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Planar Gem Mechanical Analysis

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Lina Quintie



Analysis

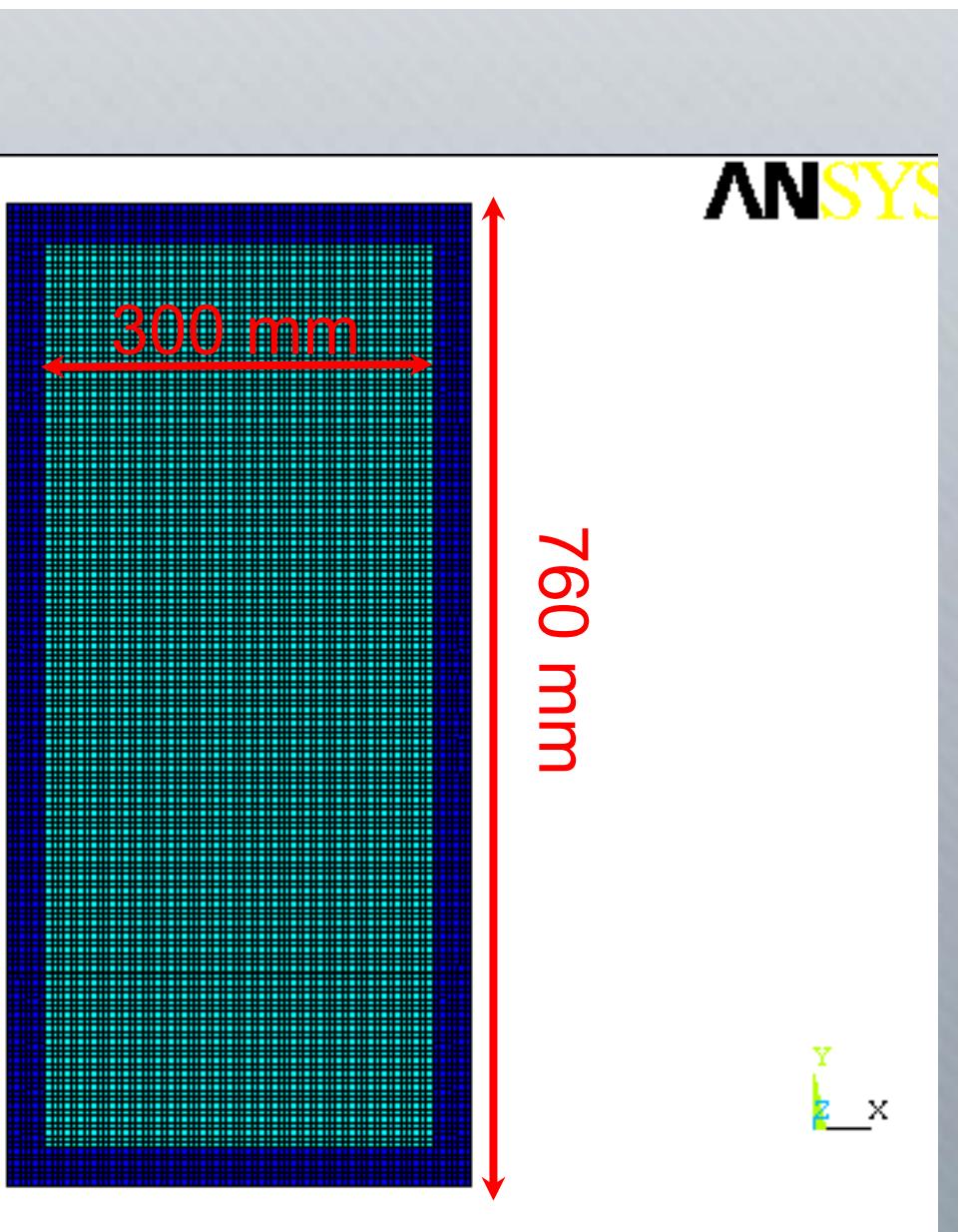
FEA Model (element type, material, geometry)

Stress and Strain Calculations (several configurations of boundary conditions and loading)

Results for static analysis

(Instability analysis in progress)





FEA model

Thin Shell: 10944 elementi

Non linear problems due to:

- 1. deformations >> thickness
 - material behaviour

- Shell63
- Shell181(keyopt0=0)
- Solid45+Shell181(keyopt1=1)



Material data

Permaglass

densità=1850 Kg/m³

Young Modulus=2.4E+10

Poisson Coeff=0.17 [Ref1]

- ▶ Gem (kapton+copper)
 - ▶ densità= 2221.63 kg/m³
 - ▶ Young Modulus=3.26E+9 (well-accordance experimental-calculated stress-strain)
 - ▶ Poisson Coeff=0.335**

**Ref:articolo



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Proceeding xxi ICTAM, 15-24 August 2004
Warsaw Poland

*<<Three-dimensional Thremoelastic
Analysis of plain/epoxy composite>>*

Poisson's ratio=0.17 →

Table 2 Elastic properties of two-layer G-11 woven glass/epoxy laminates

		Young's moduli		
		293 K	77 K	4 K
E_x (GPa)	3-D FEA	26.75	33.10	36.04
	Micromechanics model	26.66	32.96	35.94
	Experimental	27.9	32.7	36.9
E_y (GPa)	3-D FEA Case 1	25.88	31.85	34.69
	Case 2	25.51	31.23	33.89
		Poisson's ratios		
		293 K	77 K	4 K
ν_{xy}	3-D FEA	0.140	0.191	0.214
	Micromechanics model	0.13	0.19	0.21
	Experimental	0.17	0.19	0.23
ν_{xz}	3-D FEA Case 1	0.137	0.188	0.209
	Case 2	0.132	0.182	0.202

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Boundary conditions

Shell Only

Externally Simple supported
(UZ not allowed)

Frame +Shell

Rigidly clamped
ALL degree
of freedom suppressed

Loads

Shell Only

Only gravity
gravity+traction
on external side ($sf=load$
per unit length)

Frame +Shell

uniform compression
on the lower surface of
the frame nodes
($f=load$)

Model

Shell Only

Shell63
Shell181

Frame +Shell

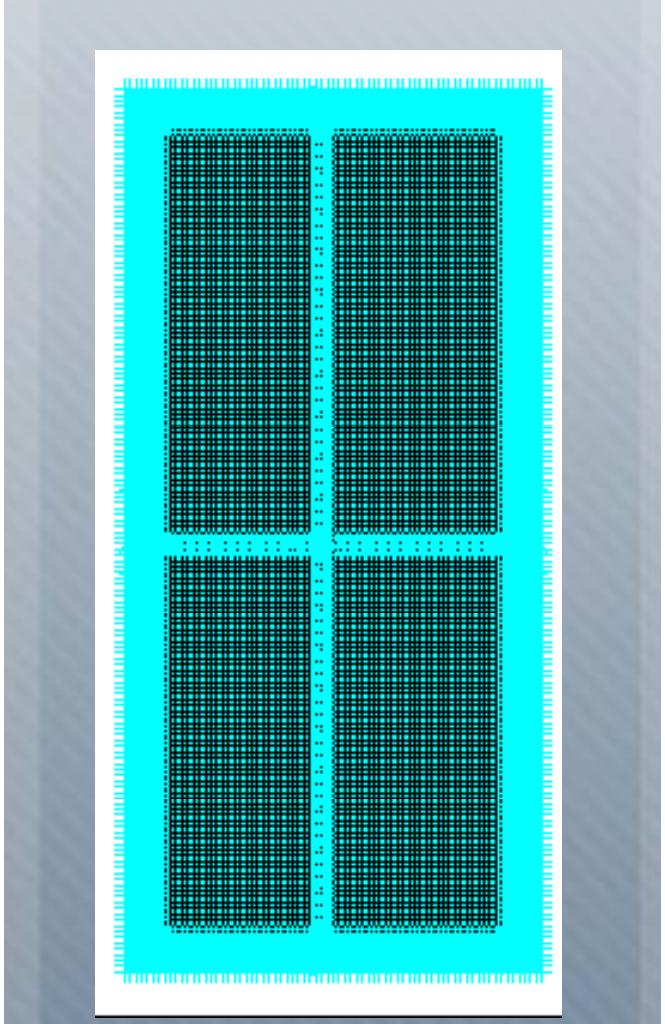
Shell63+Shell63
Shell181+Shell181
Shell181+solid4

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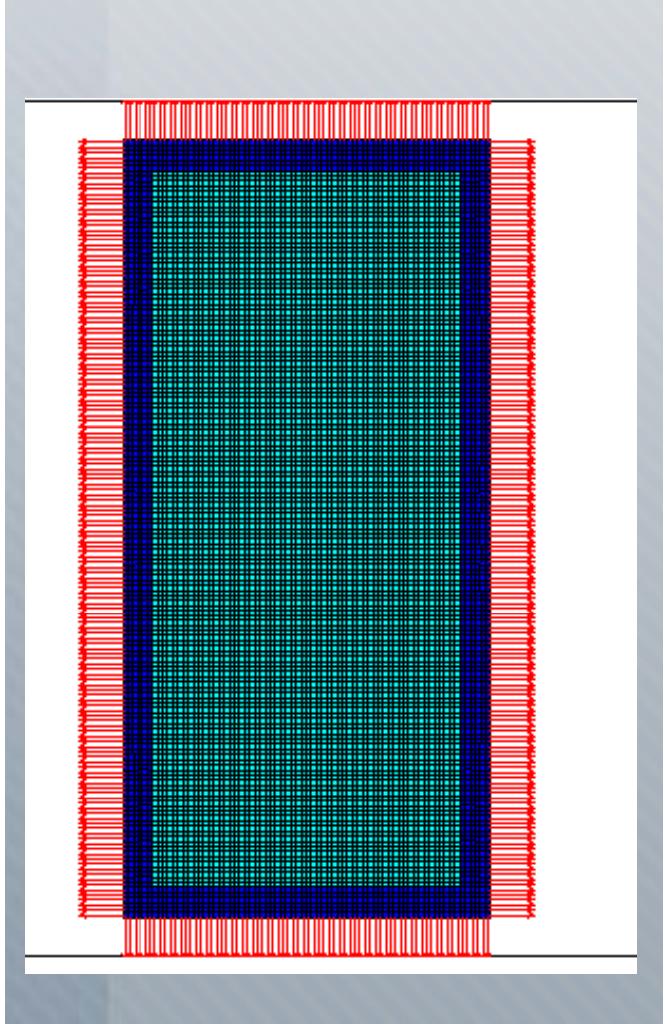
Calculations Descriptions

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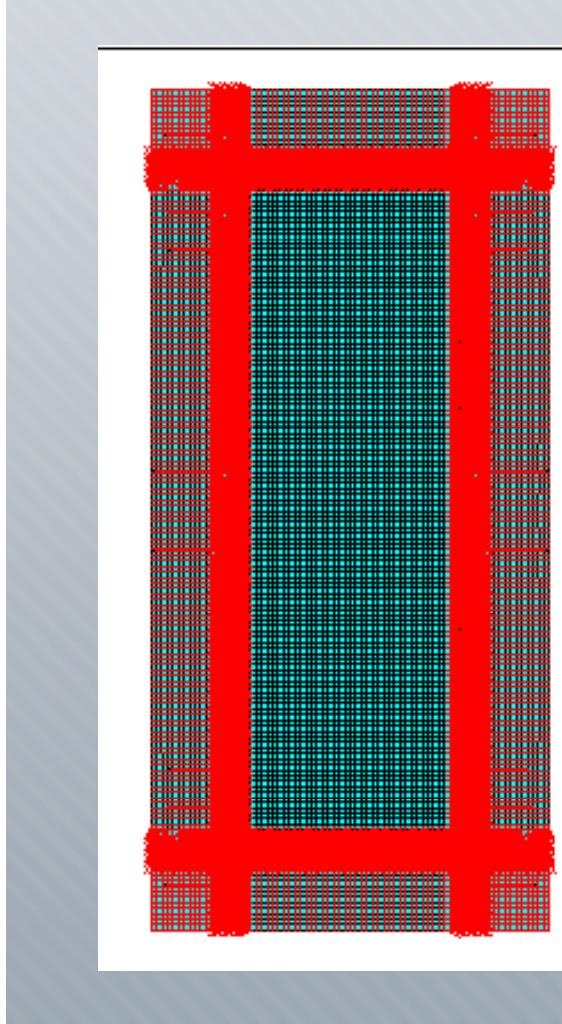
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+ only shell
with gravity



+ only shell
with tensile load + gravity



+ shell+frame wi
compression lo

Boundary condition and load configuration

Case 0

Simply supported shell with tensile load

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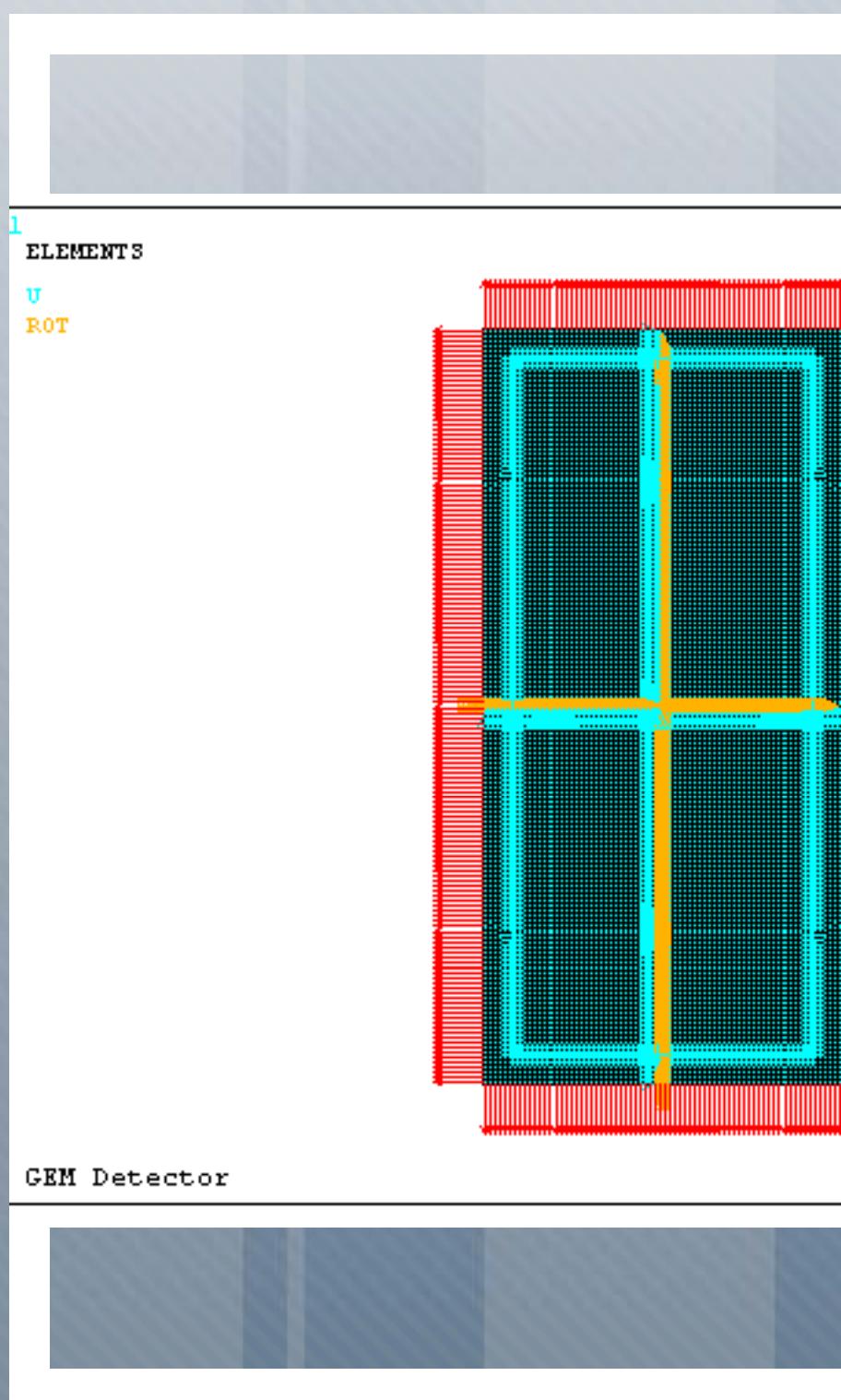
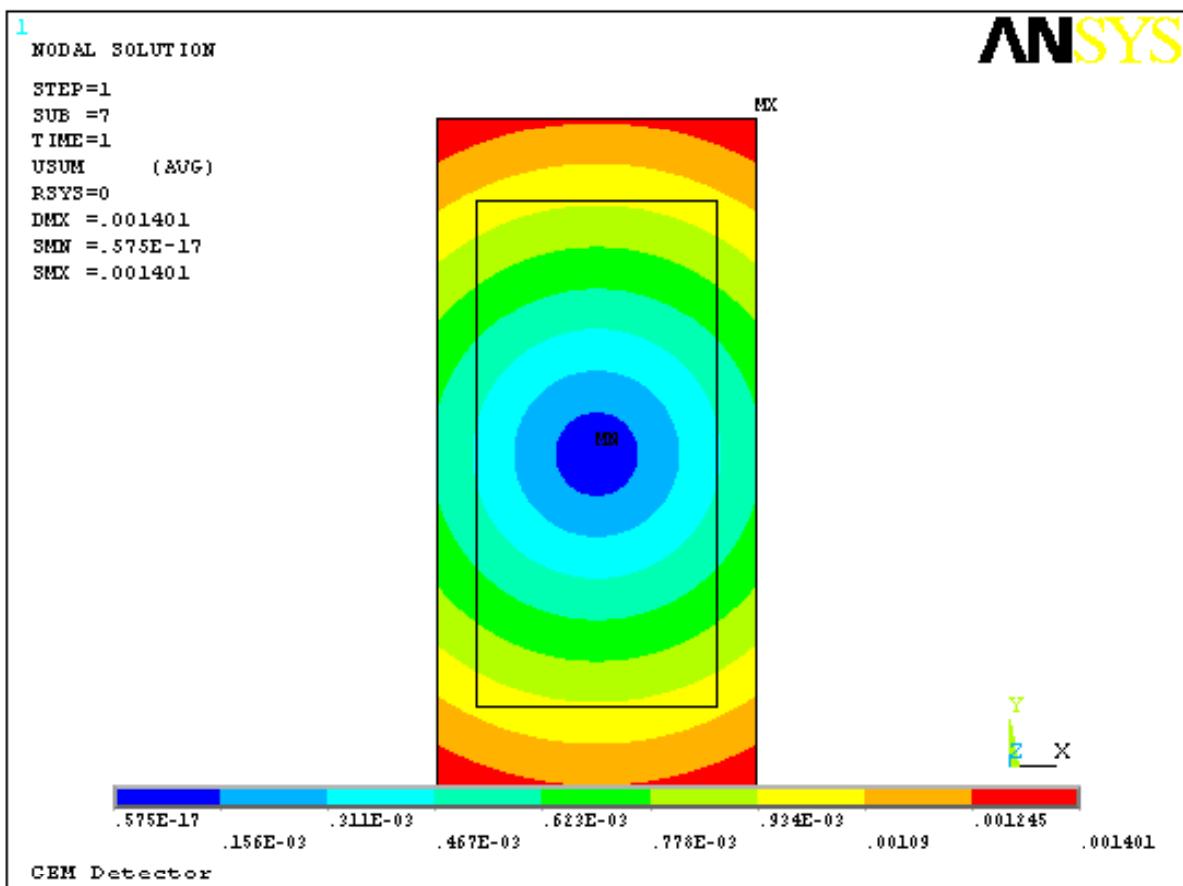
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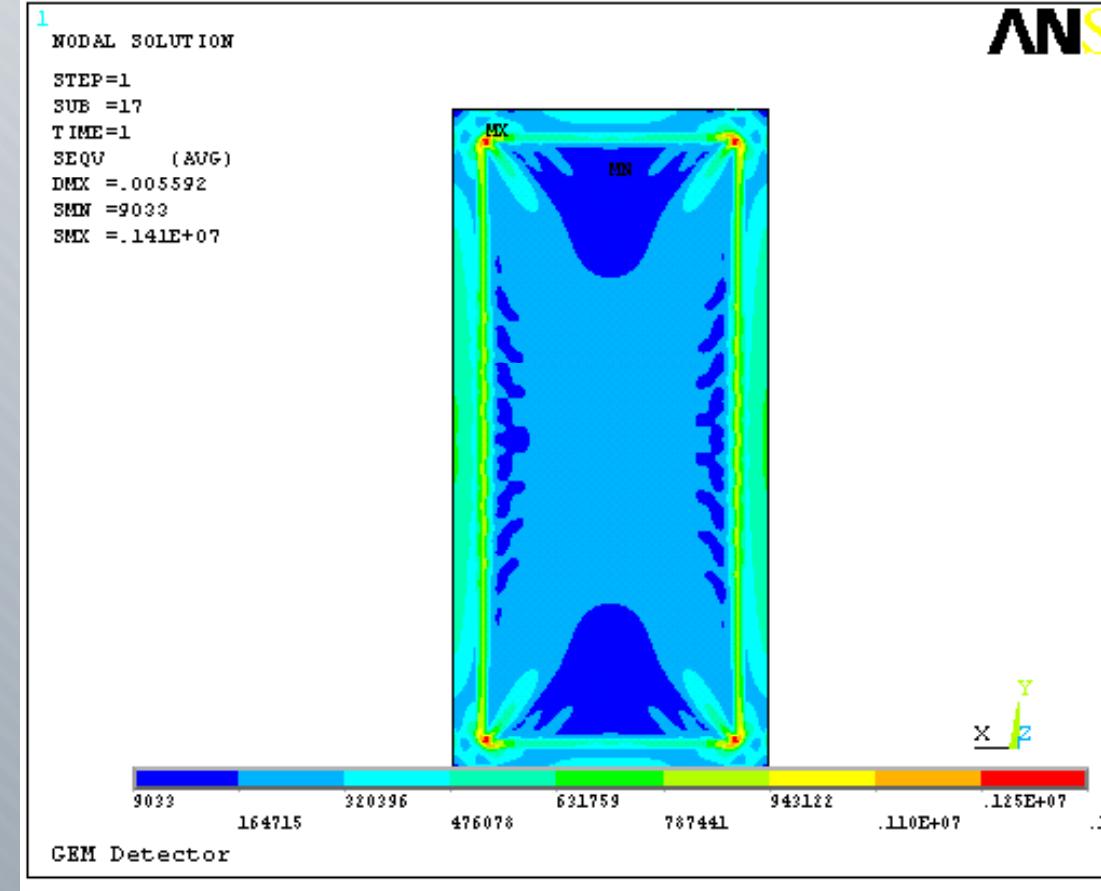
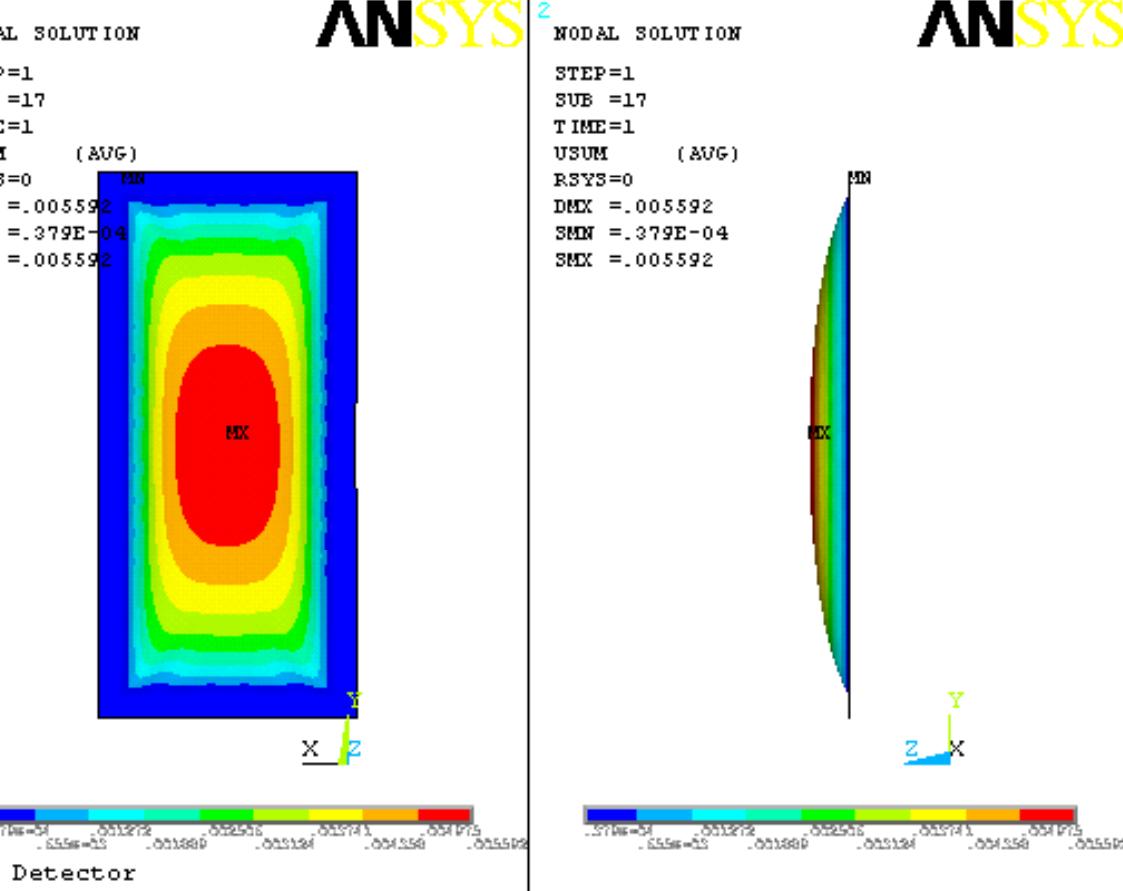
+ Umax=0.001407 m
hydrostatic stress with value
 $\sigma=0.163E+8$ Pa



CASE 1

SIMPLY SUPPORTED SHELL (WITHOUT FRAME)
WITH GRAVITY





+ Displacement scale=10

BC:simply supported Sh
LOAD:only grav

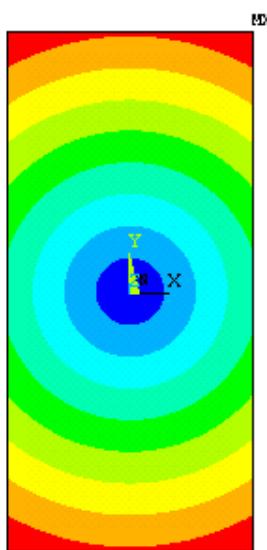
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CASE2

SIMPLY SUPPORTED SHELL (WITHOUT FRAME)
WITH GRAVITY AND TENSILE LOAD




ANSYS


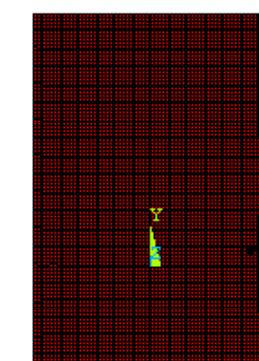
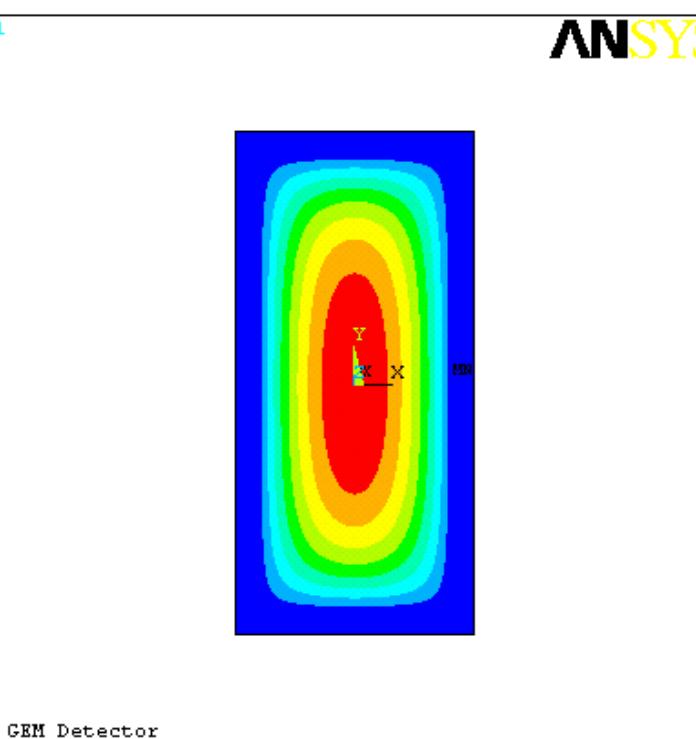
```

NODAL SOLUTION
SUB =1
TIME=1
USUM      (AVG)
RSYS=0
PowerGraphics
EFACET=1
AVRES=Mat
DMX = .001408
SMN = .147E-04
SMX = .001408

ZV =1
*DIST=.744643
ZF = .735E-03
Z-BUFFER
.147E-04
.169E-03
.324E-03
.479E-03
.634E-03
.789E-03
.943E-03
.001098
.001253
.001408

```

Detector



```

NODAL SOLUTION
SUB =1
TIME=1
UZ      (AVG)
RSYS=0
PowerGraphics
EFACET=1
AVRES=Mat
DMX = .001408
SMX = .147E-04

```

```

ZV =1
*DIST=.744643
ZF = .735E-03
Z-BUFFER
0
.163E-05
.327E-05
.490E-05
.653E-05
.816E-05
.980E-05
.114E-04
.131E-04
.147E-04

```

ANSYS

```

ELEM
SUB =
TIME=
SEQV
Power
EFACE
DMX =
SMN =
SMX =
ZW =
*DIST=
ZF =
Z-BUF

```

BC:simply supported shell
LOAD:gravity+ traction load (1kgf/cm)

CASE

SIMPLY SUPPORTED SHELL WITH FRAME
FRAME WITH COMPRESSION LOAD

$\sigma = 0.163E+8$ Pa from CASE0 $F_x = \sigma \cdot (760 * 60E-6)$ $F_y = \sigma \cdot (360 * 60E-6)$

sigma_y(max) = 0.152E+8 Pa
sigma_{eq} (max)=0.152E+8 Pa

```
STEP=1
SUB =7
TIME=1
PowerGraphics
EFACET=1
AVRFCS=Mat+
DMX = .714E-03

*DSCA=50
ZV =1
DIST=.41738
Z-BUFFER
```

1 NODAL SOLUTION
STEP=1
SUB =7
TIME=1
UY (AUG)
RSYS=0
DMX = .714E-03
SMN = -.744E-04
SMX = .744E-04

GEM Detector

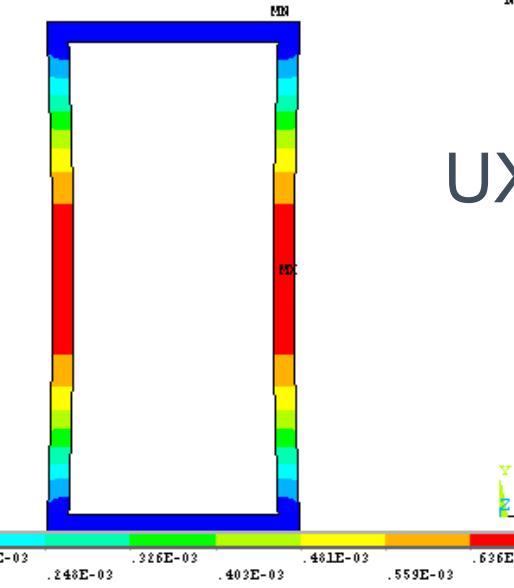
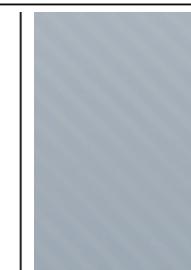


ANSY
NOV 6 200
10:10:4

UY

1 NODAL SOLUTION
STEP=1
SUB =7
TIME=1
U\$UM (AUG)
RSYS=0
DMX = .714E-03
SMN = .146E-04
SMX = .714E-03

GEM Detector



UX

Model: Simply supported shell+frame
LOAD:only uniform compression on frame

OLUTION

(AUG)

14E-03

37E-12

03168

137E-12

.352E-03

.704E-03

.001056

.001408

.00176

.002112

.002464

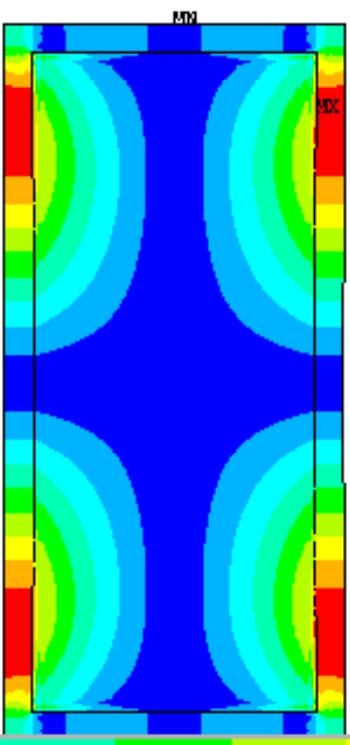
.002816

.003168

ector

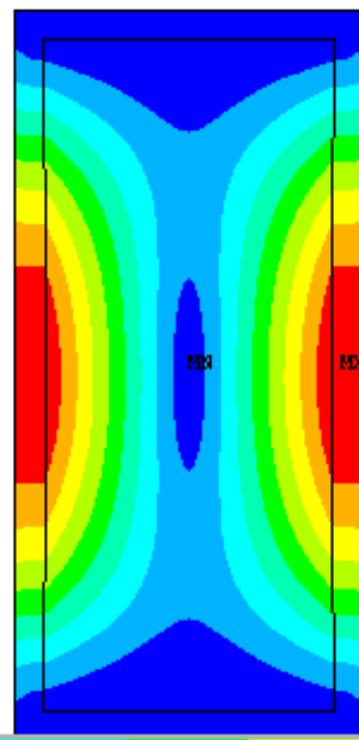
ANSYS

NOV 6 2008
10:05:48



1 NODAL SOLUTION

STEP=1
SUB =7
TIME=1
USUM (AUG)
RSYS=0
DMX =.714E-03
SMN =.305E-12
SMX =.714E-03



GEM Detector

Shell+frame=some commer
Conservative calculations (shell prestress not yet taken into accoun
transient analysis with initial stress in the shell could be done

Shell+frame=some commer

Line with different thickness: 2-4-6-8 mm

nm-->umax=0.714E-3 m

nm-->umax=0.696E-3 m

nm-->umax=0.668E-3 m

nm-->umax=0.639E-3 m

