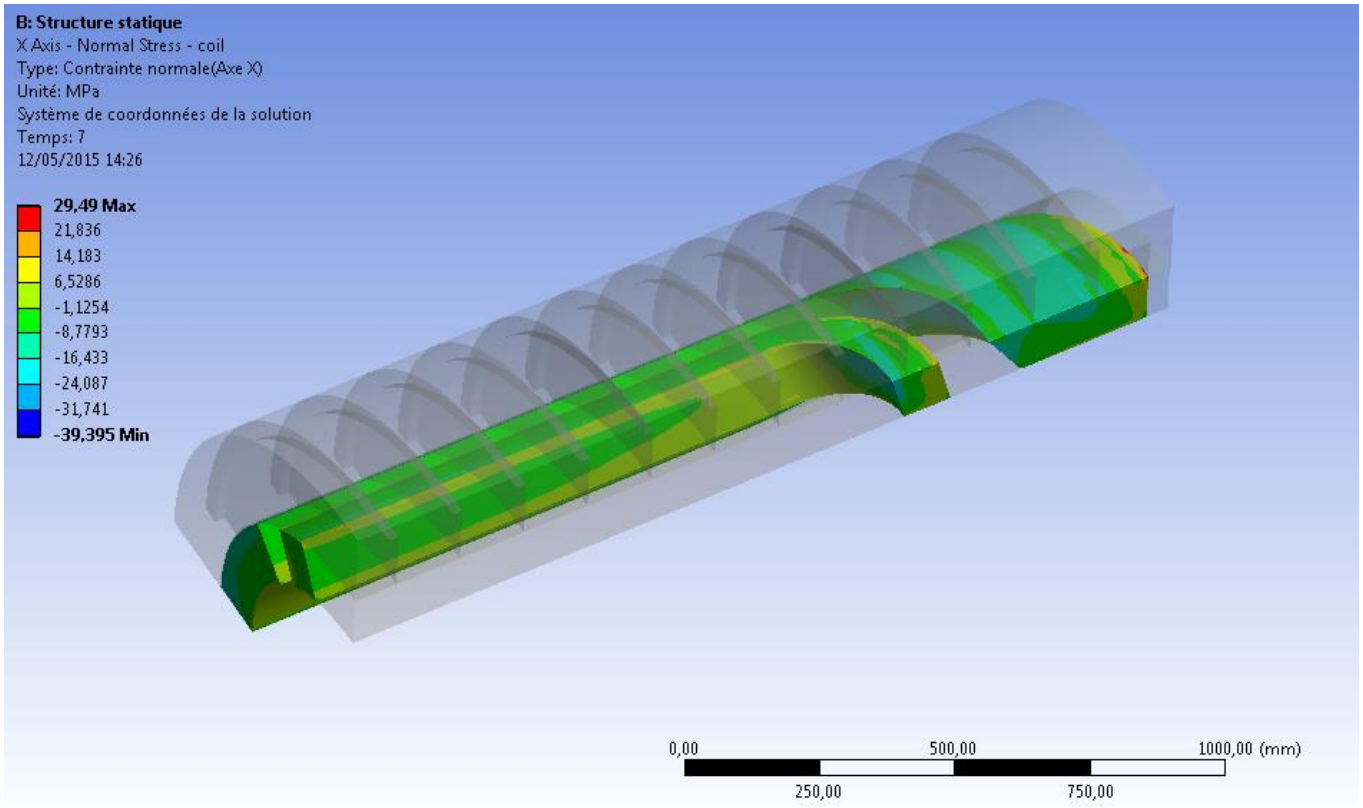


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– Normal stress X Axis

With the young modulus not modified

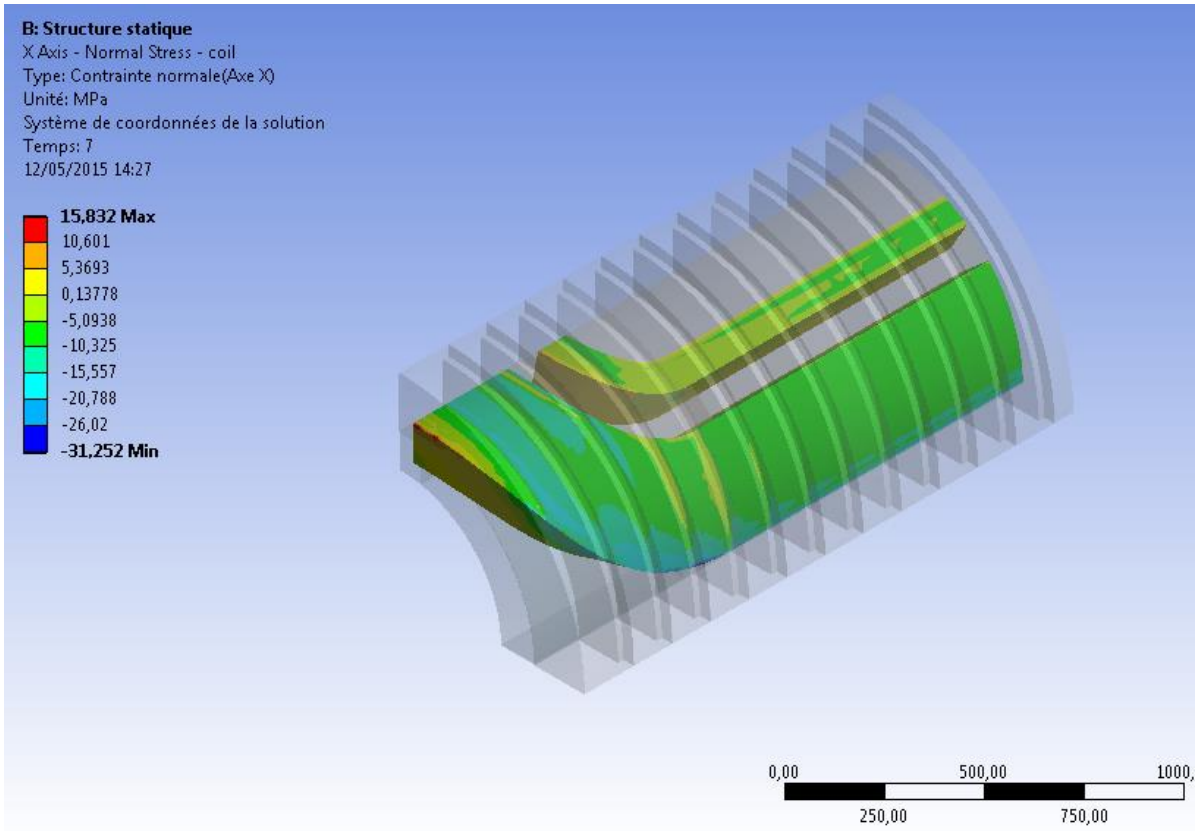


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– Normal stress X Axis

With the young modulus modified

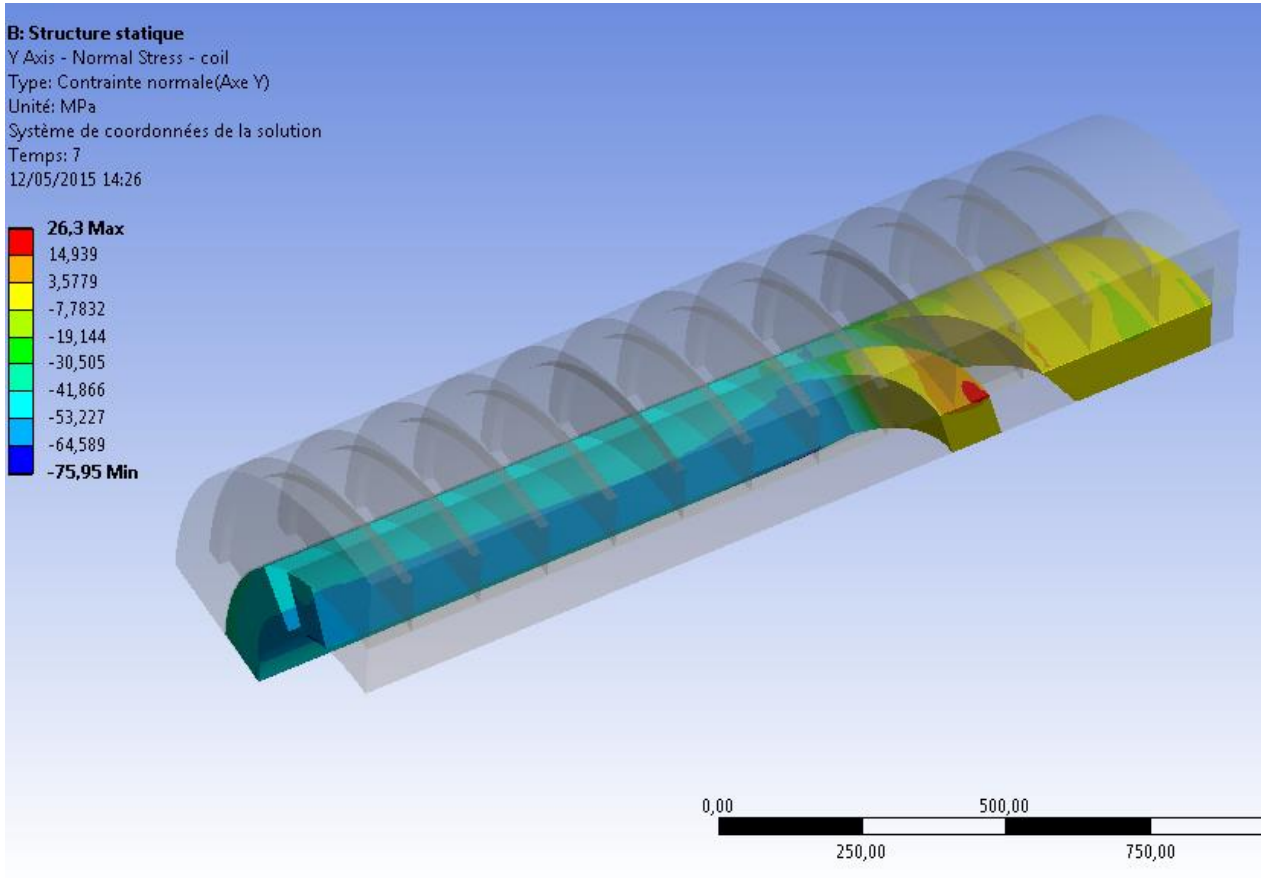


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– Normal stress Y Axis

With the young modulus not modified

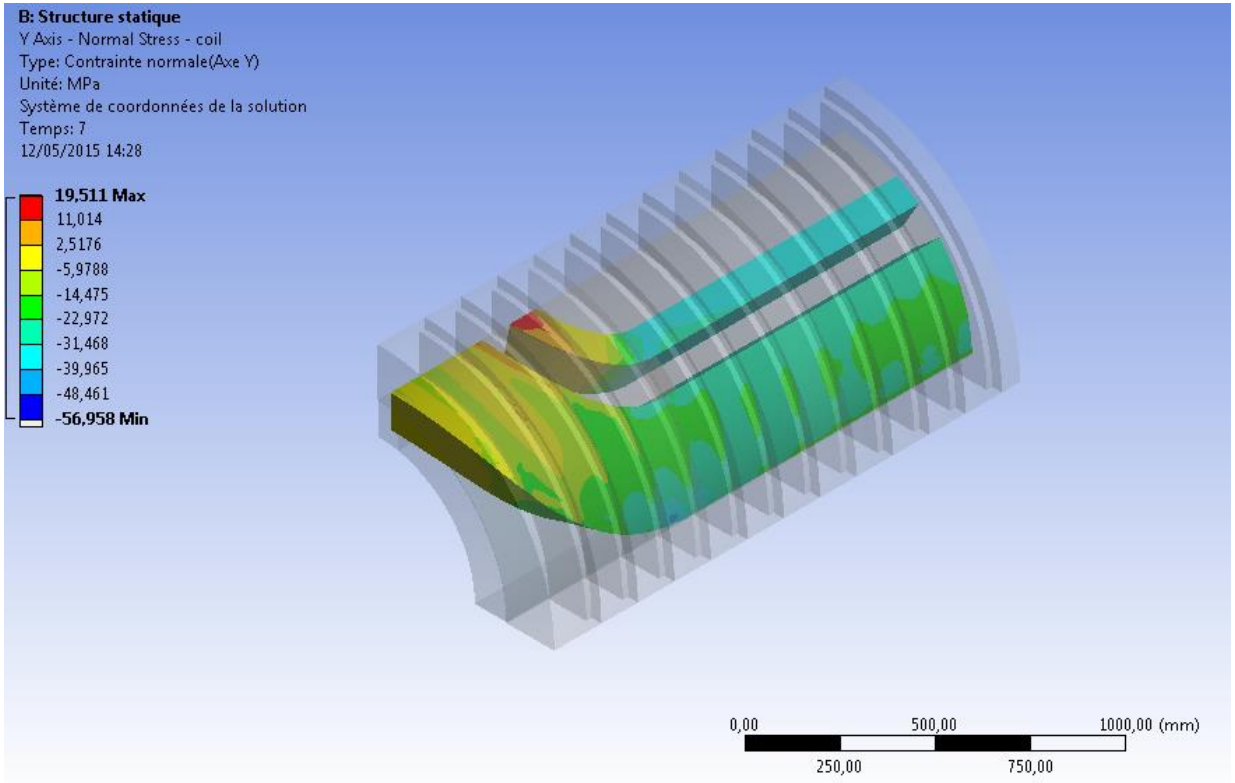


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– Normal stress Y Axis

With the young modulus modified

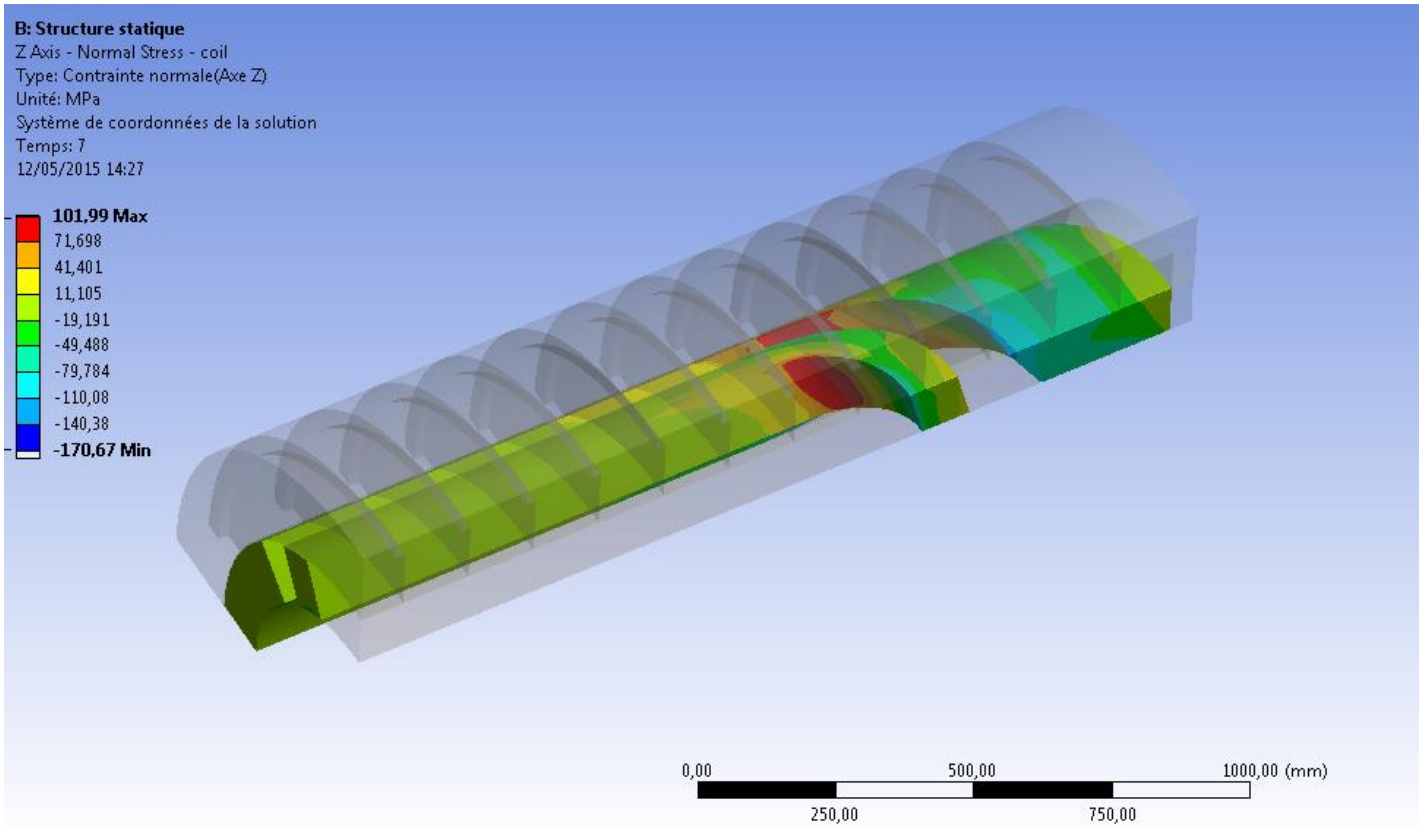


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– Normal stress ZAxis

With the young modulus not modified

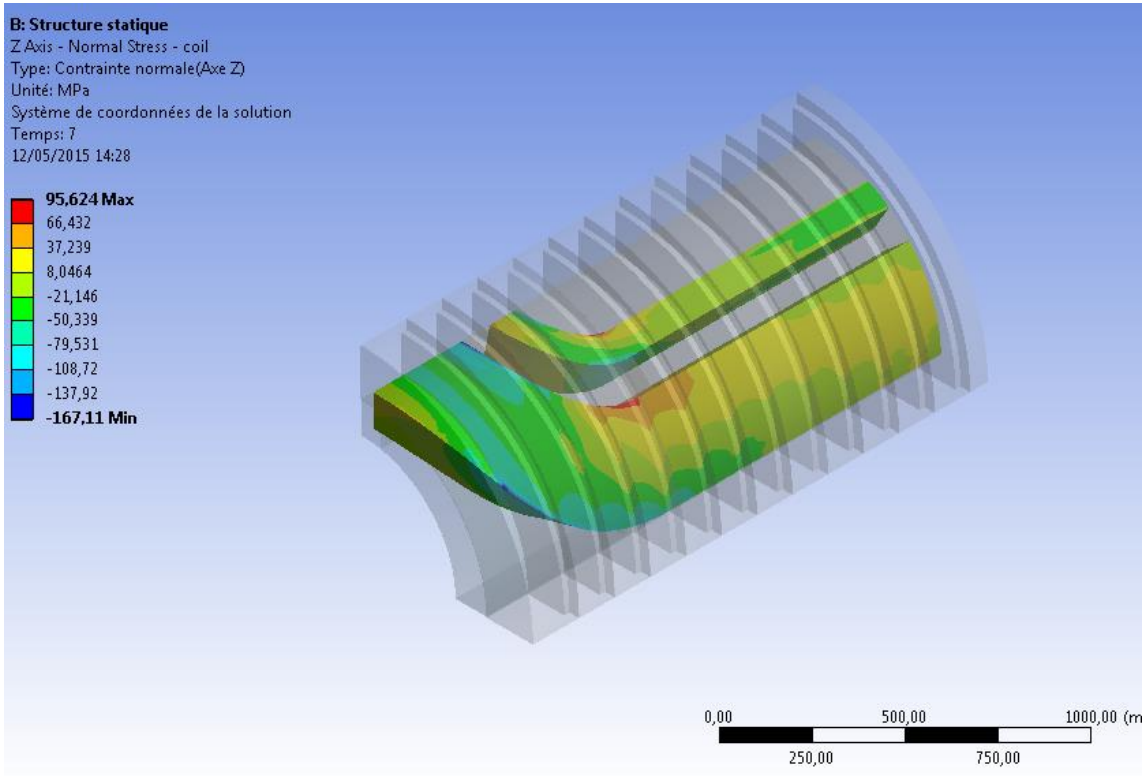


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K without forces– Normal stress ZAxis

With the young modulus modified

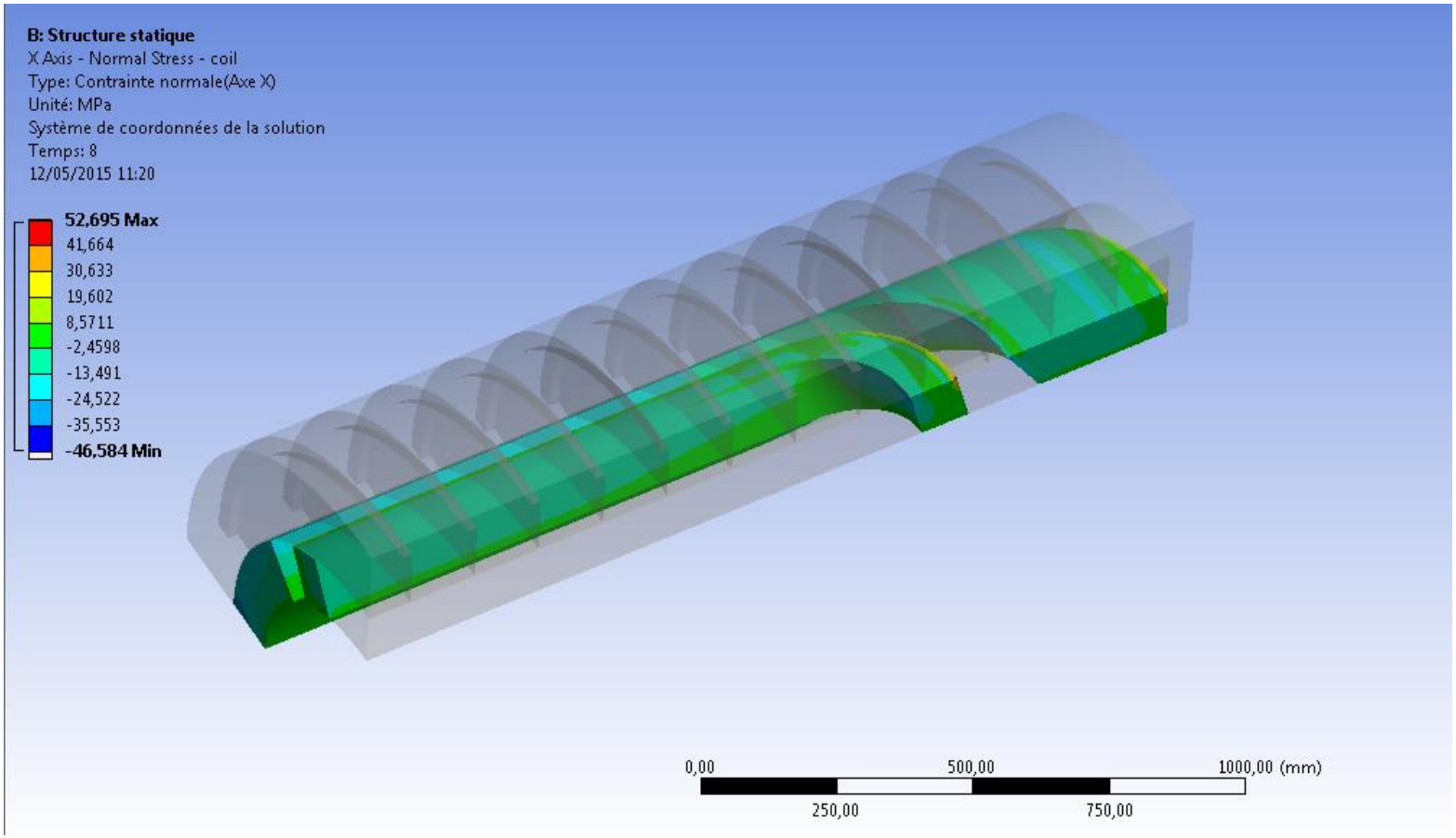


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K with forces– Normal stress X Axis

With the young modulus not modified

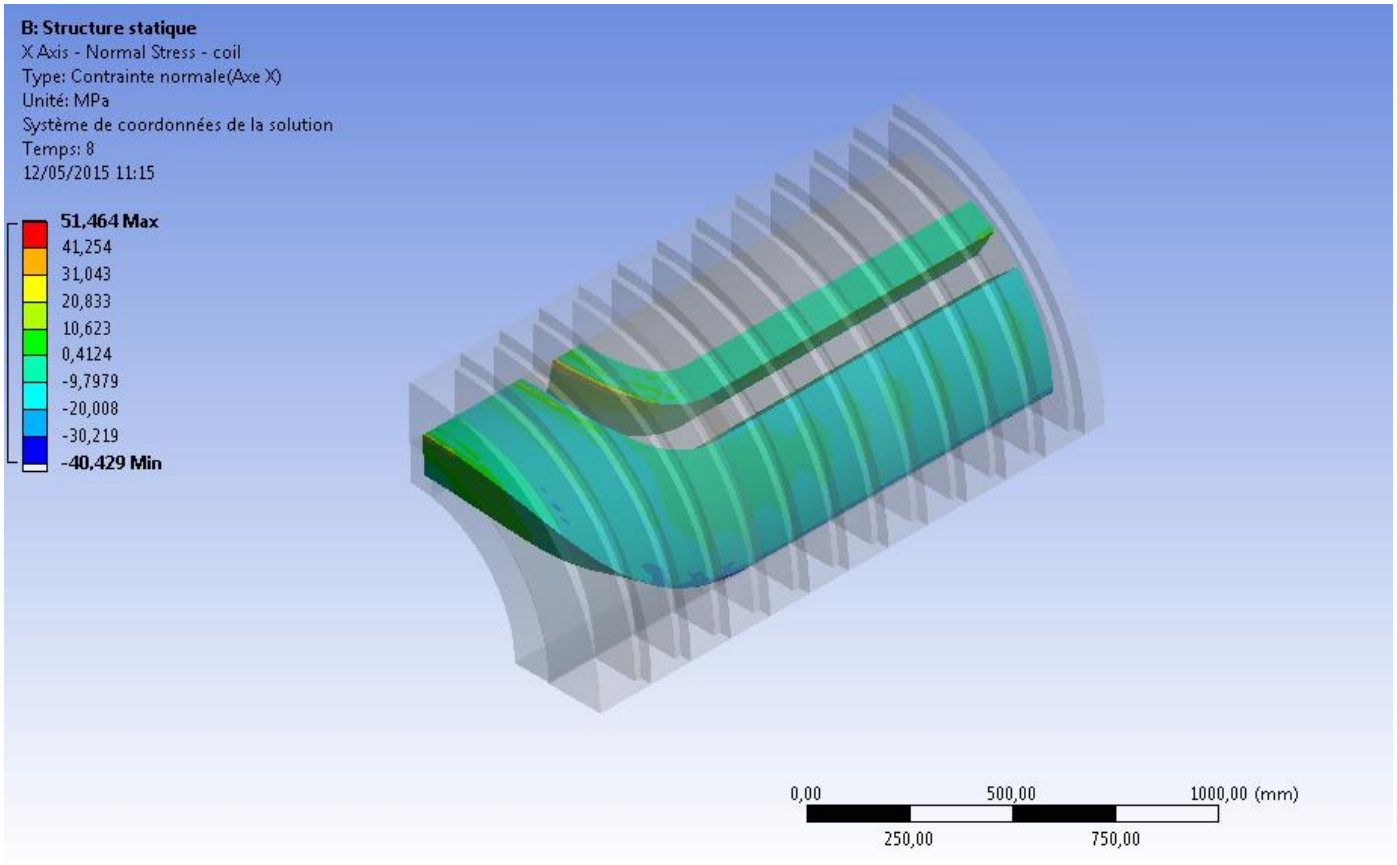


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K with forces– Normal stress X Axis

With the young modulus modified

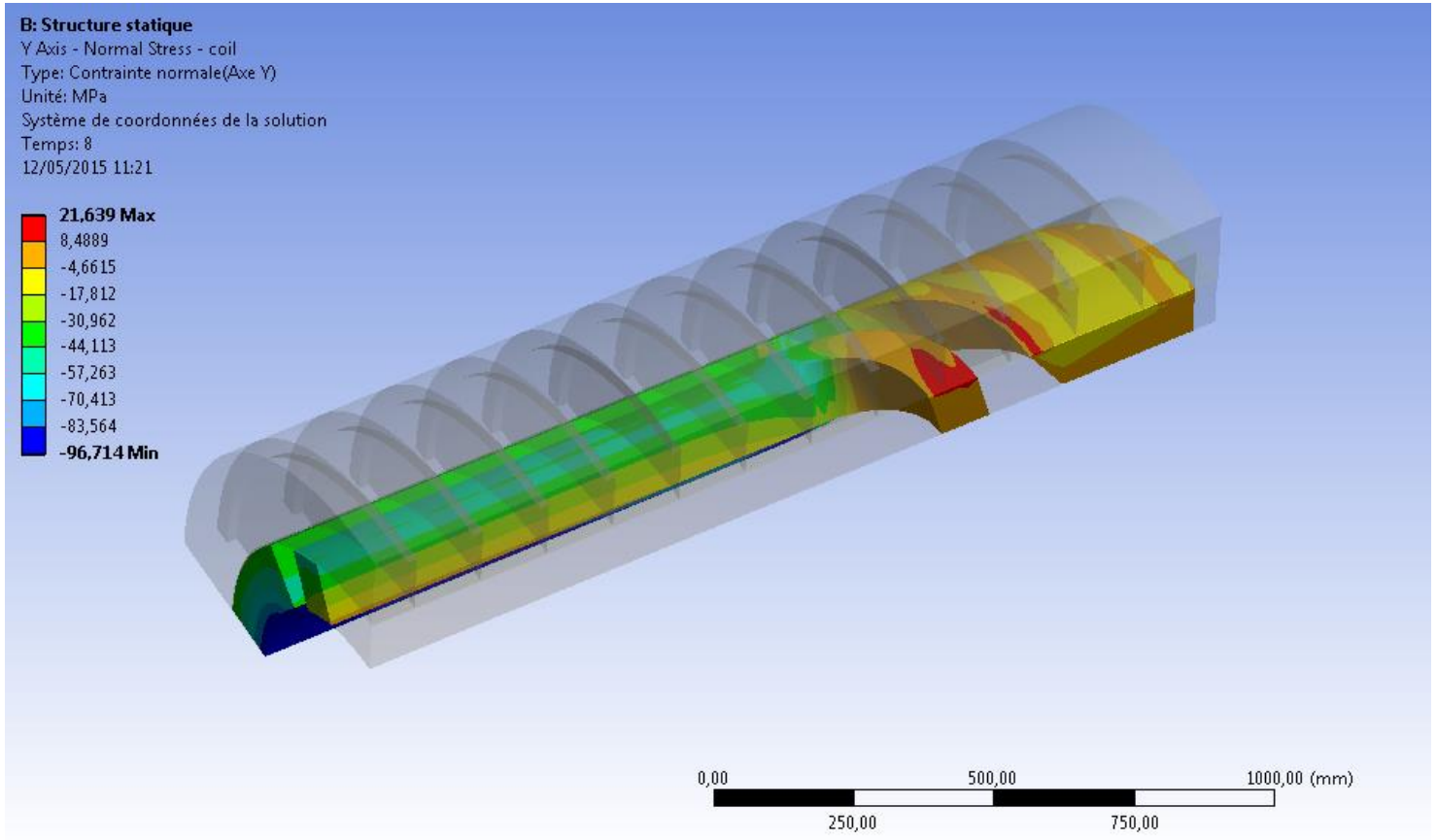


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K with forces– Normal stress Y Axis

With the young modulus not modified

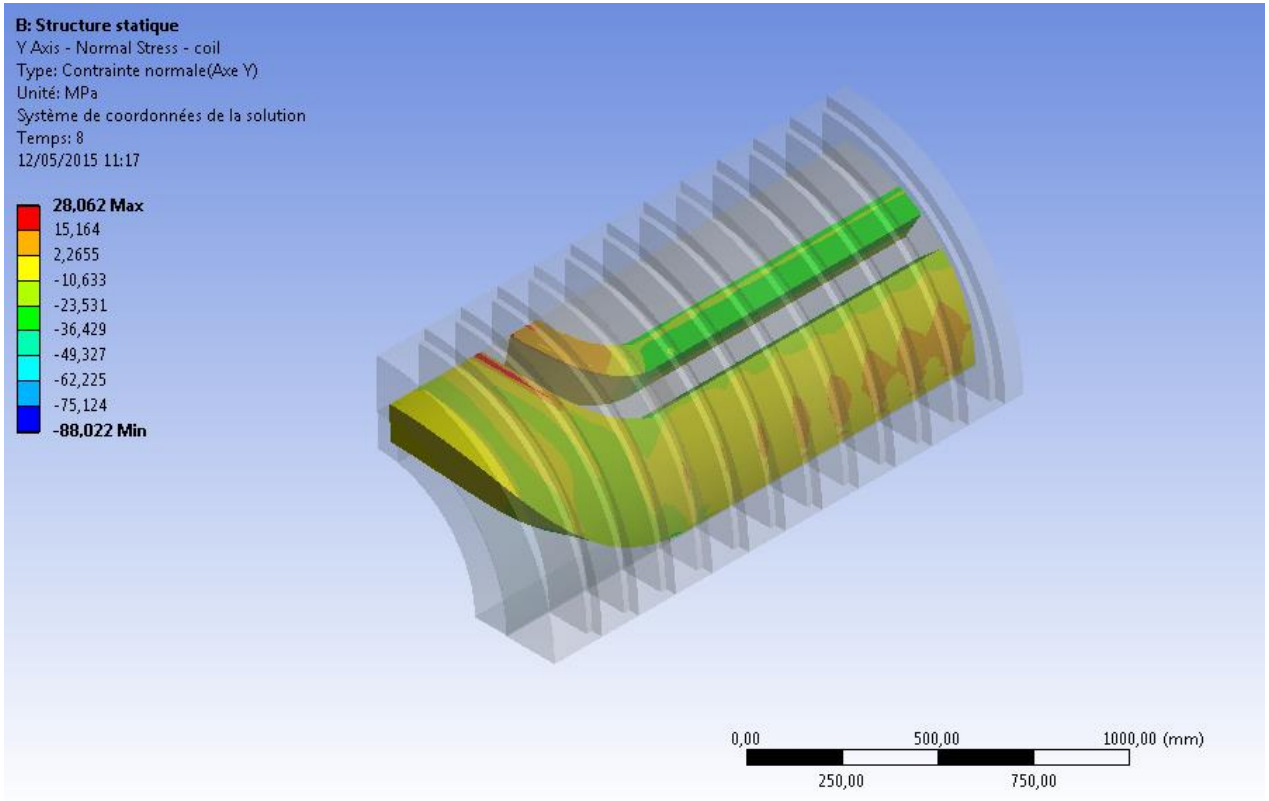


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K with forces– Normal stress Y Axis

With the young modulus modified

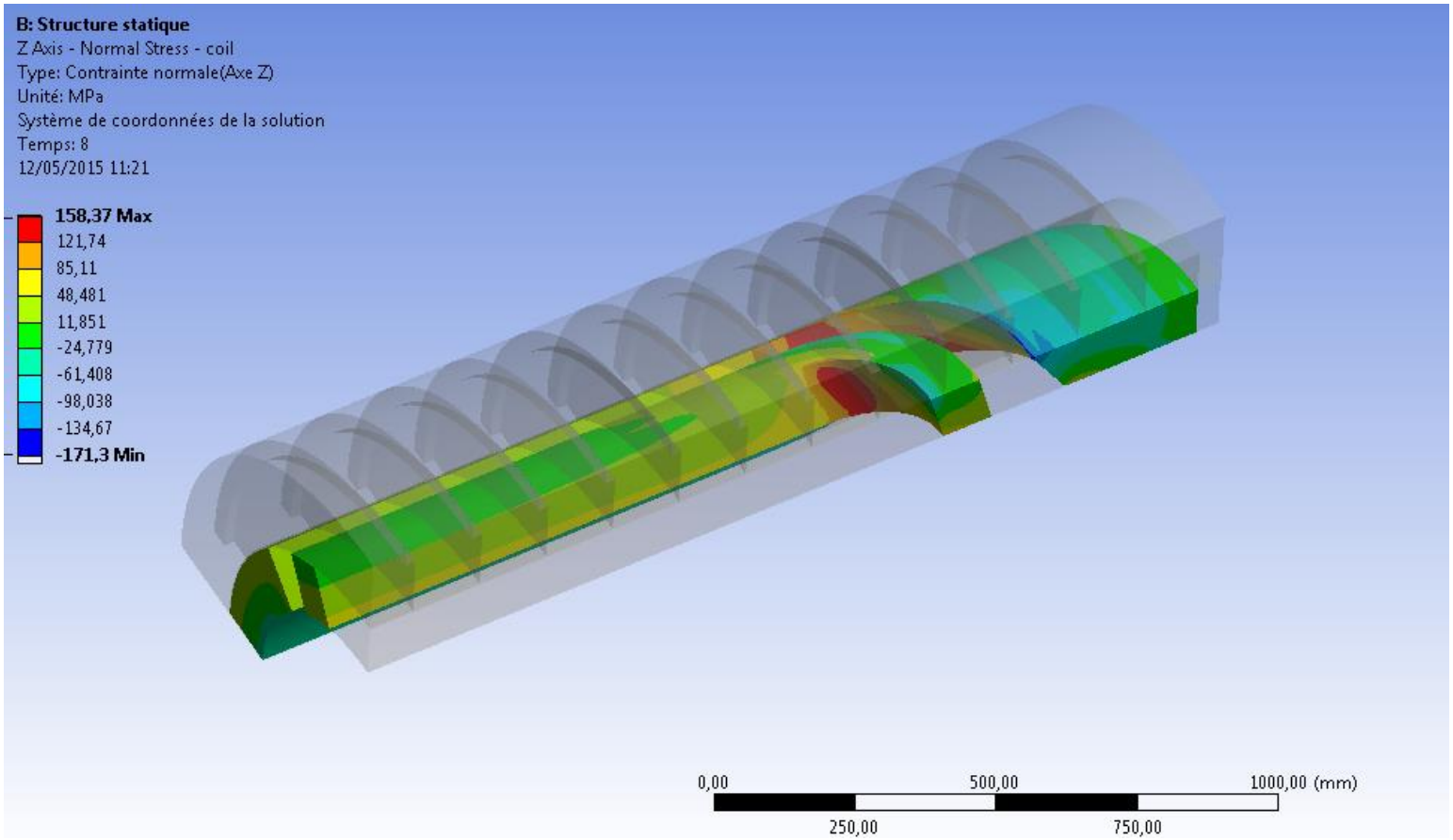


2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K with forces– Normal stress ZAxis

With the young modulus not modified



2015-05-06_317111_JLAB_Coil Stress Analysis

Case with the Collars temperature at 95°C

V37-Cooldown 4K with forces– Normal stress Z Axis

With the young modulus modified