
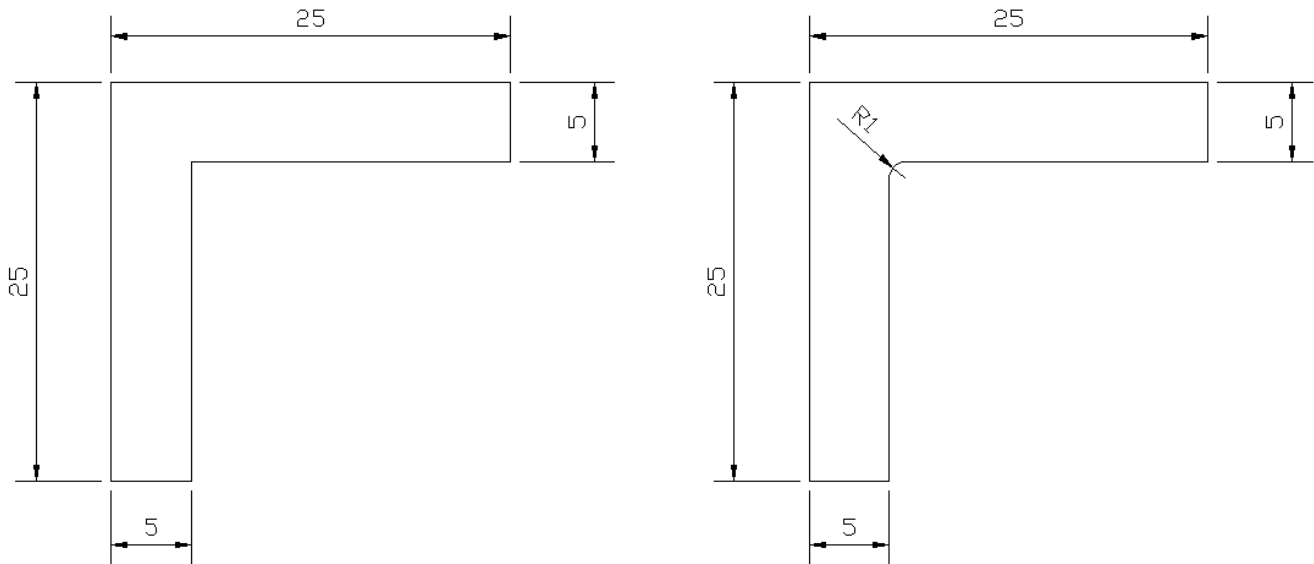


# REPORT

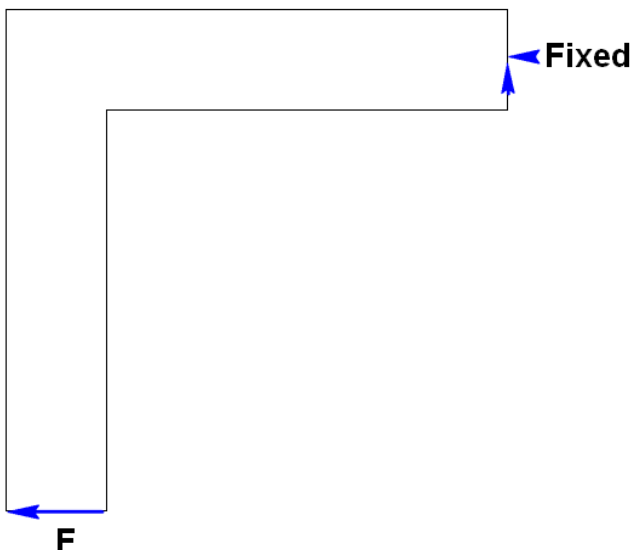
 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	1	of	31
		Job	Compiled by				
	/	Andrea Starnini					

## 1. Geometry




## 2. Mesh type - Load and constraint - Material

Plain stress elements CPS8 (see Calculix documentation)  
Element thickness 1 mm



Fixed XY DOF of nodes lie over the line  
Force applied to all node lie over the line. Total force 25 N  
Material: Structural Steel  $E = 210$  GPa; Poisson's ratio 0.3

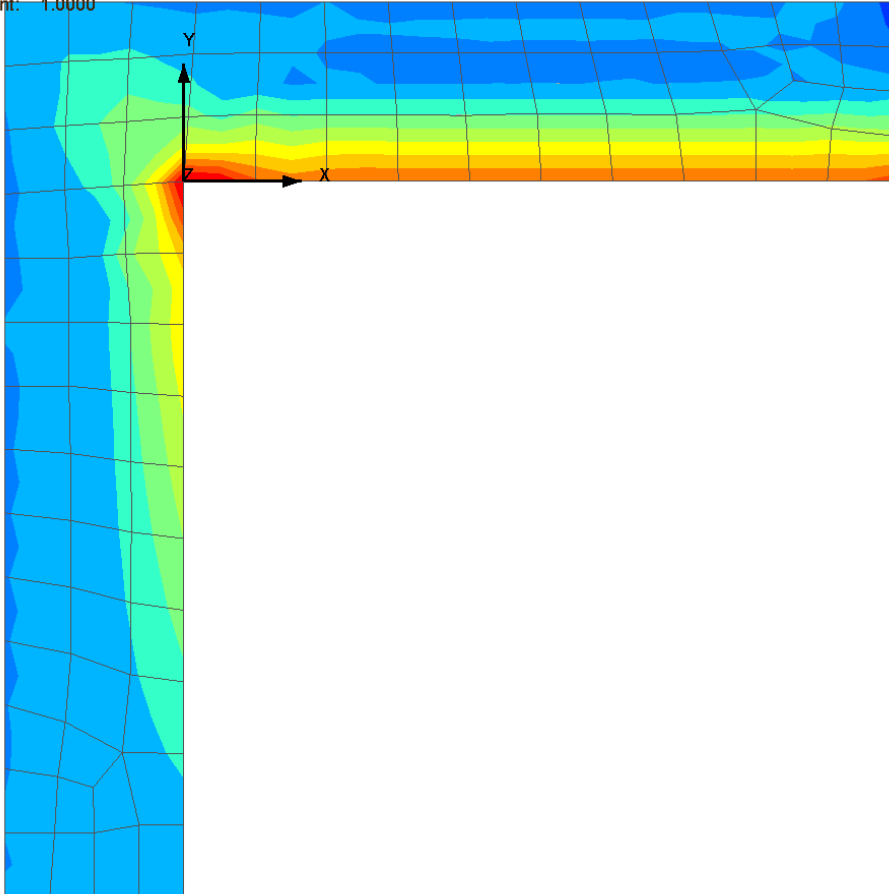
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	2	of	31
		Job	Compiled by				
	/	Andrea Starnini					

## 3. Results: no fillet radius

### 2 mm mesh size


Model : Angle  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 192.5  
Minimum = -40.5



29/12/2016  
05:09:18



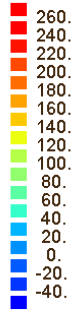
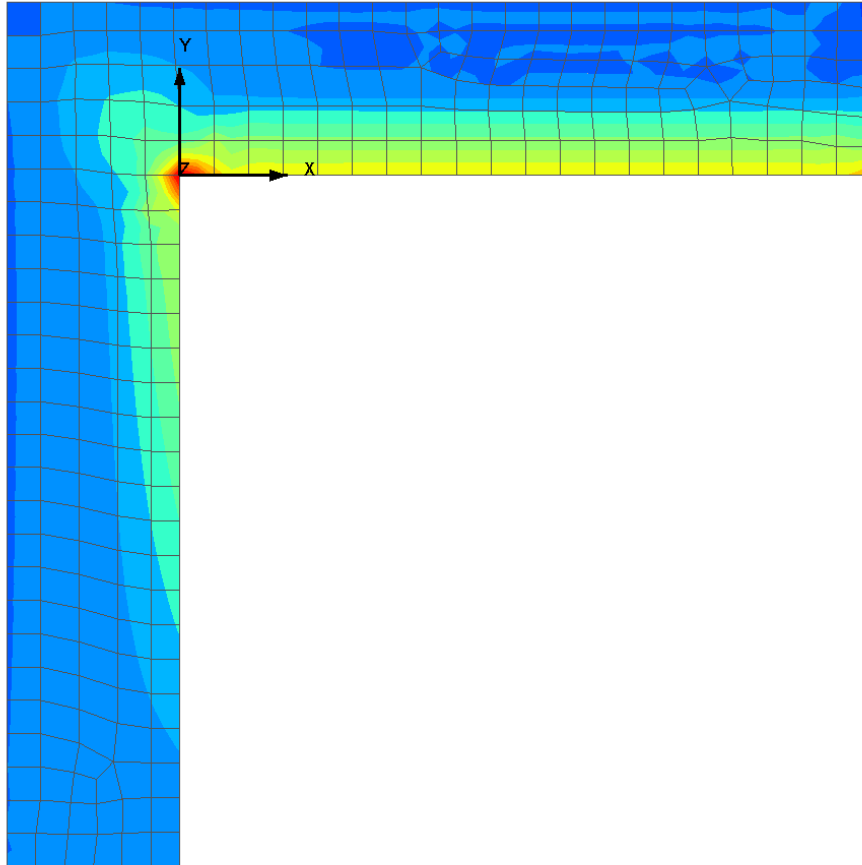
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	3	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 1 mm mesh size

Model : Angle  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 272.1  
Minimum = -42.0

29/12/2016  
05:10:31



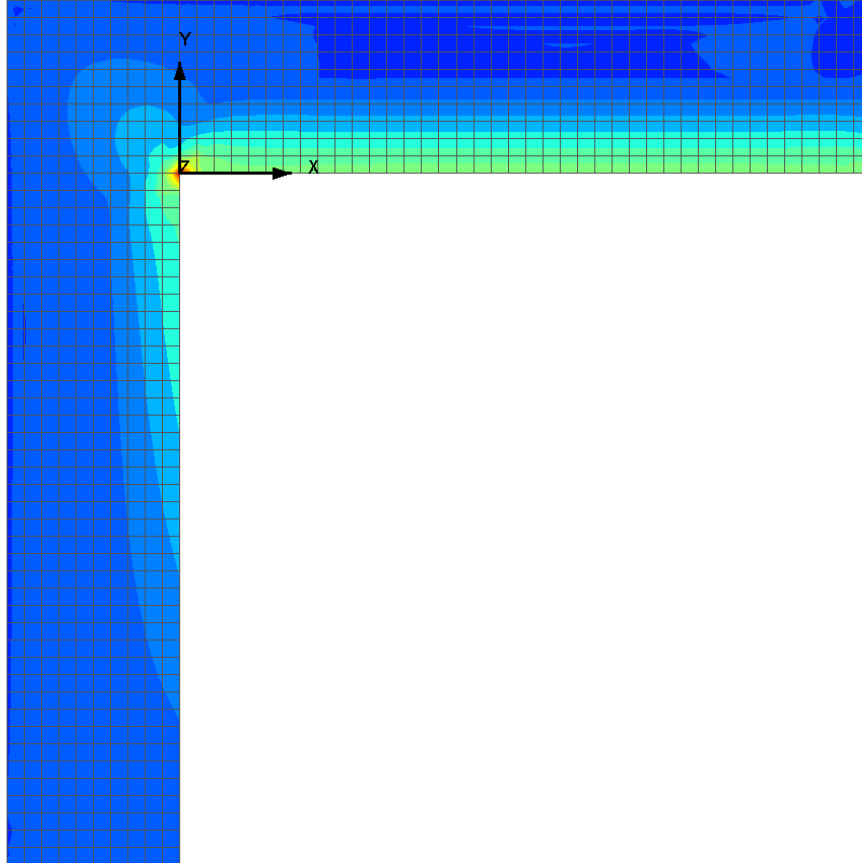
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	4	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0.5 mm mesh size

Model : Angle  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 386.8  
Minimum = -45.5

29/12/2016  
05:11:31



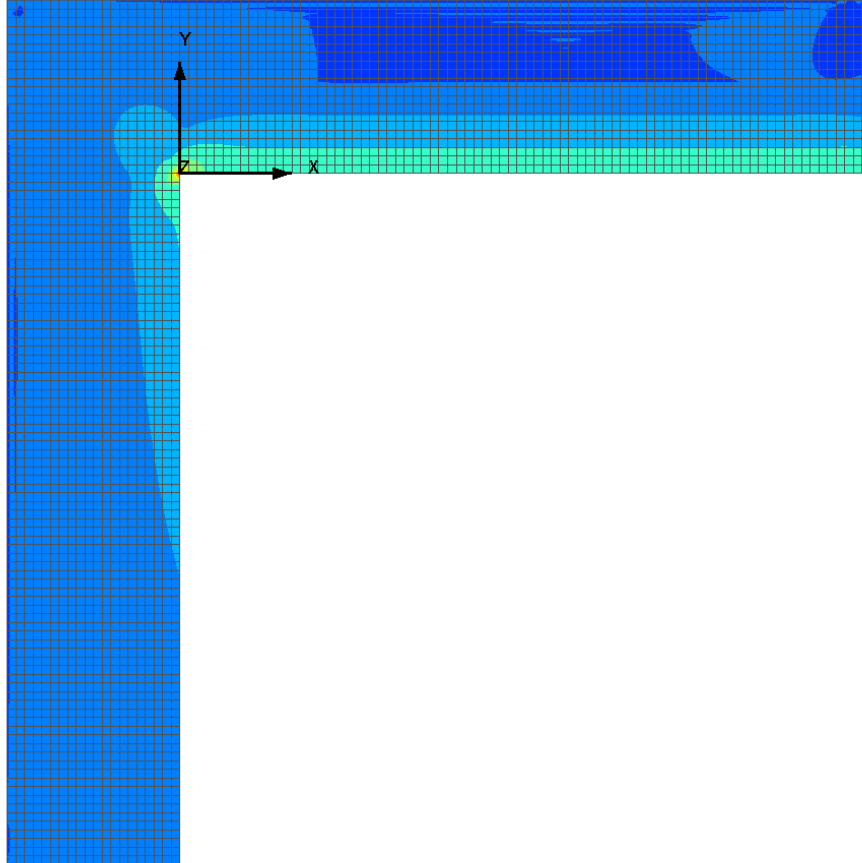
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	5	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0.25 mm mesh size

Model : Angle  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 538.2  
Minimum = -52.5

29/12/2016  
05:12:49



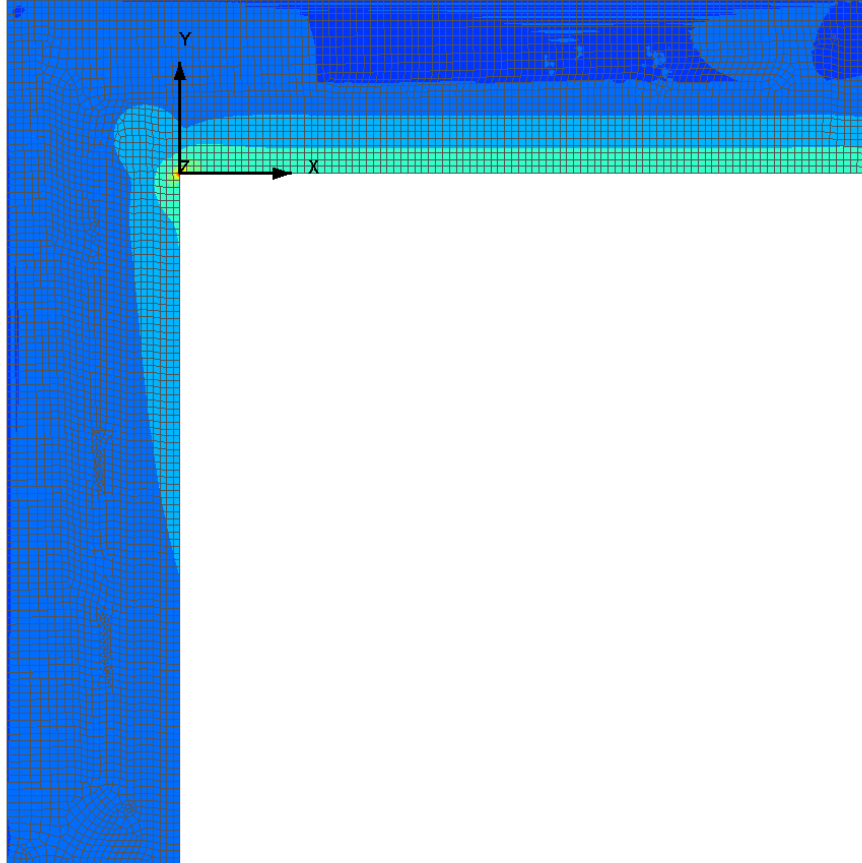
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	6	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0.2 mm mesh size

Model : Angle  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 596.8  
Minimum = -55.7

29/12/2016  
05:14:44



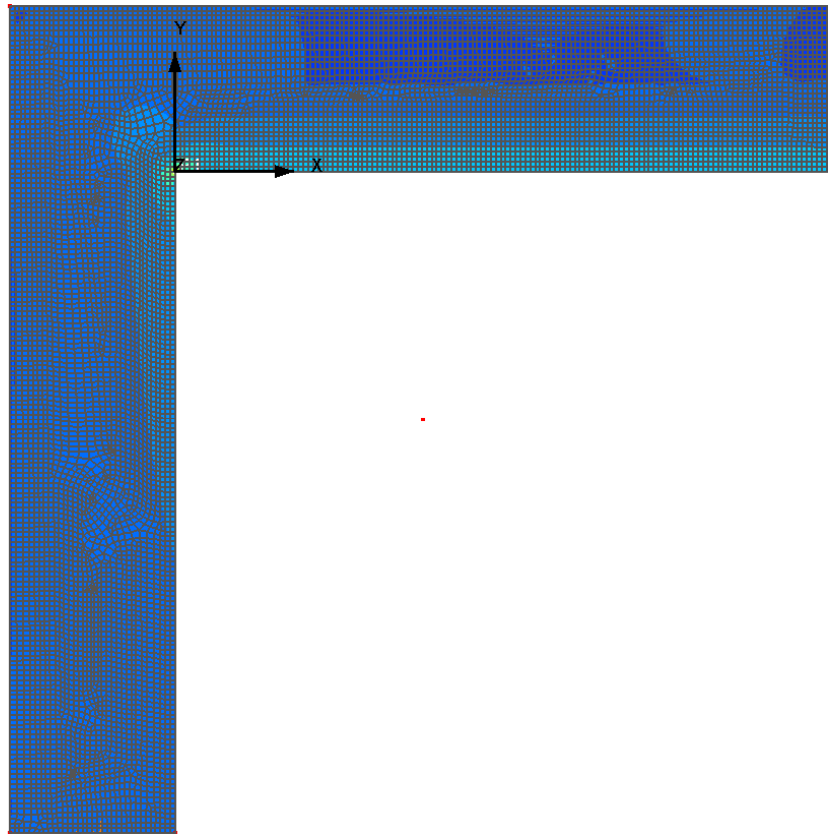
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	7	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0.15 mm mesh size

Model : Angle  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 683.7  
Minimum = -59.6

29/12/2016  
05:34:24



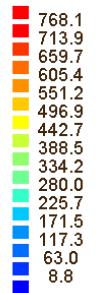
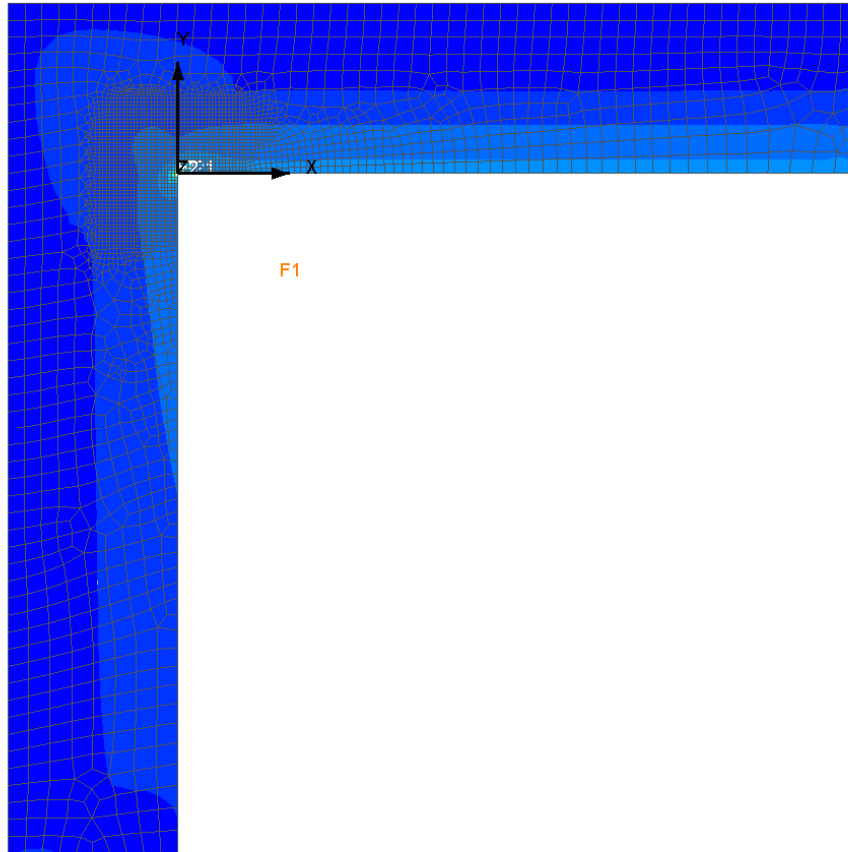
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	8	of	31
		Job	Compiled by				
	/	Andrea Starnini					

## 0.10 mm mesh size (local refinement) - local mesh size 1/5 of global mesh size


Model : Angle-2S  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 822.4  
Minimum = -45.5

29/12/2016  
05:48:20





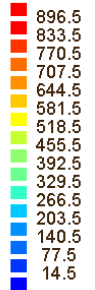
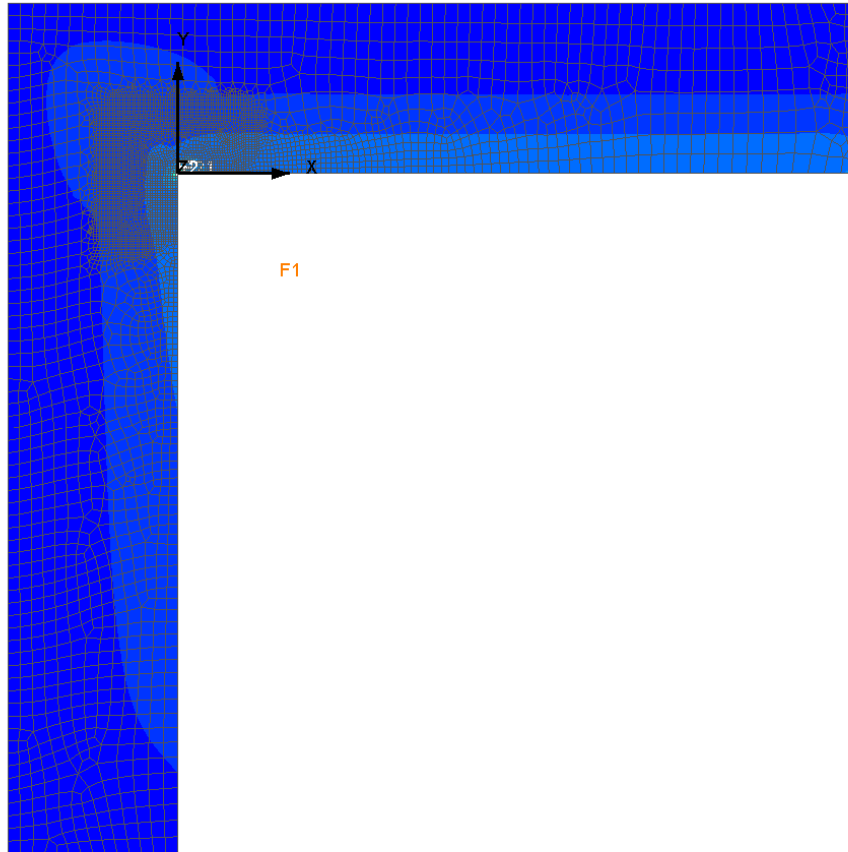
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	9	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0.075 mm mesh size (local refinement) - local mesh size 1/5 of global mesh size

Model : Angle-2S  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 959.5  
Minimum = -48.5

29/12/2016  
05:47:17



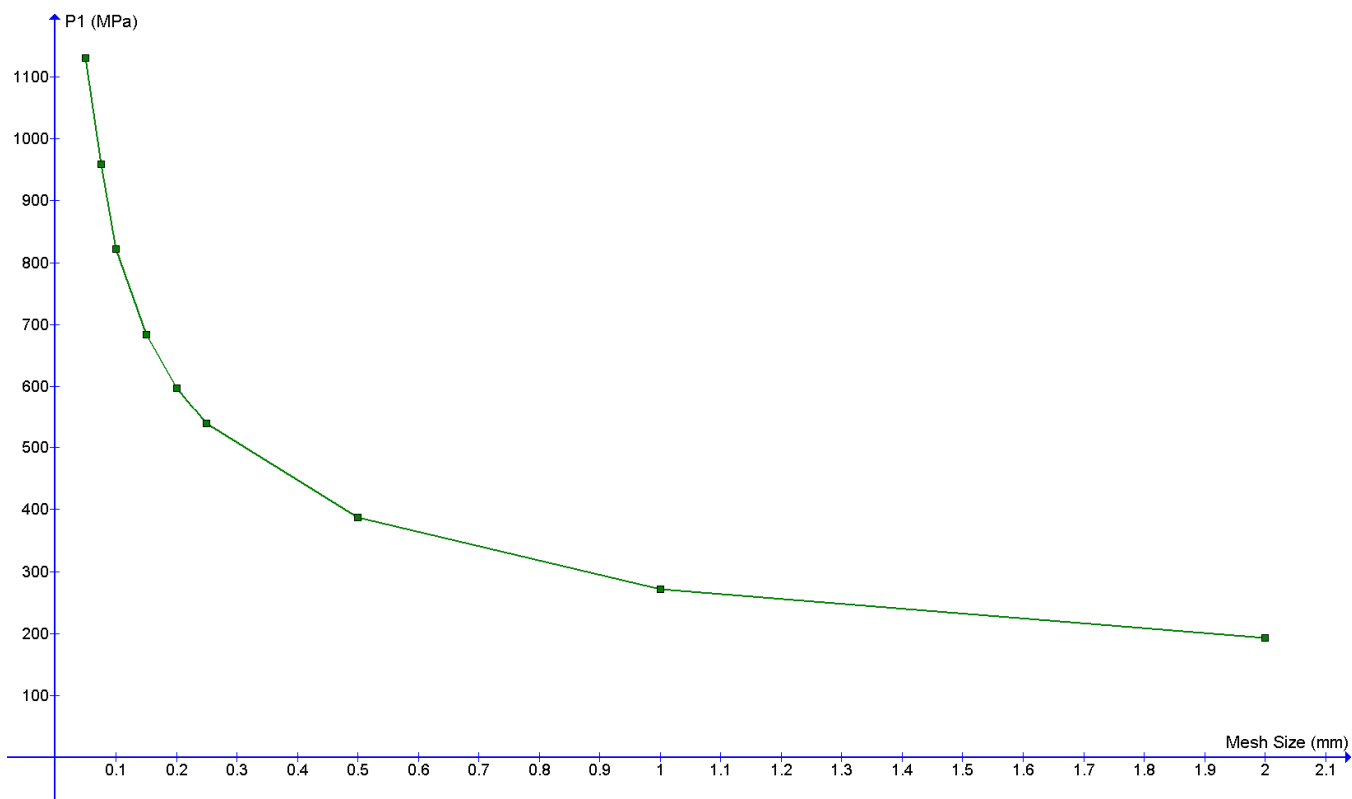
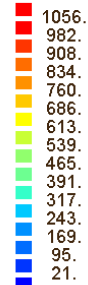
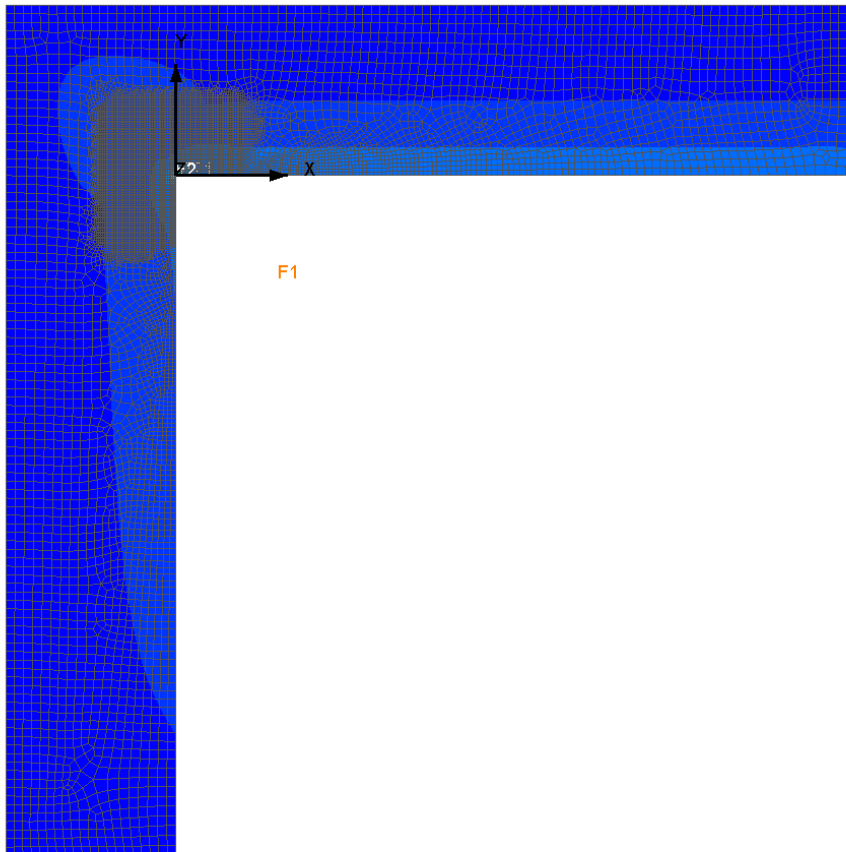
# REPORT

 <b>ing. Andrea Starnini</b>	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	10	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0.050 mm mesh size (local refinement) - local mesh size 1/5 of global mesh size

Model : Angle-2S  
 Case : Force time increment: 1.0000  
 Average Nodal Stress  
 Maximum Principal  
 Maximum = 1130.  
 Minimum = -52.

29/12/2016  
 05:50:34



# REPORT

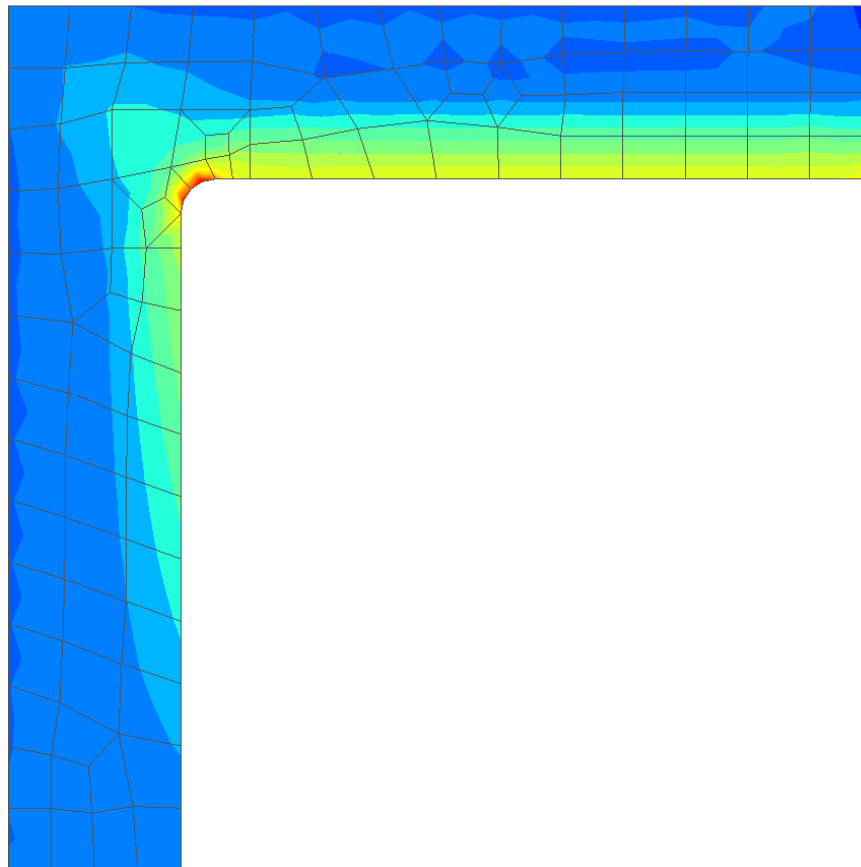
 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	11	of	31
		Job	Compiled by				
	/	Andrea Starnini					

## 4. Results: fillet radius 1 mm


### 2 mm mesh size

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 281.4  
Minimum = -40.6

29/12/2016  
06:34:12



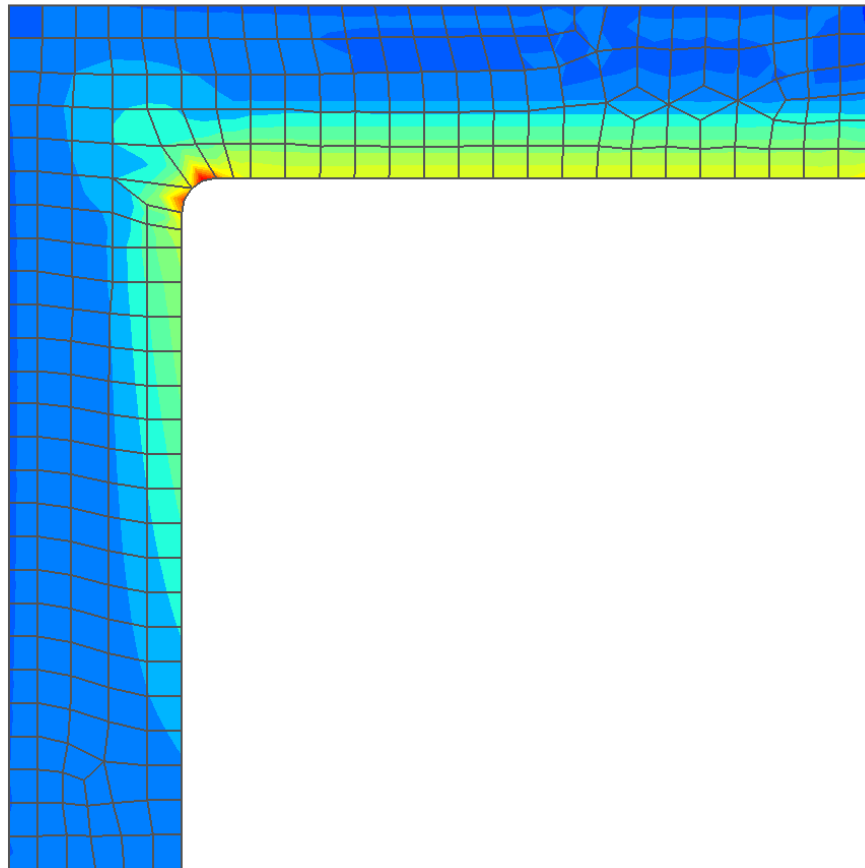
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	12	of	31
		Job	Compiled by				
	/	Andrea Starnini					

## 1 mm mesh size


Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 288.3  
Minimum = -41.9

29/12/2016  
06:10:41



NOTE: This is a free mesh - Not acceptable over the fillet radius

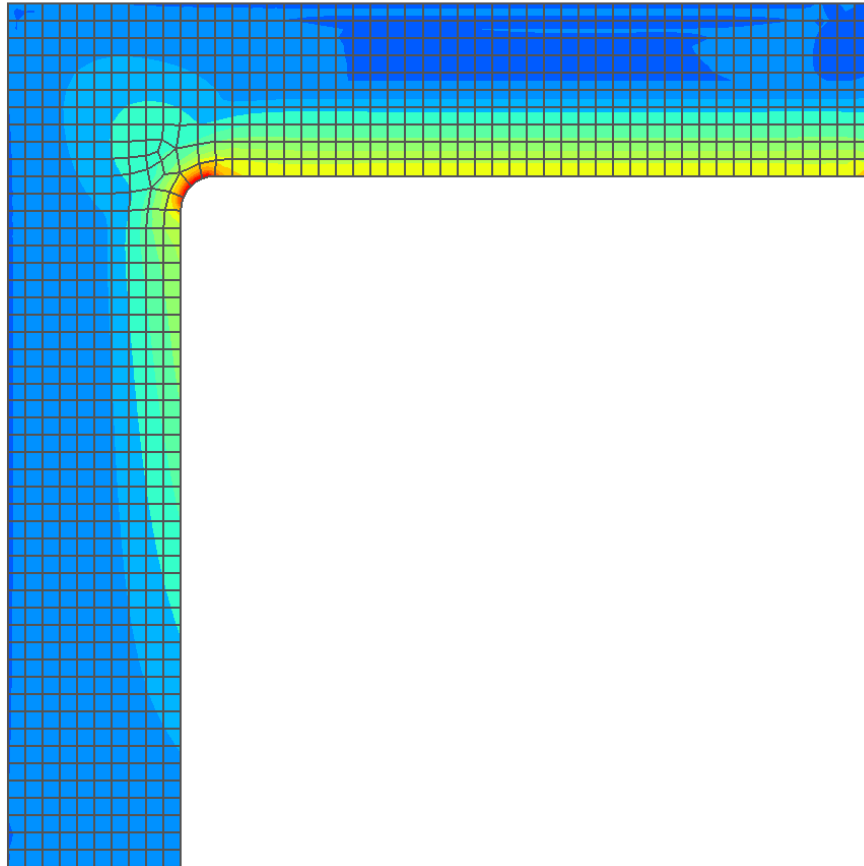
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	13	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0.5 mm mesh size

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 273.6  
Minimum = -45.5

29/12/2016  
06:11:56



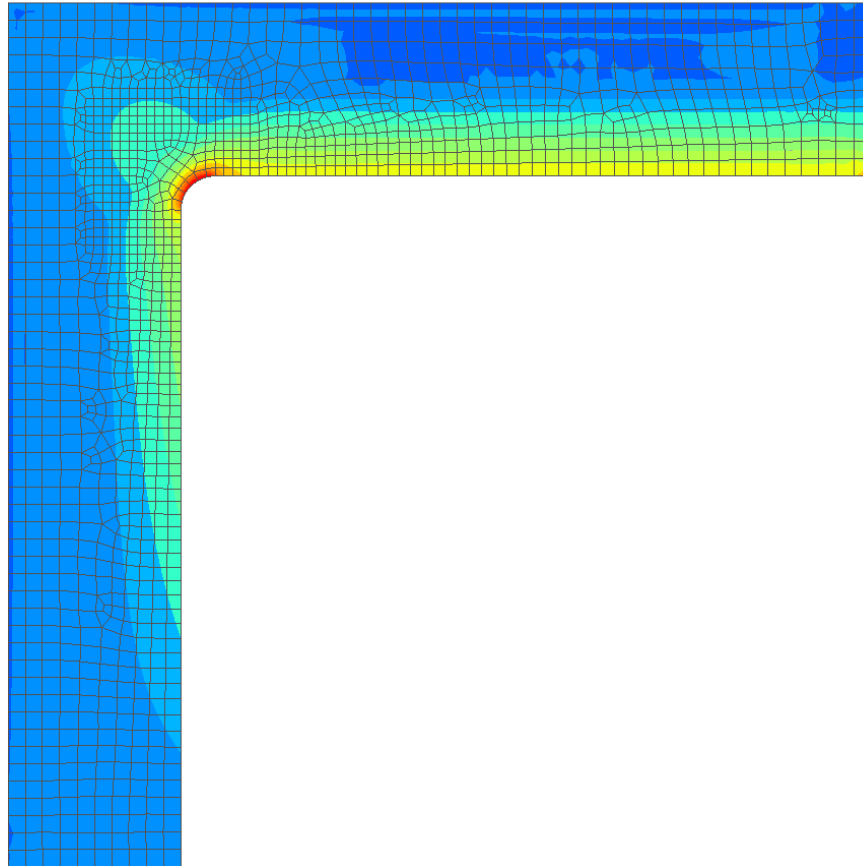
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	14	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0.25 mm mesh size - Local refinement 1/2 of global mesh size

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 270.3  
Minimum = -45.5

29/12/2016  
06:14:15



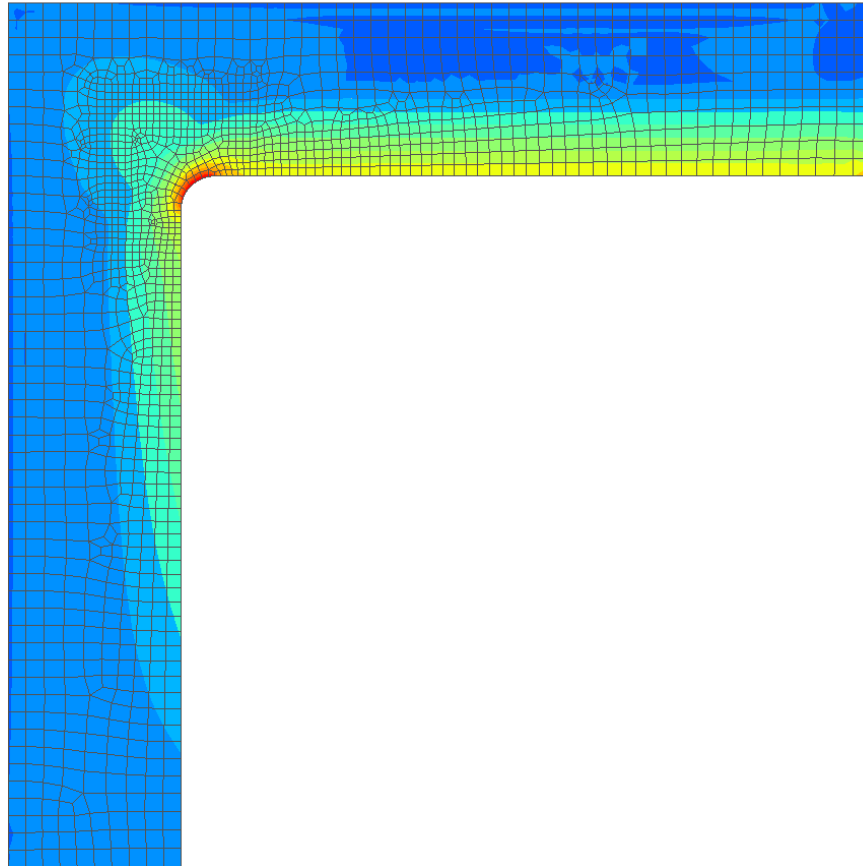
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	15	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0.20 mm mesh size - Local refinement 1/2 of global mesh size

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 269.8  
Minimum = -45.5

29/12/2016  
06:15:06



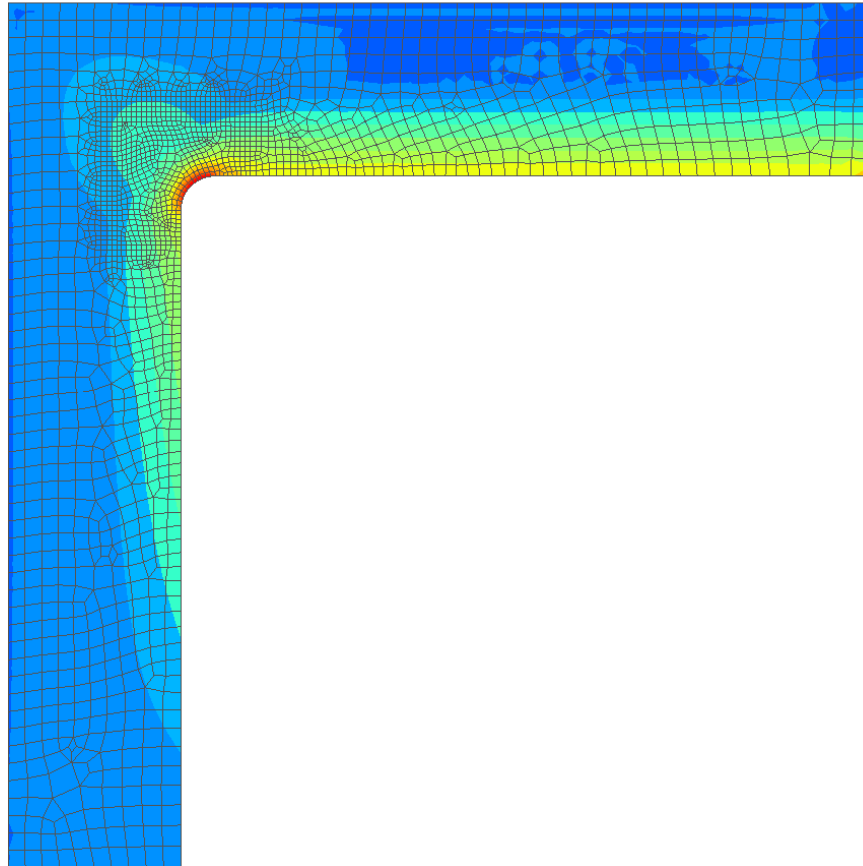
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	16	of	31
		Job	Compiled by				
	/	Andrea Starnini					

## 0.15 mm mesh size - Local refinement 3/10 of global mesh size


Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 269.0  
Minimum = -45.5

29/12/2016  
06:16:26





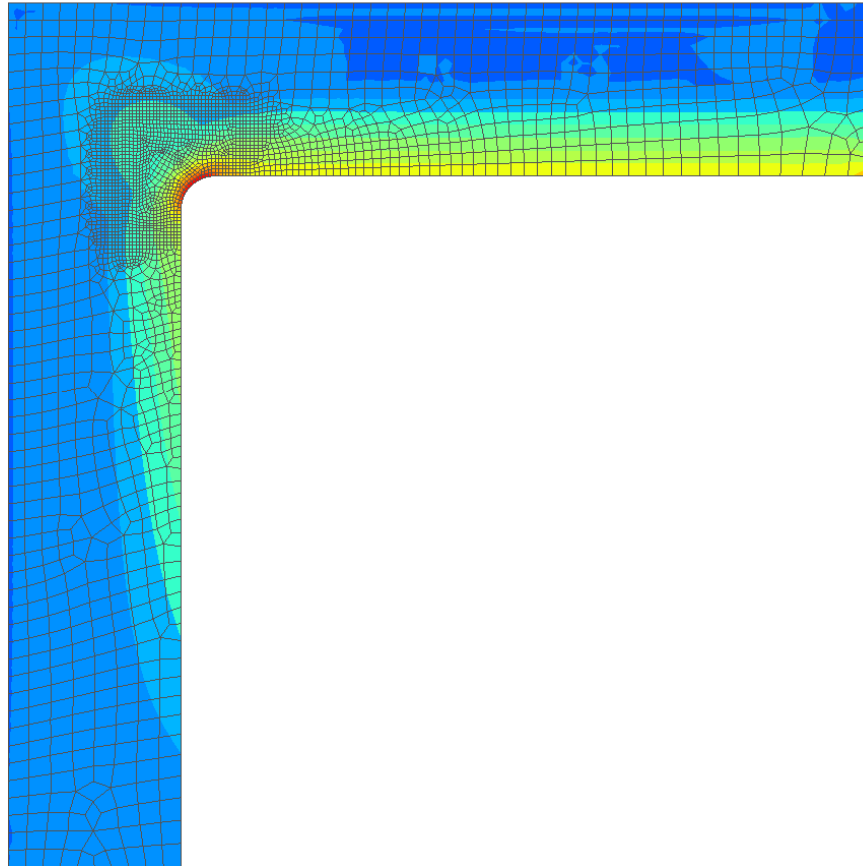
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	17	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0.10 mm mesh size - Local refinement 1/5 of global mesh size

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 268.5  
Minimum = -45.5

29/12/2016  
06:19:03



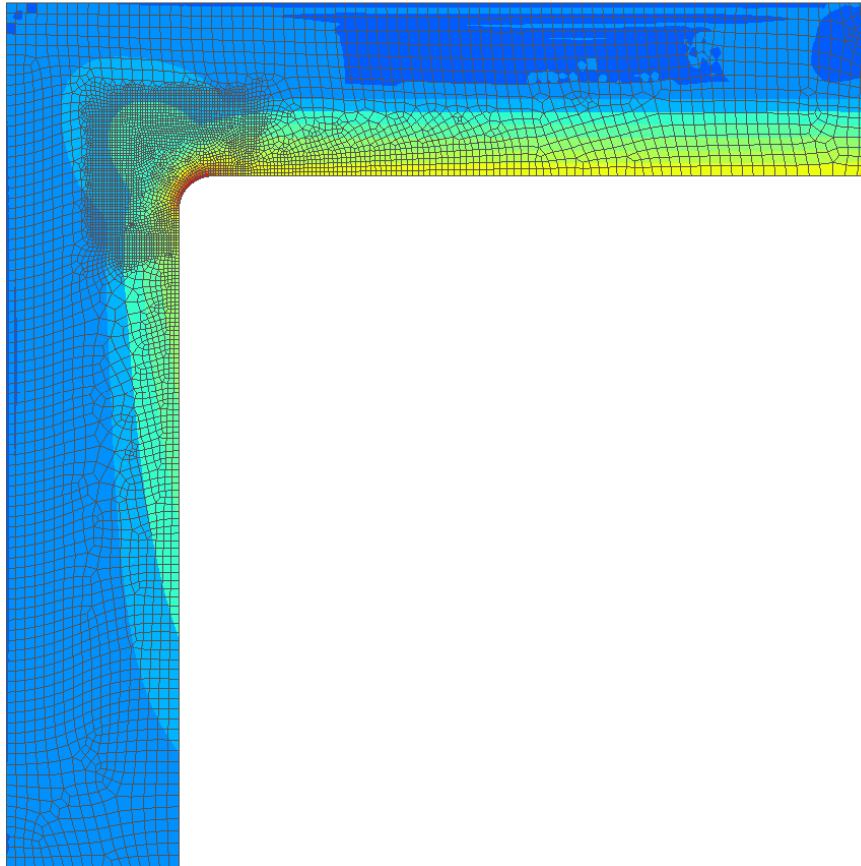
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	18	of	31
		Job	Compiled by				
		/	Andrea Starnini				


## 0.075 mm mesh size - Local refinement 1/4 of global mesh size

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 268.1  
Minimum = -50.3

29/12/2016  
06:23:11



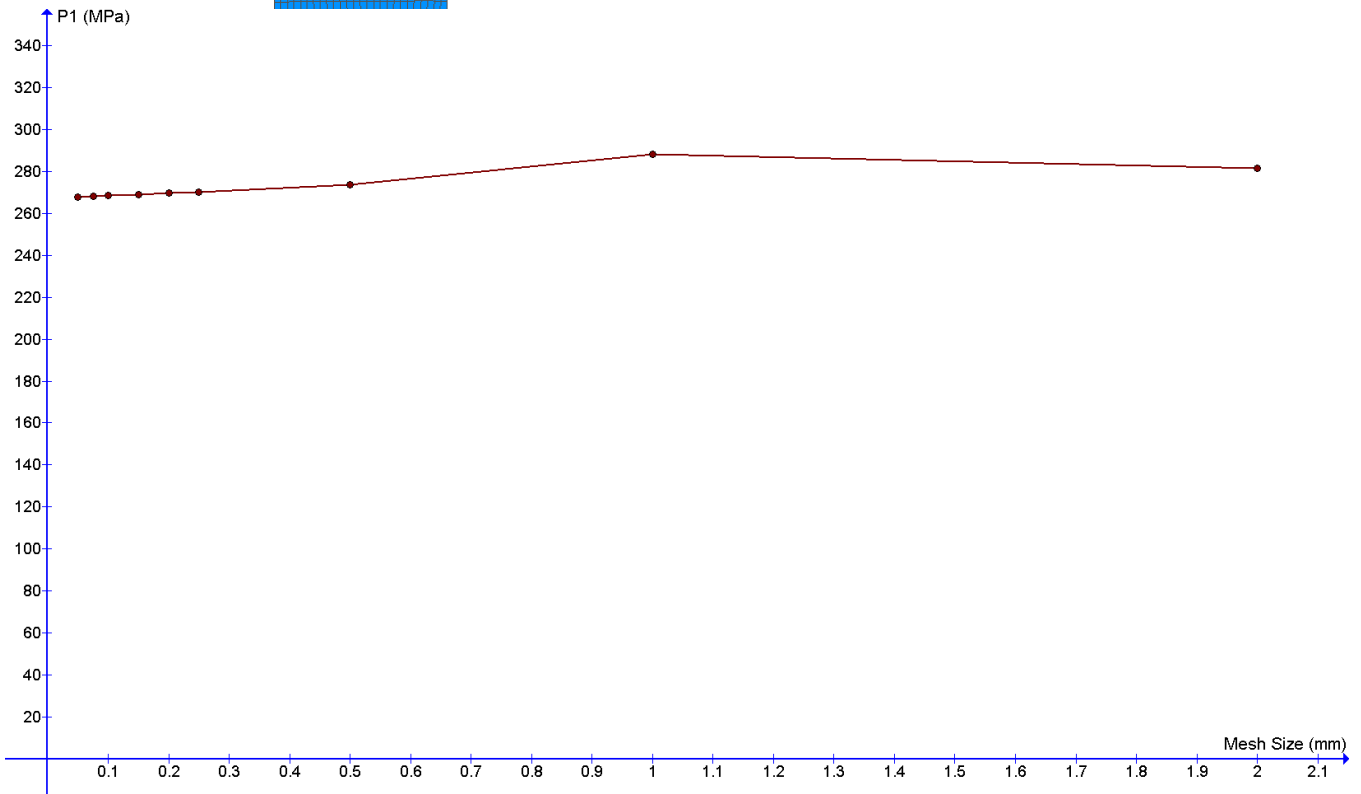
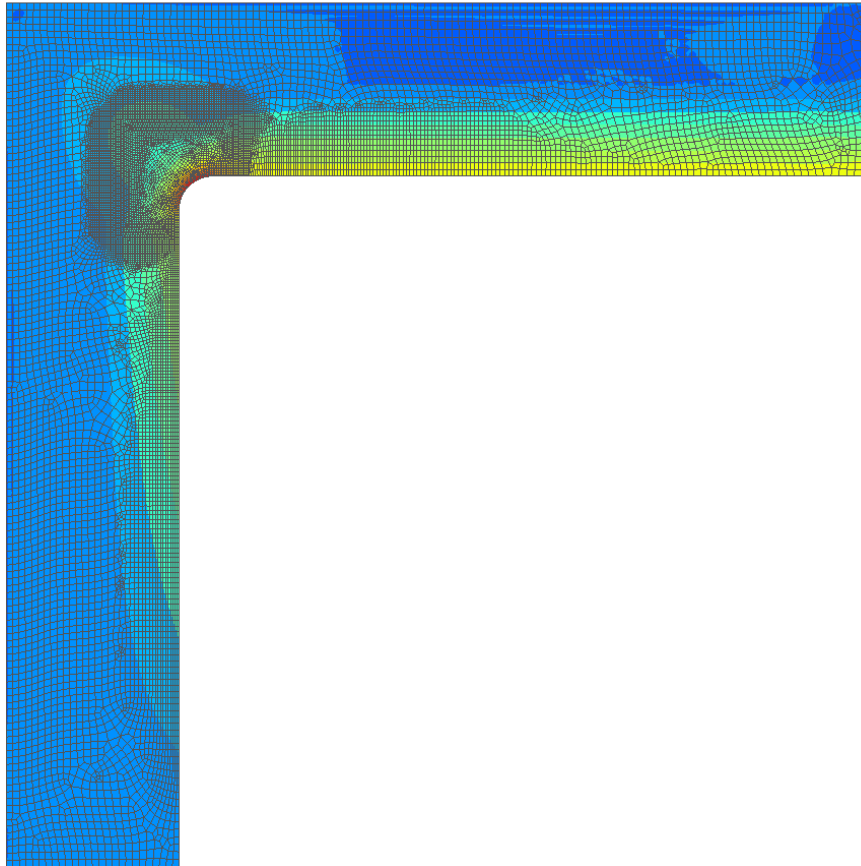
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	19	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0.050 mm mesh size - Local refinement 1/4 of global mesh size

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 268.0  
Minimum = -55.1

29/12/2016  
06:32:23



# REPORT

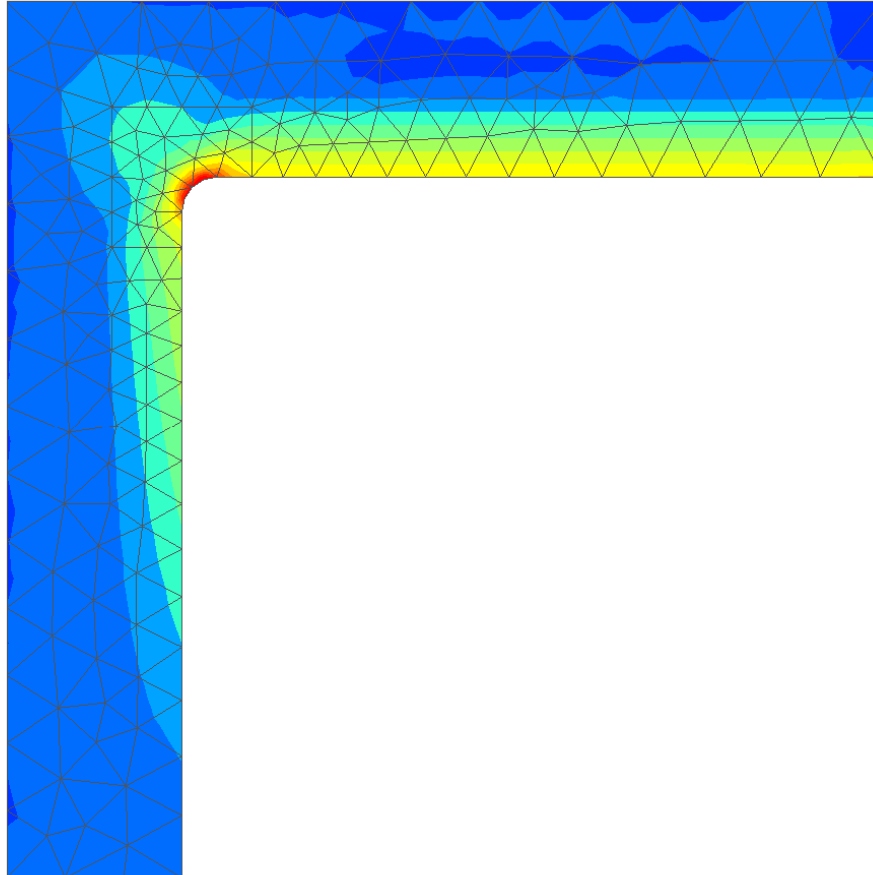
 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	20	of	31
		Job	Compiled by				
	/	Andrea Starnini					

## 5. Triangular elements - Plain stress CPS6


### 2 mm global mesh size (free mesh)

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 256.5  
Minimum = -26.1

29/12/2016  
06:46:49



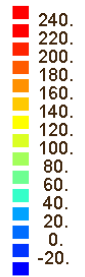
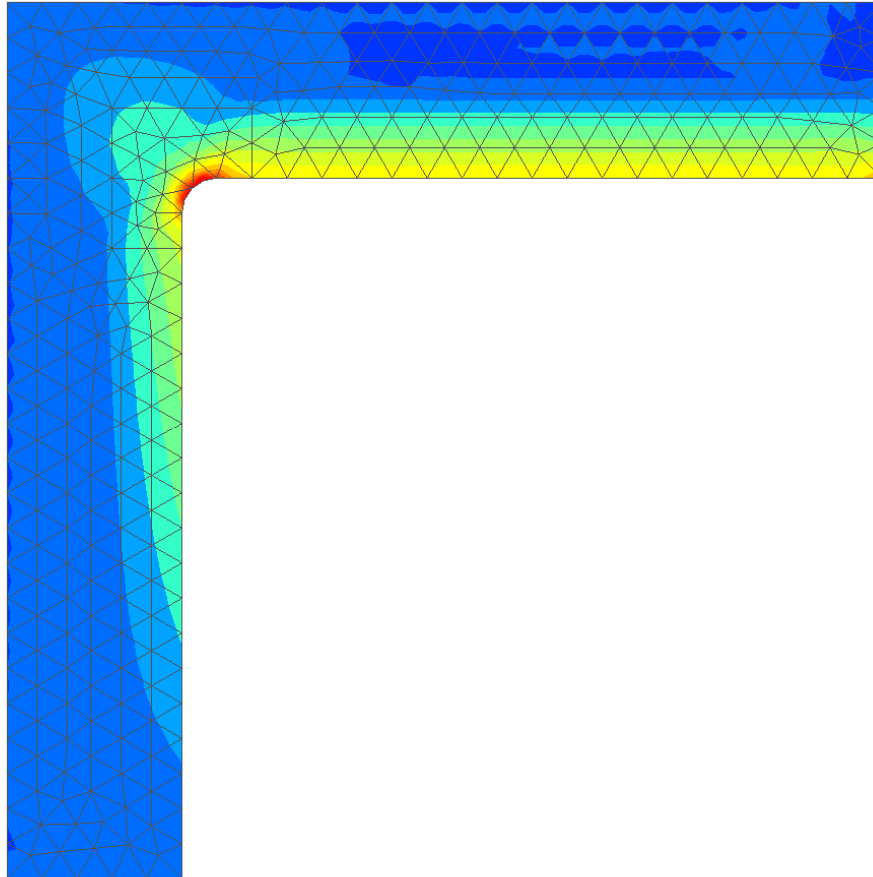
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	21	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 1 mm global mesh size (free mesh)

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 256.6  
Minimum = -29.9

29/12/2016  
06:47:25



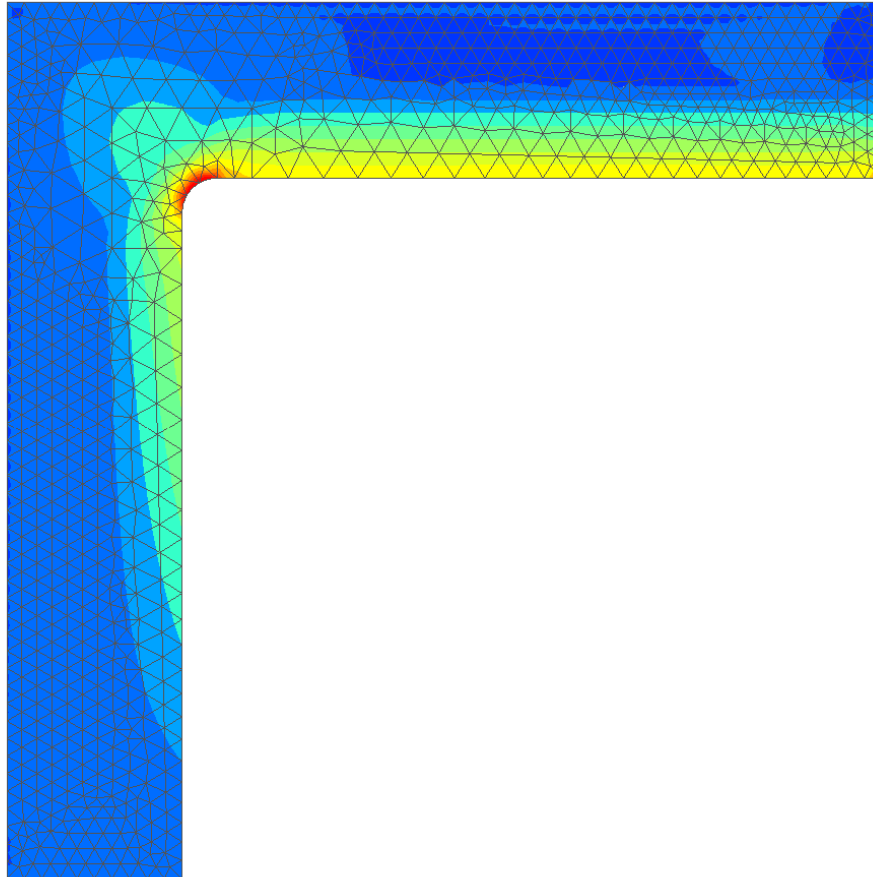
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	22	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0,5 mm global mesh size (free mesh)

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 258.9  
Minimum = -33.9

29/12/2016  
06:49:04



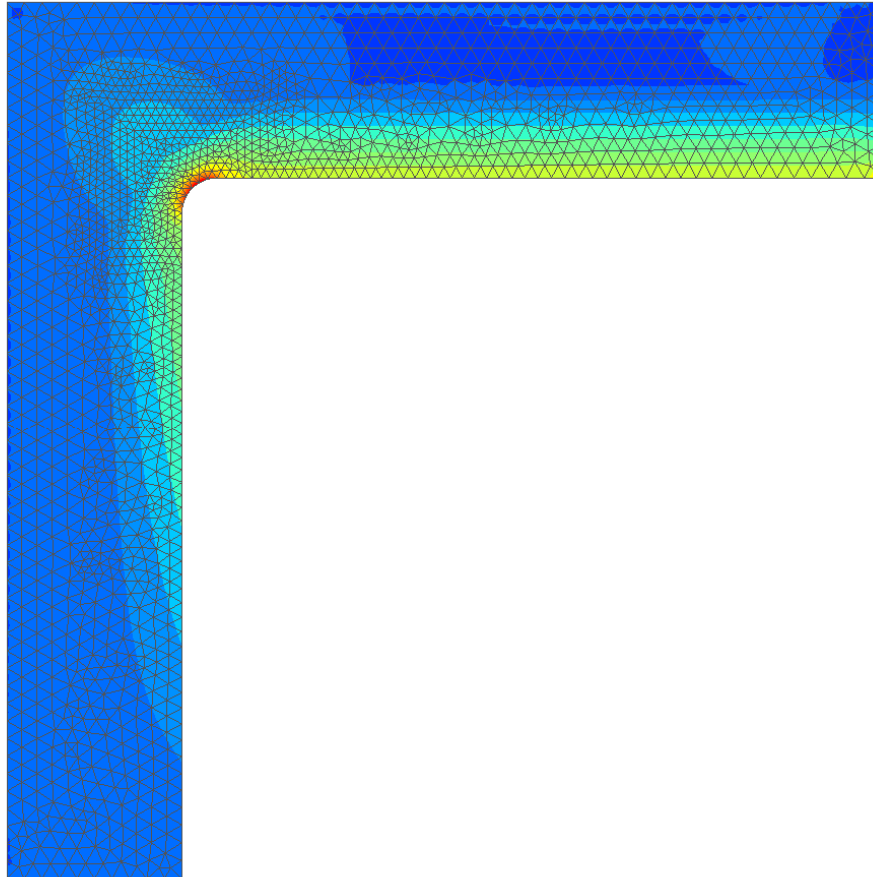
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	23	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0,25 mm local mesh size (free mesh) - 1/2 of global mesh size

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 266.3  
Minimum = -34.0

29/12/2016  
06:50:16



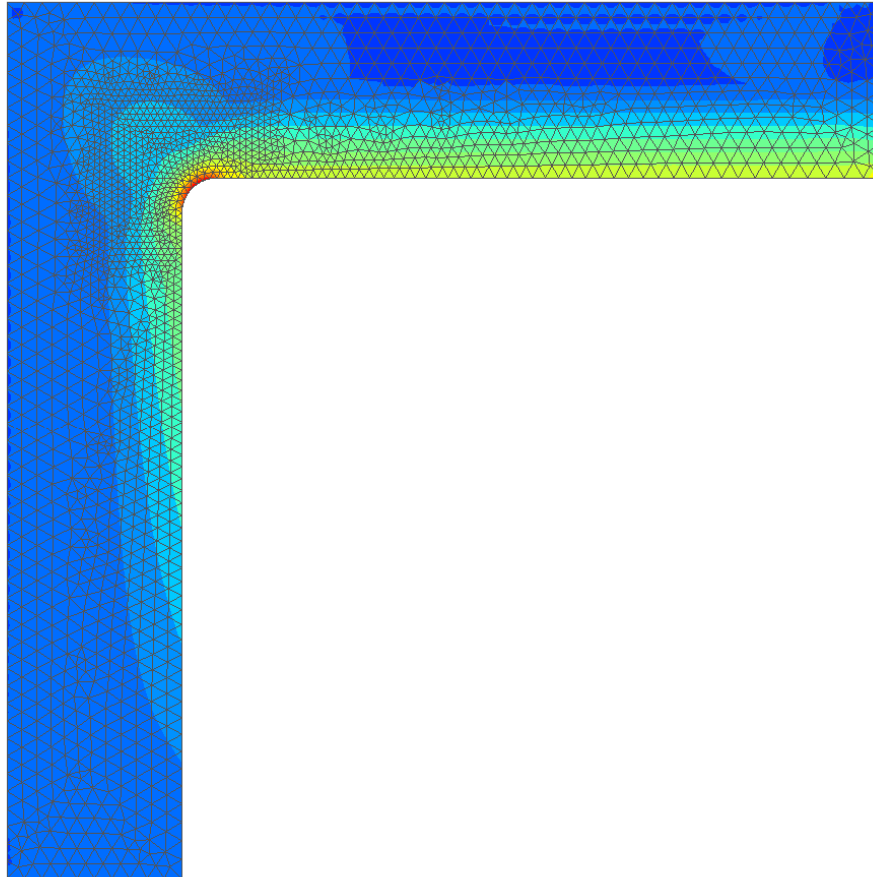
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	24	of	31
		Job	Compiled by				
	/	Andrea Starnini					

## 0,20 mm local mesh size (free mesh) - 2/5 of global mesh size


Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 269.0  
Minimum = -34.0

29/12/2016  
06:51:24





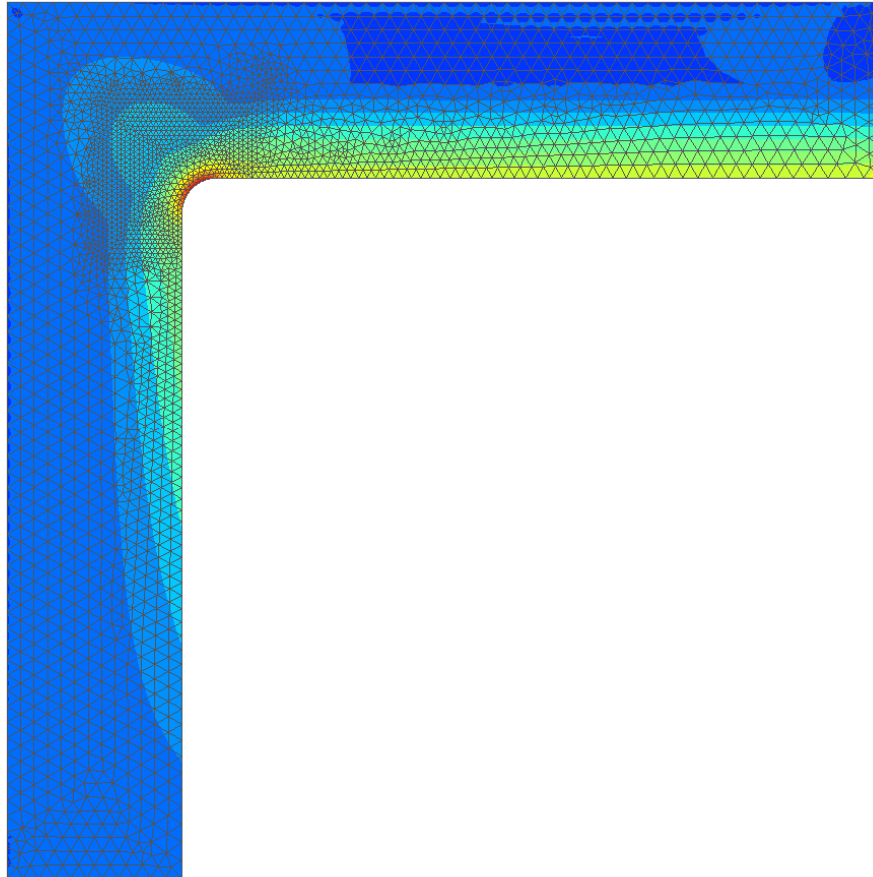
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	25	of	31
		Job	Compiled by				
	/	Andrea Starnini					


## 0,15 mm local mesh size (free mesh) - 1/3 of global mesh size

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 268.3  
Minimum = -34.4

29/12/2016  
06:53:06



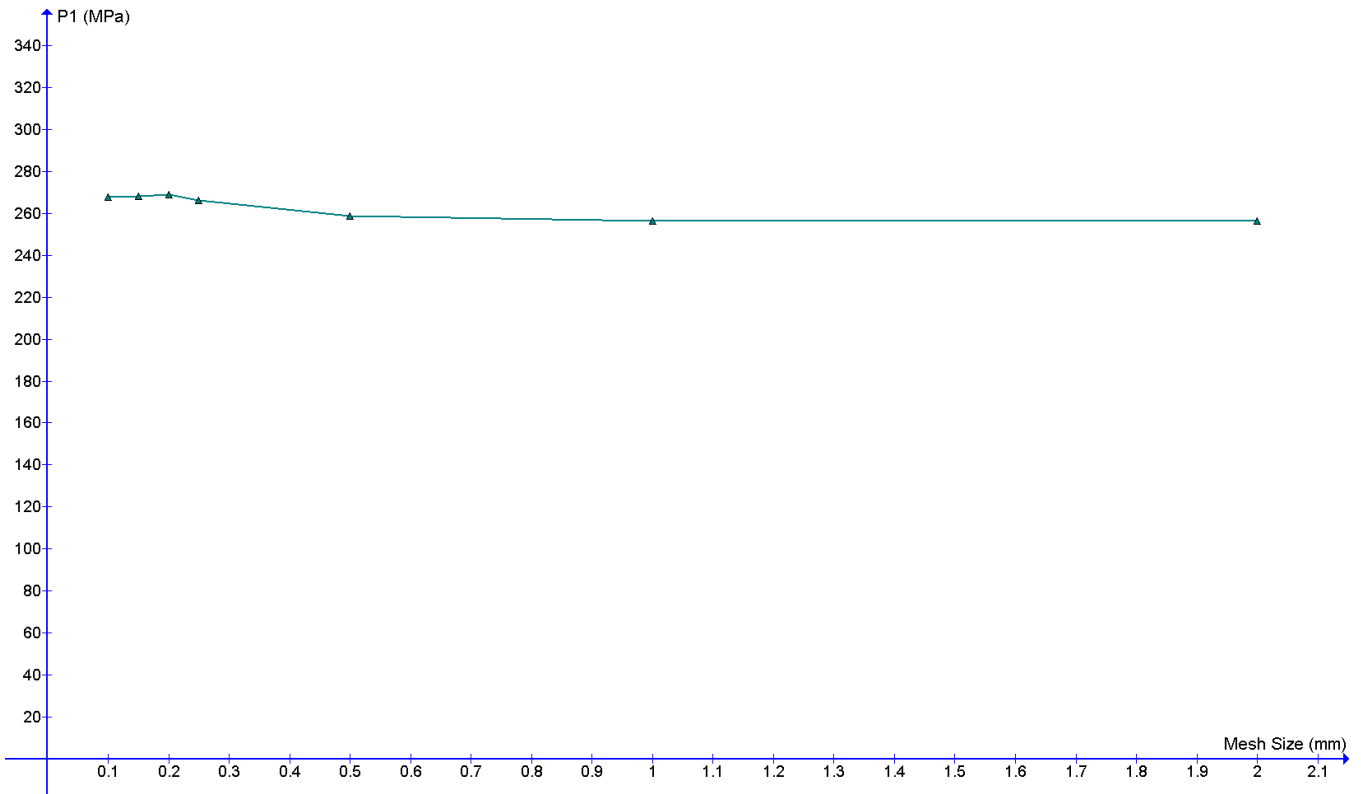
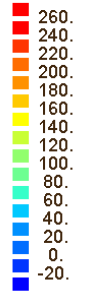
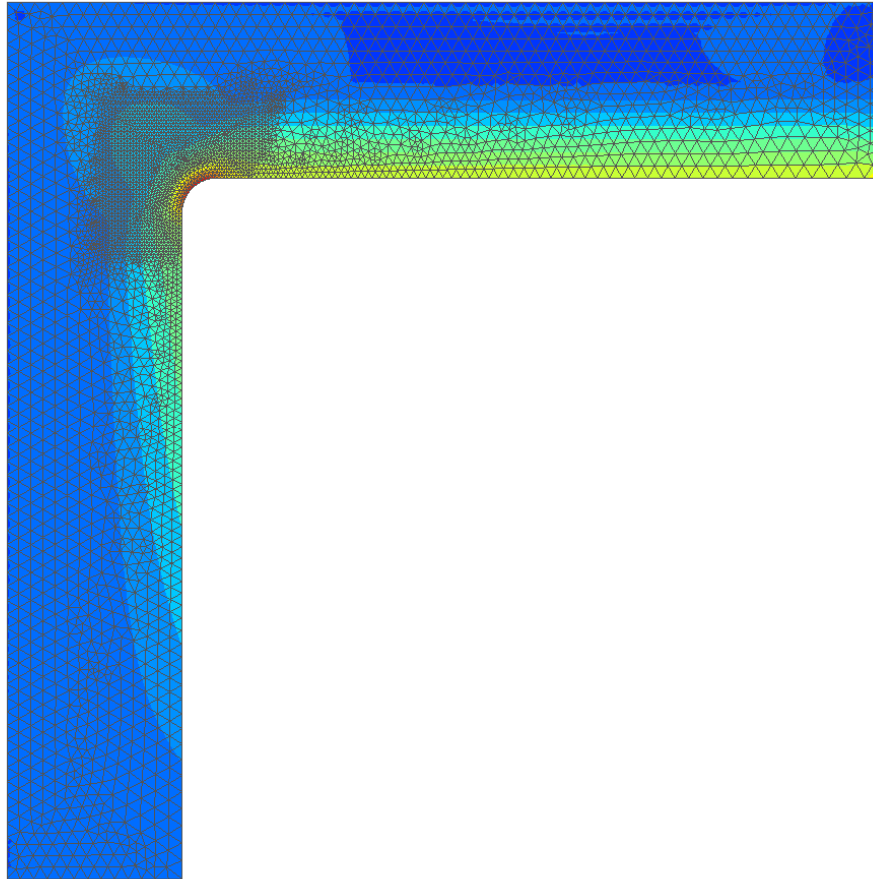
# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	26	of	31
		Job	Compiled by				
	/	Andrea Starnini					

## 0,10 mm local mesh size (free mesh) - 1/4 of global mesh size

Model : Angle-R  
Case : Force time increment: 1.0000  
Average Nodal Stress  
Maximum Principal  
Maximum = 267.7  
Minimum = -35.2

29/12/2016  
06:55:30

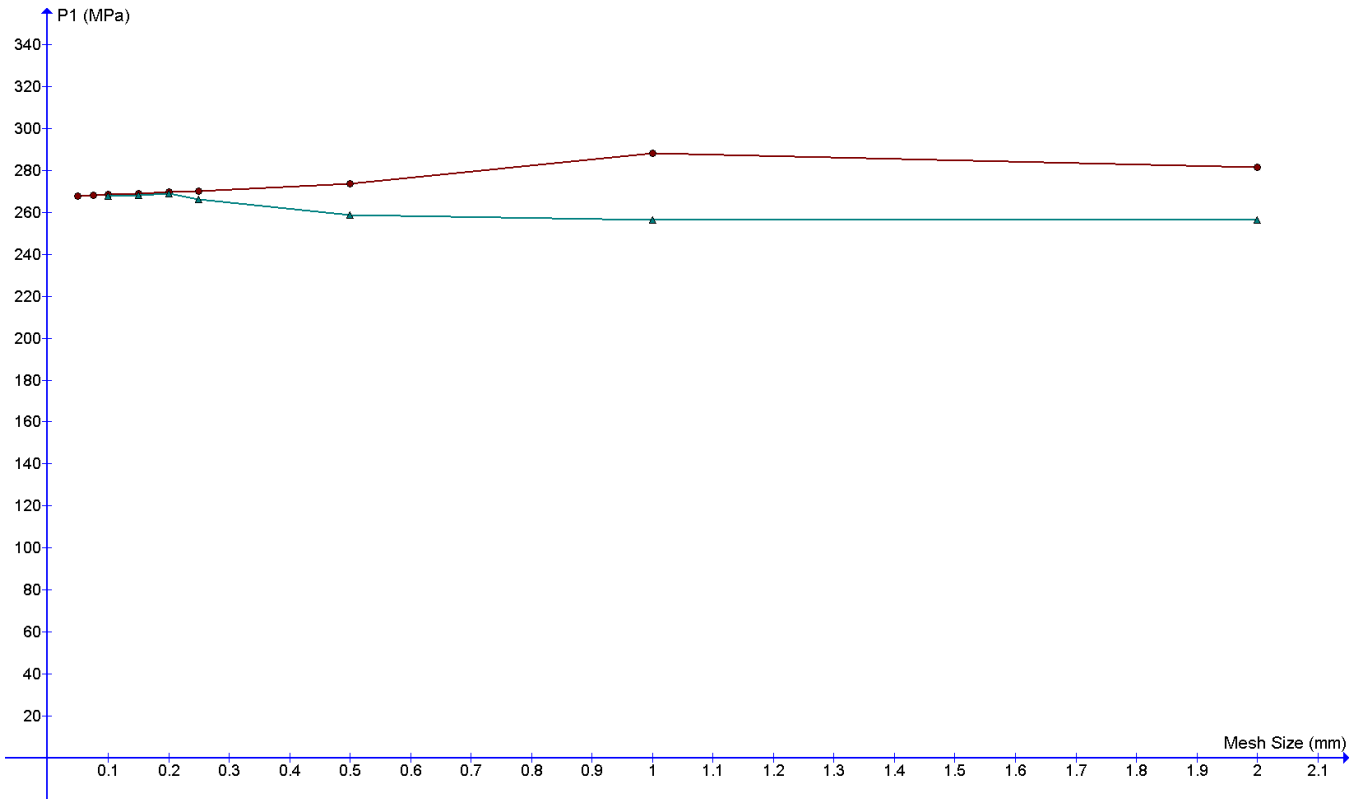


# REPORT




ing. Andrea Starnini

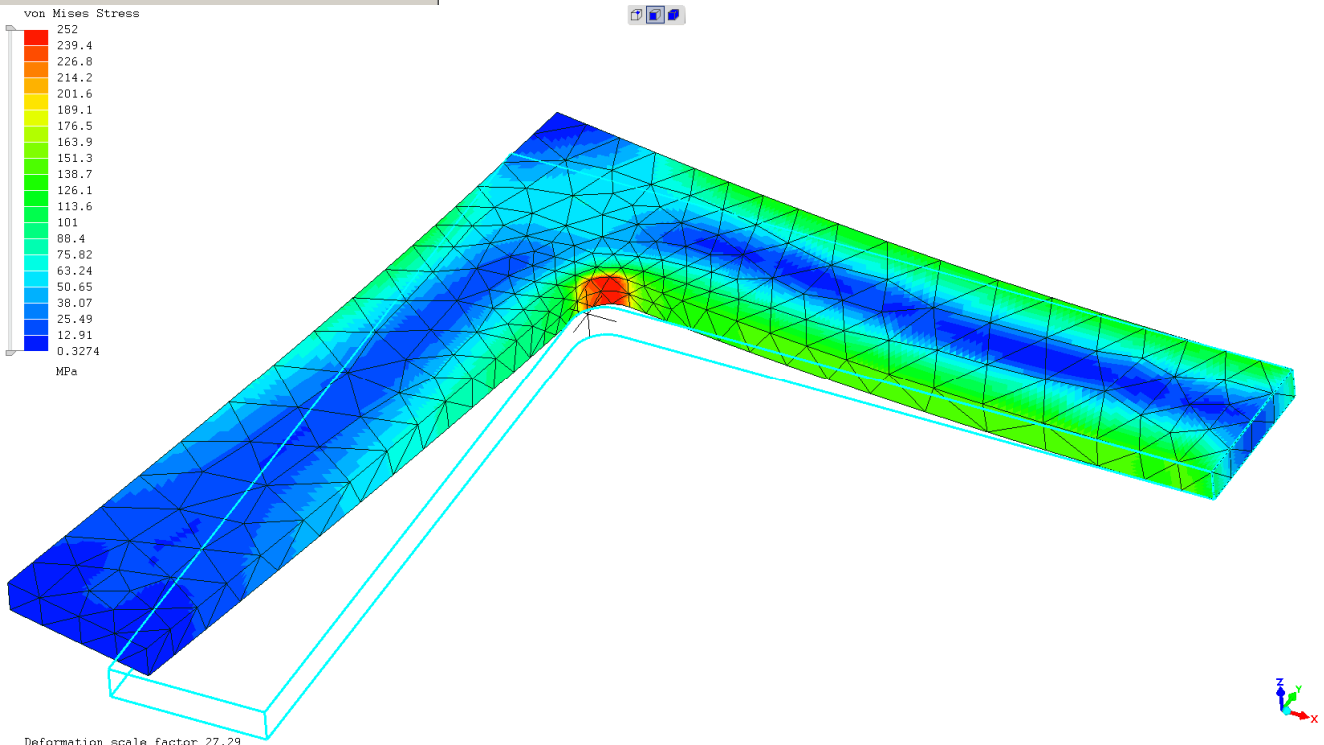
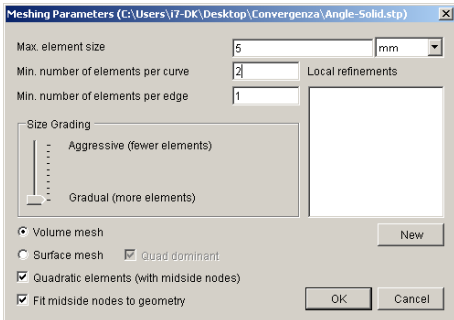
Subject	Report N°	Rev.	Date	Sheet		
Mesh Convergence	/	0	/	27	of	31
	Job	Compiled by				
	/	Andrea Starnini				



# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	28	of	31
		Job	Compiled by				
	/	Andrea Starnini					

## 6. Solid elements C3D10- Free Mesh - Solver CCX



# REPORT



Subject  
Mesh Convergence

Report N°

Rev.

Date

Sheet

Job

Compiled by

/

Andrea Starnini

29 of 31

Meshing Parameters (C:\Users\i7-DK\Desktop\Convergenza\Angle-Solid.stp)

Max. element size: 5 mm

Min. number of elements per curve: 5

Min. number of elements per edge: 1

Local refinements: [Empty box]

Size Grading: [Slider from Aggressive (fewer elements) to Gradual (more elements)]

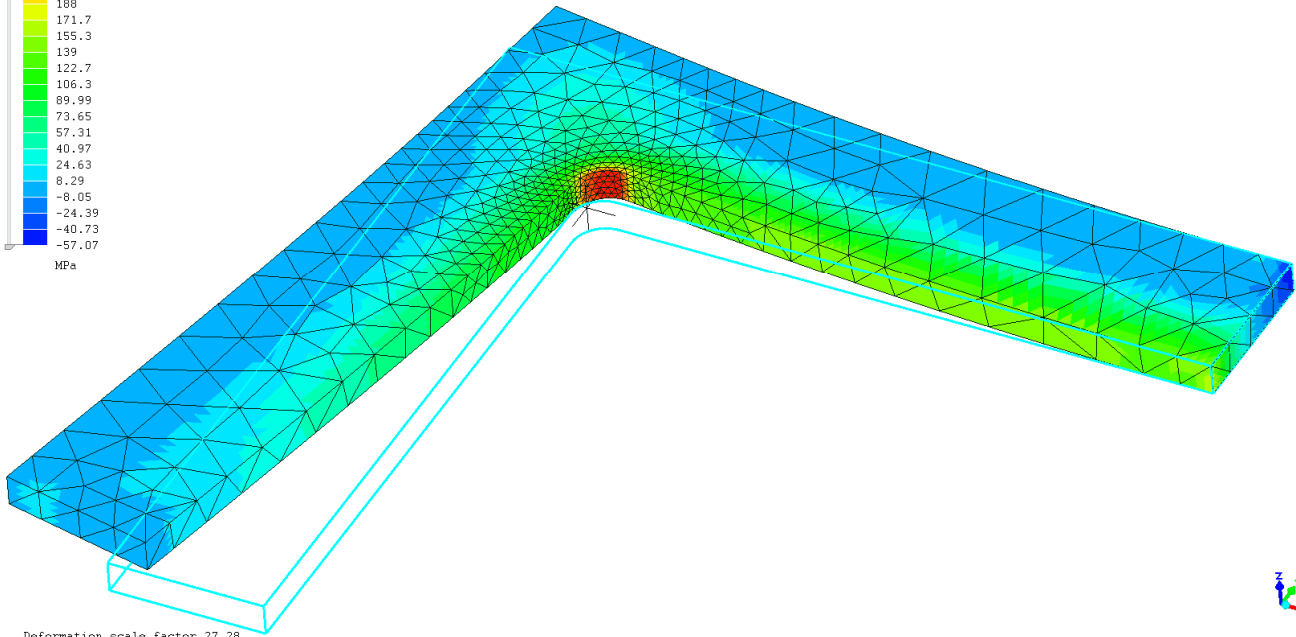
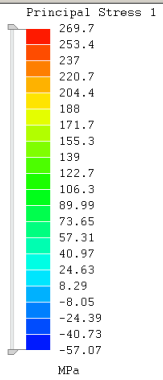
Volume mesh

Surface mesh  Quad dominant


Quadratic elements (with midside nodes)

Fit midside nodes to geometry

Buttons: New, OK, Cancel



# REPORT

 ing. Andrea Starnini	Subject	Report N°	Rev.	Date	Sheet		
	Mesh Convergence	/	0	/	30	of	31
		Job	Compiled by				
	/	Andrea Starnini					

Meshing Parameters (C:\Users\i7-DK\Desktop\Convergenza\Angle-Solid.stp)

Max. element size: 5 mm

Min. number of elements per curve: 10 Local refinements

Min. number of elements per edge: 2

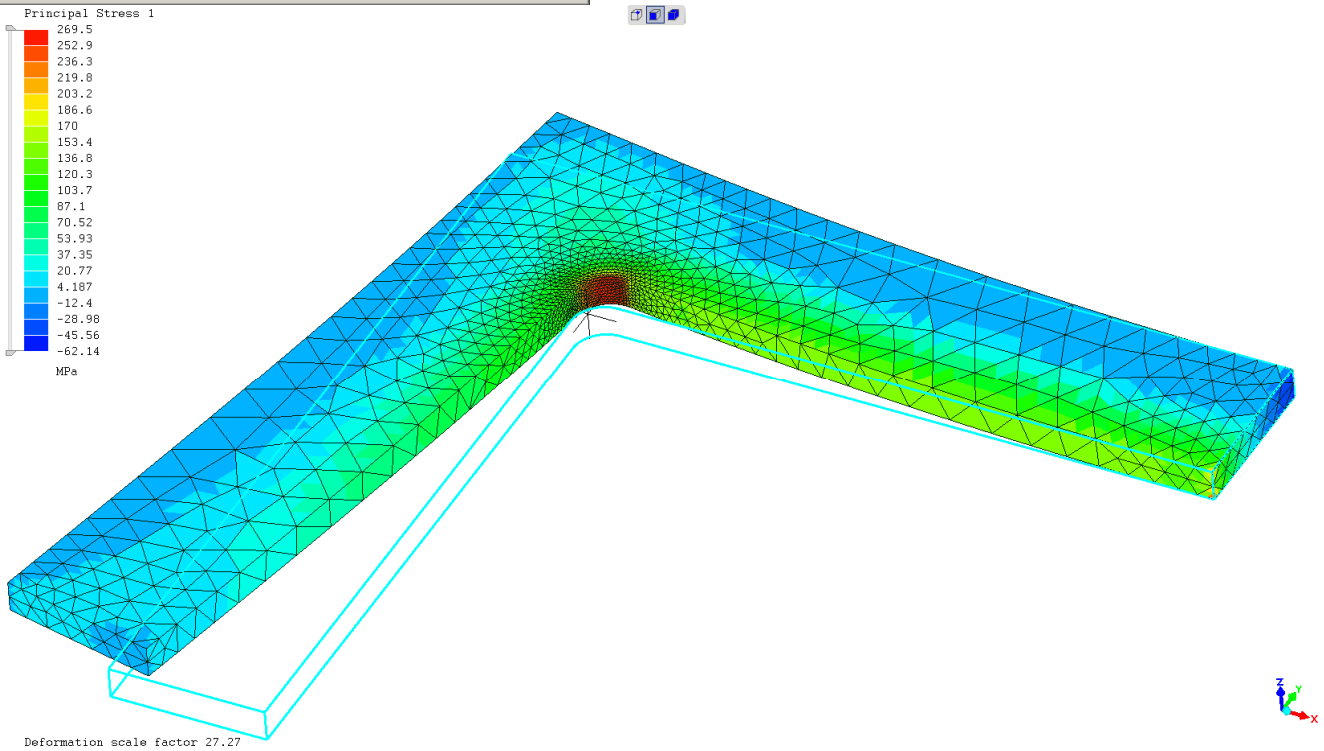
Size Grading: Aggressive (fewer elements) / Gradual (more elements)

Volume mesh  Surface mesh  Quad dominant

Quadratic elements (with midside nodes)

Fit midside nodes to geometry

Buttons: New, OK, Cancel



# REPORT



Subject  
Mesh Convergence

Report N°

Rev.

Date

Sheet

/

0

/

31

of

31

Job

/

Compiled by

Andrea Starnini

Meshing Parameters (C:\Users\i7-DK\Desktop\Convergenza\Angle-Solid.stp)

Max. element size: 2 mm

Min. number of elements per curve: 5

Min. number of elements per edge: 2

Size Grading: Aggressive (fewer elements) / Gradual (more elements)

Volume mesh  Surface mesh  Quad dominant

Quadratic elements (with midside nodes)

Fit midside nodes to geometry

Buttons: New, OK, Cancel

