



Wydział Mechaniczny Energetyki i Lotnictwa
Zakład Wytrzymałości Materiałów i Konstrukcji



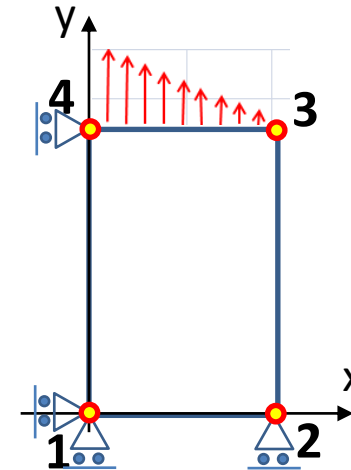
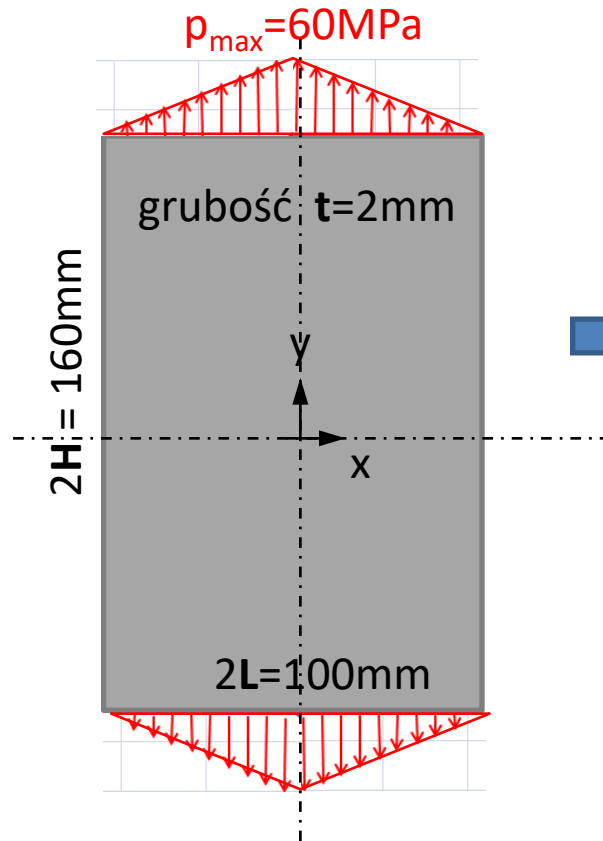
Metoda elementów skończonych (MES1)

Wykład 1f. Tarcza 2D modelowana elementami 4-węzłowymi

(przypomnienie z MES1)

10.2024

Przykład. 2D tarcza model MES z użyciem elementów 4-węzłowych



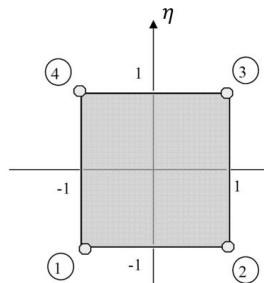
Model ćwiartki tarczy
o jednym elemencie skończonym

wektory współrzędnych węzłowych:

$$[x_i]_1 = [0, L, L, 0]$$

$$[y_i]_1 = [0, 0, H, H]$$

układ współrzędnych naturalnych

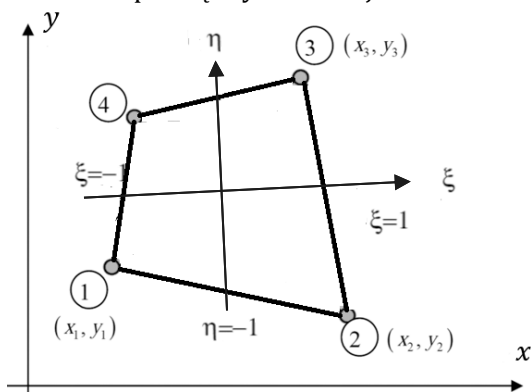


funkcje kształtu elementu i ich pochodne w układzie naturalnym:

$$\begin{aligned}
 N_1(\xi, \eta) &= \frac{1}{4}(1 - \xi)(1 - \eta) \\
 N_2(\xi, \eta) &= \frac{1}{4}(1 + \xi)(1 - \eta) \\
 N_3(\xi, \eta) &= \frac{1}{4}(1 + \xi)(1 + \eta) \\
 N_4(\xi, \eta) &= \frac{1}{4}(1 - \xi)(1 + \eta)
 \end{aligned}$$

i	$N_i(\xi, 1)$
1	0
2	0
3	$\frac{1}{2}(1 + \xi)$
4	$-\frac{1}{2}(1 - \xi)$

układ współrzędnych kartezjańskich



i	$\frac{\partial N_i}{\partial \xi}$	$\frac{\partial N_i}{\partial \eta}$
1	$-\frac{1}{4}(1 - \eta)$	$-\frac{1}{4}(1 - \xi)$
2	$\frac{1}{4}(1 - \eta)$	$-\frac{1}{4}(1 + \xi)$
3	$\frac{1}{4}(1 + \eta)$	$\frac{1}{4}(1 + \xi)$
4	$-\frac{1}{4}(1 + \eta)$	$\frac{1}{4}(1 - \xi)$



$\frac{\partial N_i(\xi, 1)}{\partial \xi}$
$-\frac{1}{4}(1 - 1) = 0$
$\frac{1}{4}(1 - 1) = 0$
$\frac{1}{4}(1 + 1) = \frac{1}{2}$
$-\frac{1}{4}(1 + 1) = -\frac{1}{2}$

$$\{q\} = [k]^{-1} \{F\}$$

4×1 4×4 4×1

F		q	
0		-.012724	u2
0		-.001562	u3
1000	N	.02286	v3
2000	N	.045711	v4

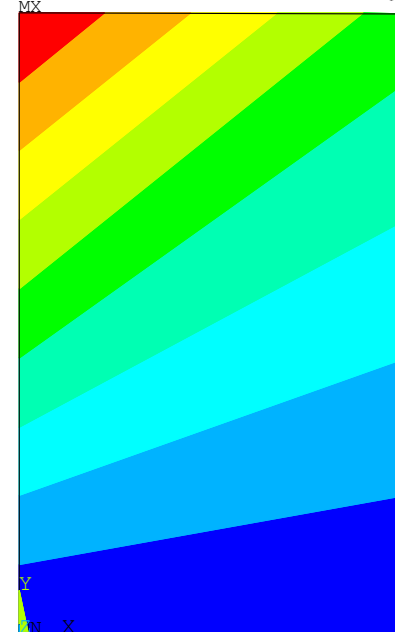
UX displacement



PLOT NO. 1
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.045711
 SMN =-.012724

Dark Blue	-.012724
Blue	-.01131
Light Blue	-.009896
Cyan	-.008483
Green	-.007069
Light Green	-.005655
Yellow	-.004241
Orange	-.002828
Red	-.001414
Dark Red	0

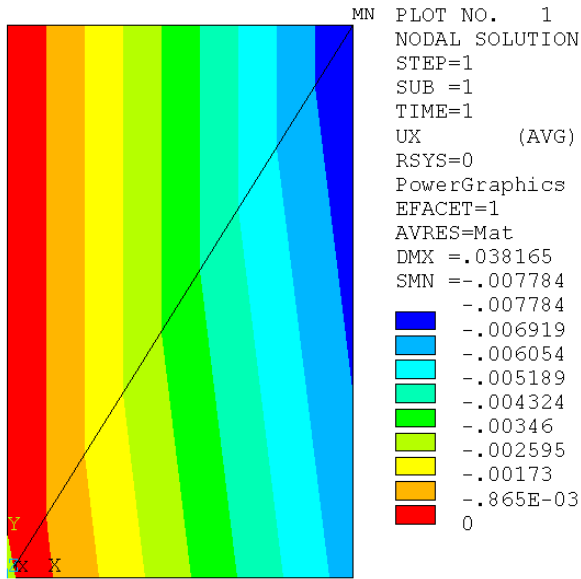
UY displacement



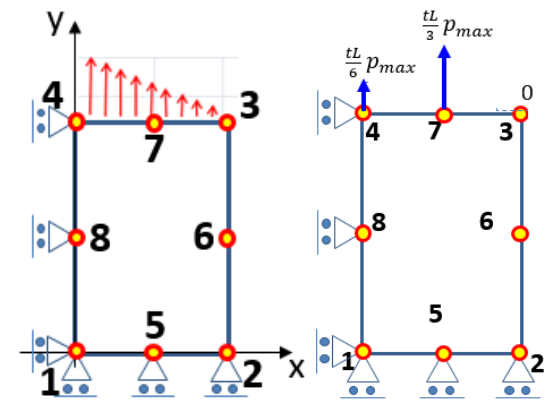
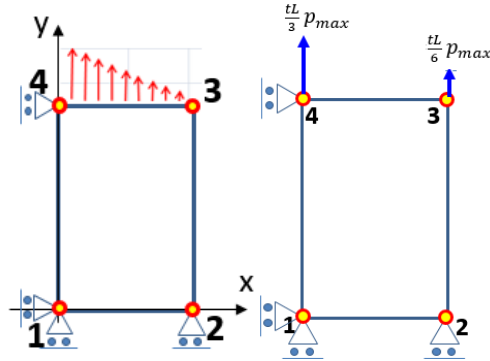
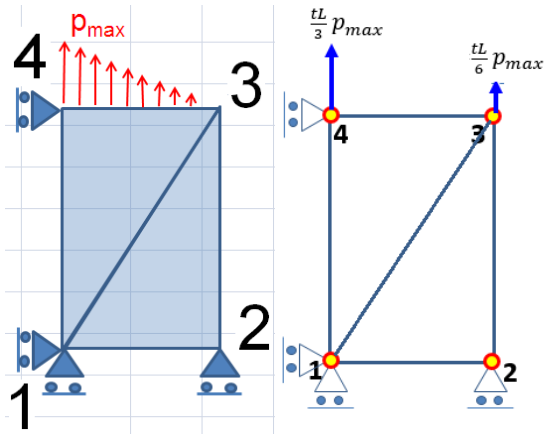
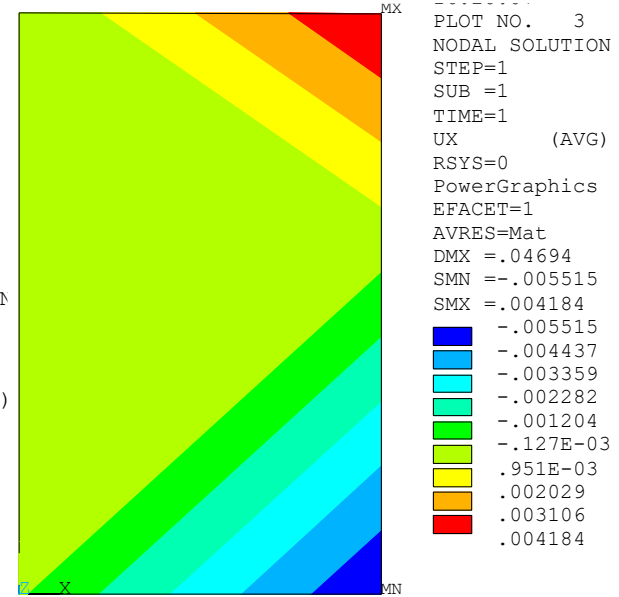
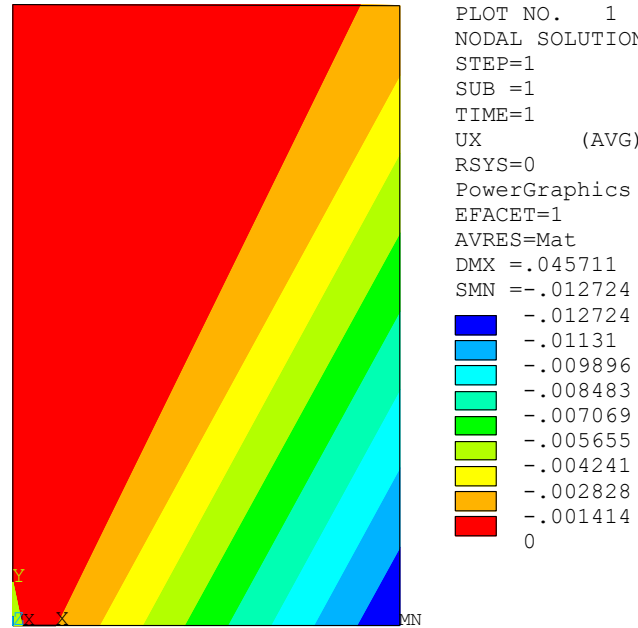
PLOT NO. 2
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.045711
 SMX =.045711

Dark Blue	0
Blue	.005079
Light Blue	.010158
Cyan	.015237
Green	.020316
Light Green	.025395
Yellow	.030474
Orange	.035553
Red	.040632
Dark Red	.045711

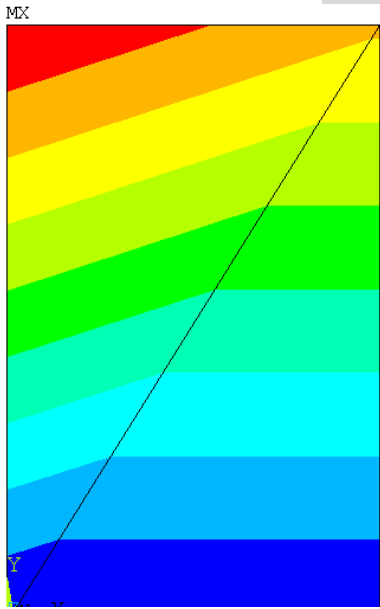
Przemieszczenia na kierunek X



UX displacement



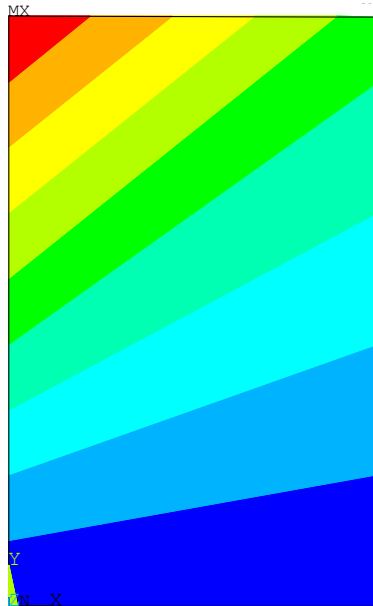
Przemieszczenia na kierunku Y



PLOT NO. 2
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.038165
 SMX =.038165

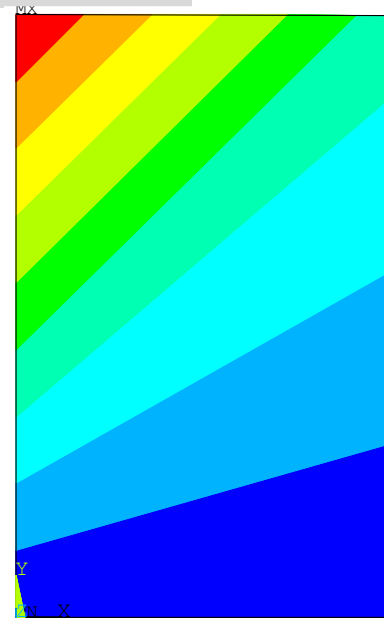
0	.004241
	.008481
	.012722
	.016962
	.021203
	.025444
	.029684
	.033925
	.038165

UY displacement



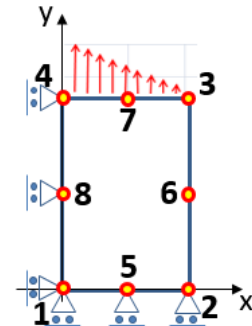
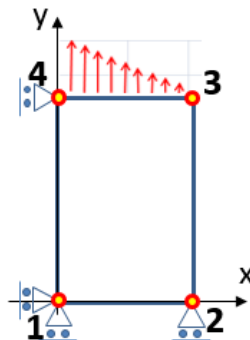
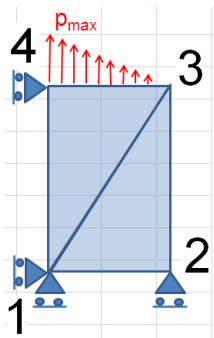
PLOT NO. 2
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.045711
 SMX =.045711

0	.005079
	.010158
	.015237
	.020316
	.025395
	.030474
	.035553
	.040632
	.045711

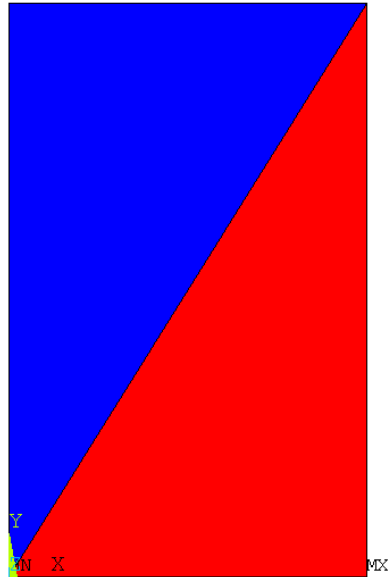


PLOT NO. 4
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.04694
 SMX =.04694

0	.005216
	.010431
	.015647
	.020862
	.026078
	.031293
	.036509
	.041724
	.04694



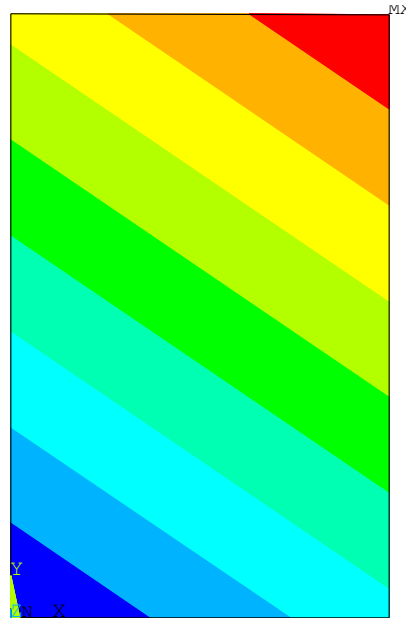
Odształcenia na kierunku X



PLOT NO. 7
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 EPELX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.038165
 SMN =-.156E-03
 SMX =-.130E-03

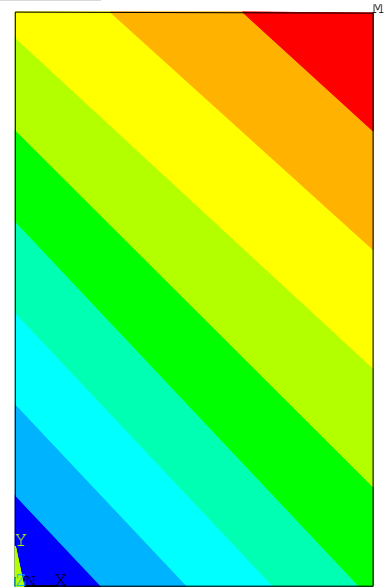
Blue	-.156E-03
Light Blue	-.153E-03
Light Cyan	-.150E-03
Cyan	-.147E-03
Green	-.144E-03
Light Green	-.141E-03
Yellow	-.139E-03
Orange	-.136E-03
Red	-.133E-03
Dark Red	-.130E-03

ϵ_x strain



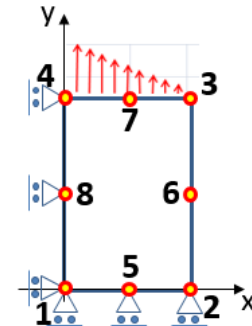
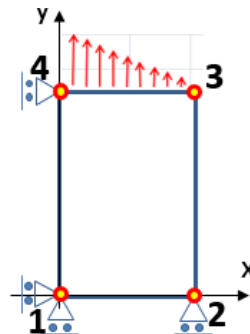
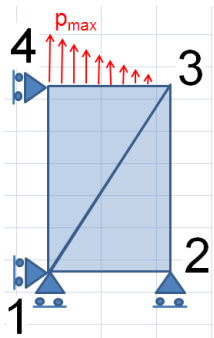
PLOT NO. 3
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 EPELX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.045711
 SMN =-.302E-03
 SMX =.164E-04

Blue	-.302E-03
Light Blue	-.267E-03
Light Cyan	-.231E-03
Cyan	-.196E-03
Green	-.161E-03
Light Green	-.125E-03
Yellow	-.898E-04
Orange	-.544E-04
Red	-.190E-04
Dark Red	.164E-04

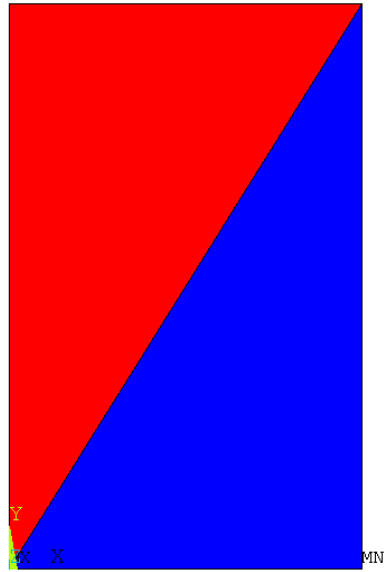


PLOT NO. 12
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 EPELX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.04694
 SMN =-.313E-03
 SMX =.157E-05

Blue	-.313E-03
Light Blue	-.278E-03
Light Cyan	-.243E-03
Cyan	-.208E-03
Green	-.173E-03
Light Green	-.138E-03
Yellow	-.103E-03
Orange	-.682E-04
Red	-.333E-04
Dark Red	.157E-05

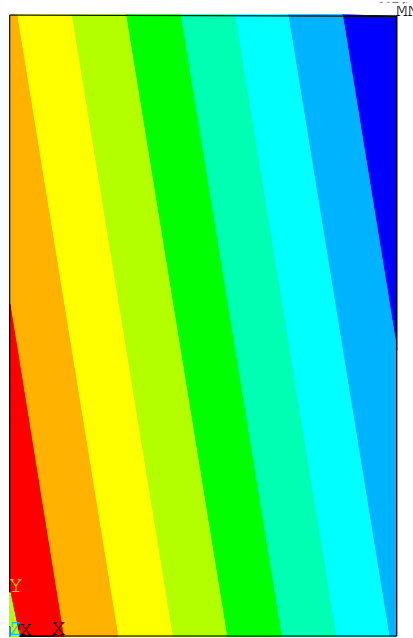


Odształcenia na kierunku Y

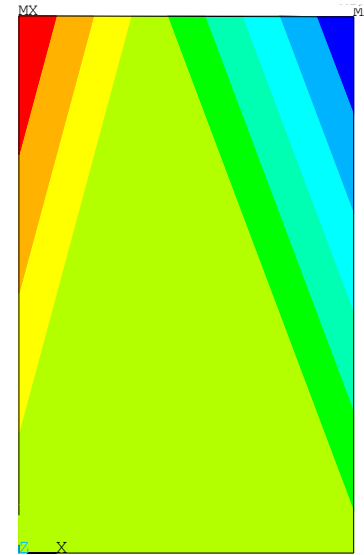


PLOT NO. 8
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 EPELY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.038165
 SMN =.380E-03
 SMX =.477E-03
 .380E-03
 .391E-03
 .402E-03
 .412E-03
 .423E-03
 .434E-03
 .445E-03
 .456E-03
 .466E-03
 .477E-03

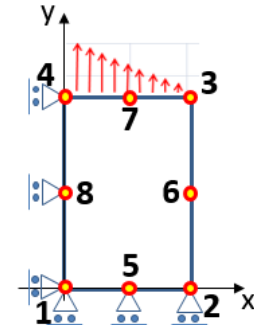
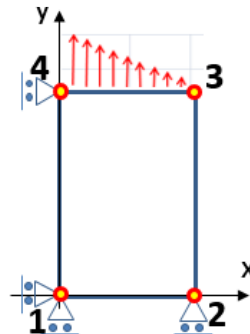
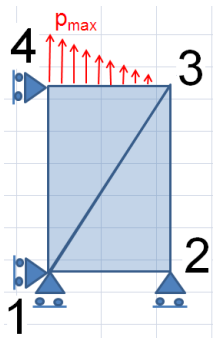
ϵ_y strain



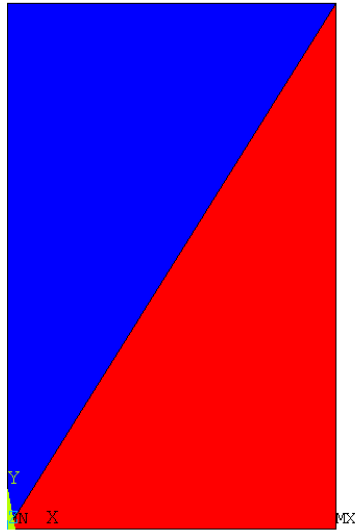
PLOT NO. 4
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 EPELY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.045711
 SMN =.249E-03
 SMX =.609E-03
 .249E-03
 .289E-03
 .329E-03
 .369E-03
 .409E-03
 .449E-03
 .489E-03
 .529E-03
 .569E-03
 .609E-03



PLOT NO. 13
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 EPELY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.04694
 SMN =.238E-04
 SMX =.769E-03
 .238E-04
 .107E-03
 .189E-03
 .272E-03
 .355E-03
 .438E-03
 .520E-03
 .603E-03
 .686E-03
 .769E-03

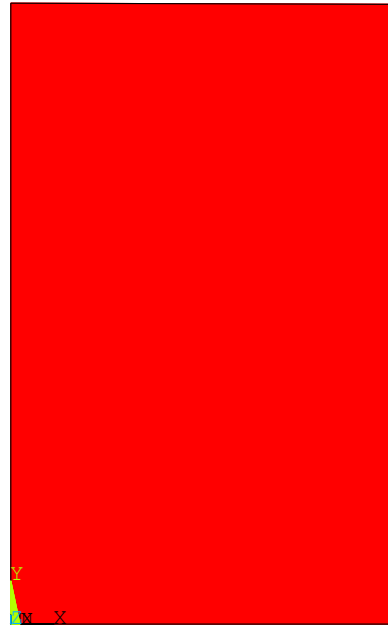


Odkształcenia postaciowe

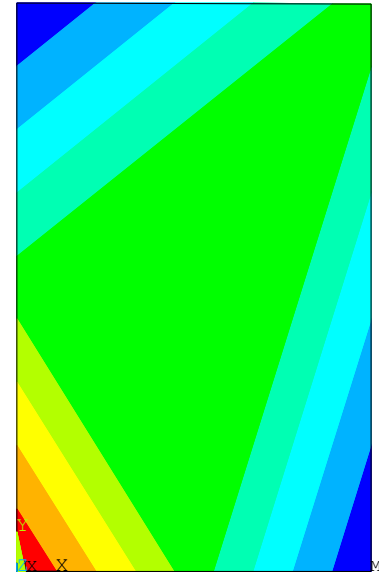


PLOT NO. 1
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 EPELXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.038165
 SMN =-.155E-03
 SMX =-.160E-04
 -.155E-03
 -.140E-03
 -.124E-03
 -.109E-03
 -.933E-04
 -.779E-04
 -.624E-04
 -.470E-04
 -.315E-04
 -.160E-04

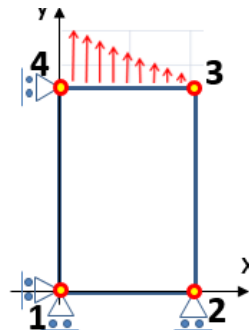
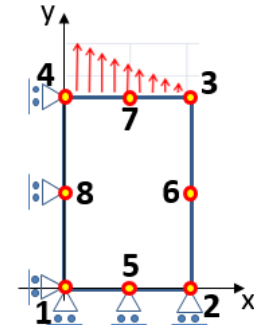
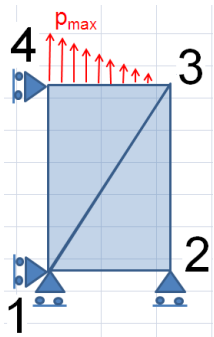
γ_{xy} strain



PLOT NO. 5
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 EPELXY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.045711
 SMN =-.159E-03
 SMX =-.159E-03

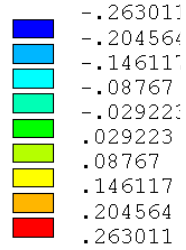


PLOT NO. 14
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 EPELXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.04694
 SMN =-.259E-03
 SMX =.105E-03
 -.259E-03
 -.219E-03
 -.178E-03
 -.138E-03
 -.974E-04
 -.569E-04
 -.164E-04
 .241E-04
 .646E-04
 .105E-03

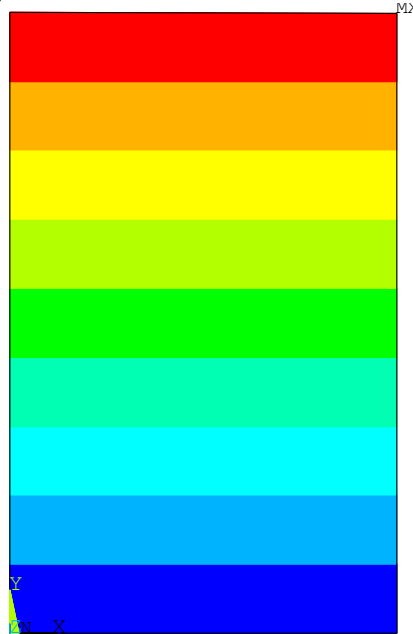


Naprężenia na kierunku X

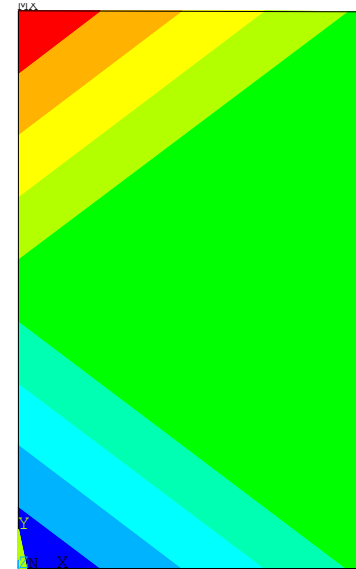
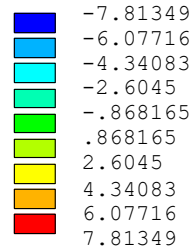
PLOT NO. 3
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.038165
 SMN =-.263011
 SMX =.263011



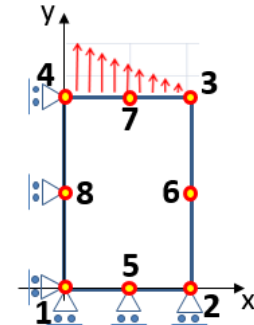
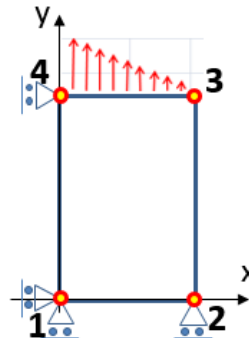
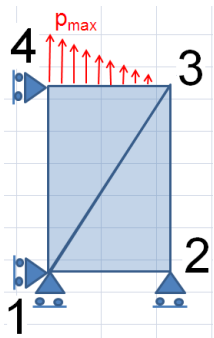
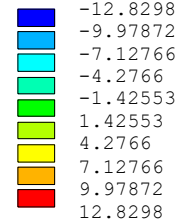
σ_x stress



PLOT NO. 6
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.045711
 SMN =-7.81349
 SMX =7.81349



PLOT NO. 5
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.04694
 SMN =-12.8298
 SMX =12.8298

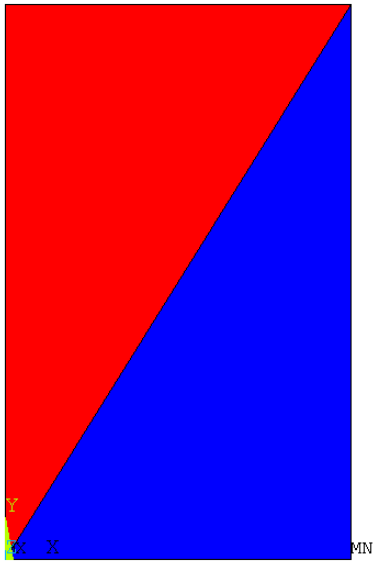


Naprężenia na kierunek Y

PLOT NO. 4
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1

DMX =.038165
 SMN =26.518
 SMX =33.482

26.518
27.292
28.065
28.839
29.613
30.387
31.161
31.935
32.708
33.482

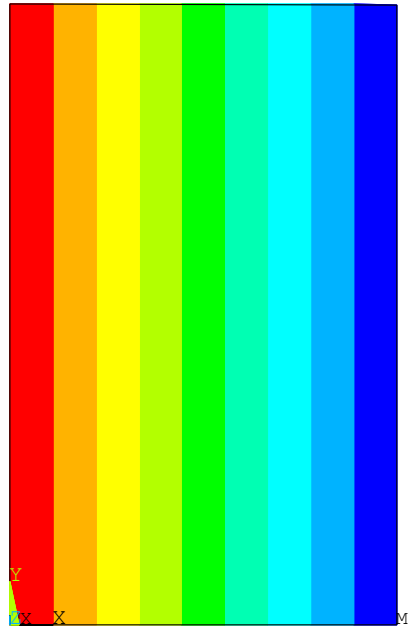


σ_y stress

PLOT NO. 7
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1

DMX =.045711
 SMN =20.0025
 SMX =39.9975

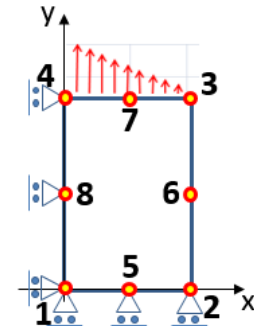
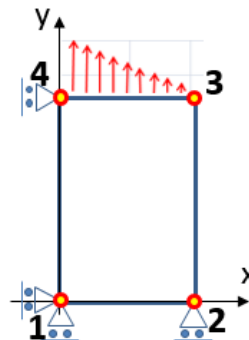
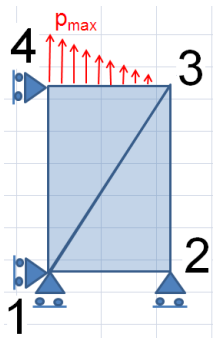
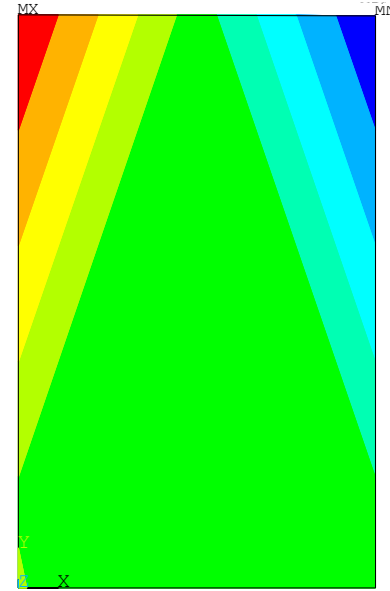
20.0025
22.2242
24.4459
26.6675
28.8892
31.1108
33.3325
35.5541
37.7758
39.9975



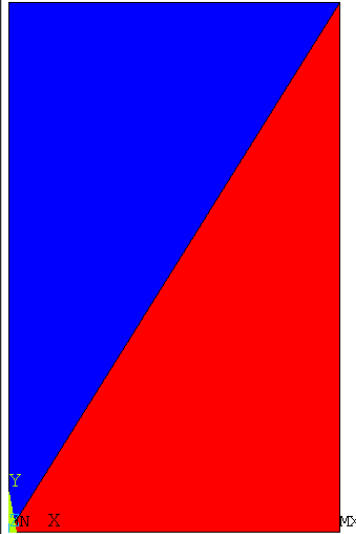
PLOT NO. 6
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1

DMX =.04694
 SMN =1.91405
 SMX =58.086

1.91405
8.15537
14.3967
20.638
26.8793
33.1207
39.362
45.6033
51.8446
58.086

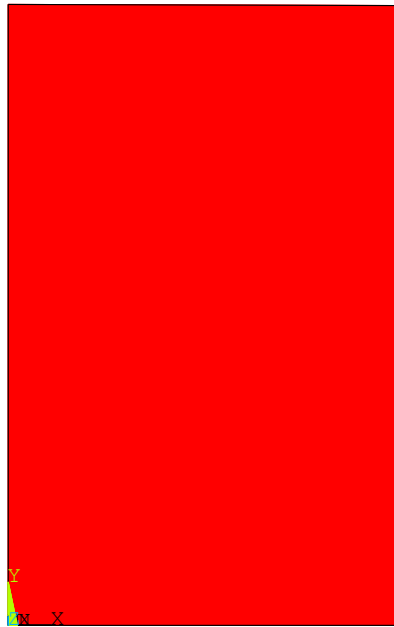


Naprężenia styczne

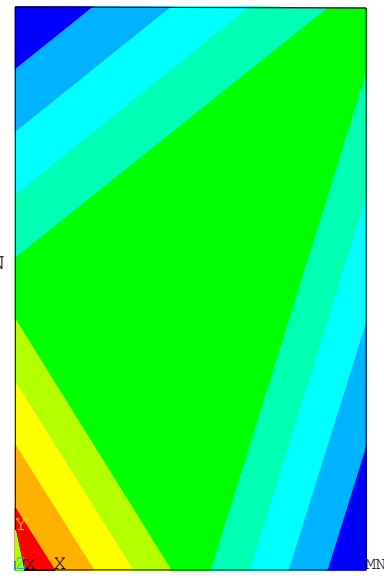


PLOT NO. 5
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.038165
 SMN =-4.074
 SMX =-.420818
 -4.074
 -3.668
 -3.262
 -2.856
 -2.45
 -2.044
 -1.638
 -1.233
 -.826679
 -.420818

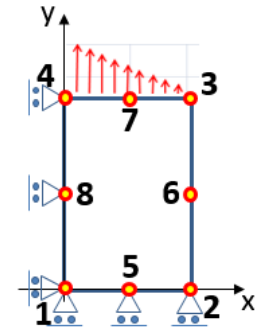
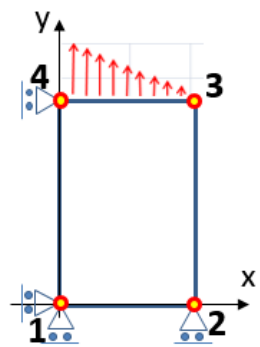
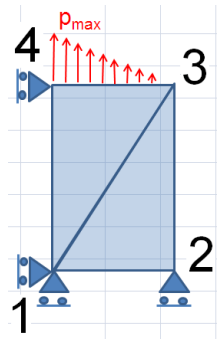
τ_{xy} stress



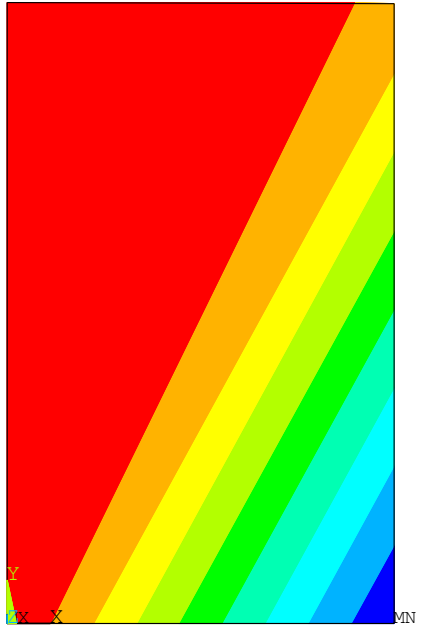
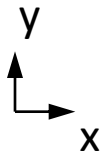
PLOT NO. 8
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.045711
 SMN =-4.16719
 SMX =-4.16719



PLOT NO. 7
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.04694
 SMN =-6.81074
 SMX =2.7595
 -6.81074
 -5.74738
 -4.68402
 -3.62066
 -2.5573
 -1.49394
 -.430576
 .632784
 1.69614
 2.7595



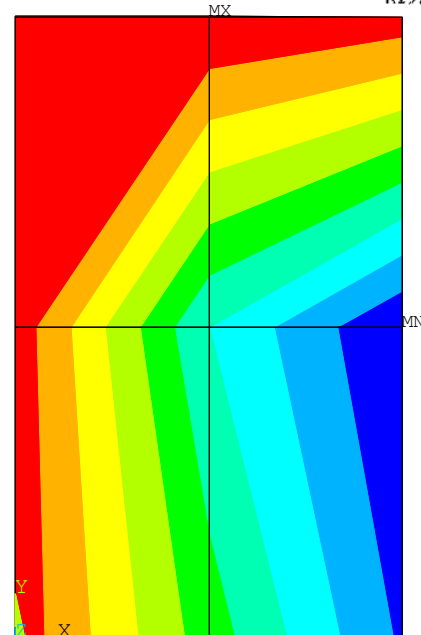
Wpływ dyskretyzacji na jakość wyników



PLOT NO. 1
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.045711
 SMN =-.012724

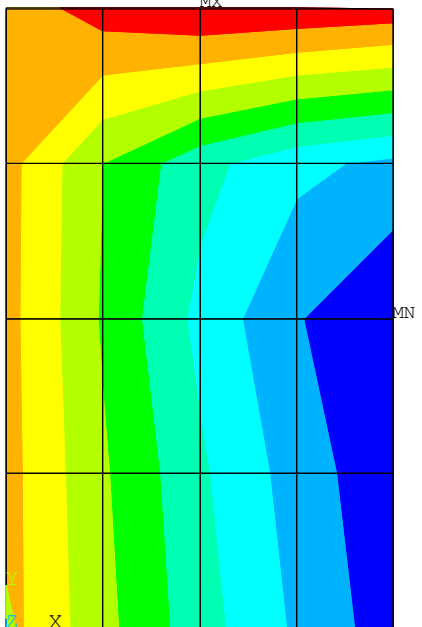
Blue	-.012724
Light Blue	-.01131
Cyan	-.009896
Green	-.008483
Light Green	-.007069
Yellow	-.005655
Orange	-.004241
Red	-.002828
Dark Red	-.001414
Black	0

UX
 [mm]



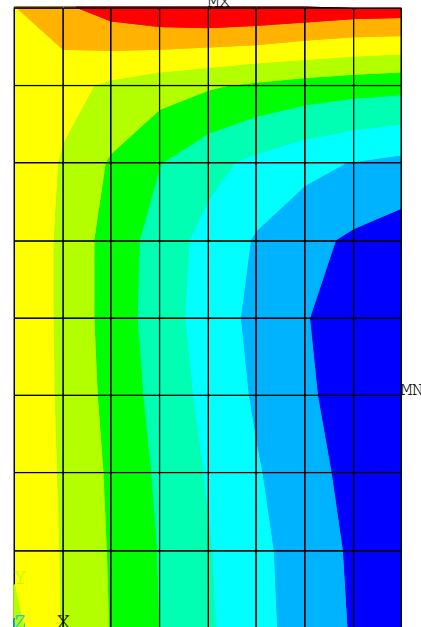
PLOT NO. 10
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.046436
 SMN =-.009823

Blue	-.009823
Light Blue	-.008682
Cyan	-.00754
Green	-.006398
Light Green	-.005257
Yellow	-.004115
Orange	-.002974
Red	-.001832
Dark Red	-.690E-03
Black	.451E-03



PLOT NO. 15
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.046861
 SMN =-.009151

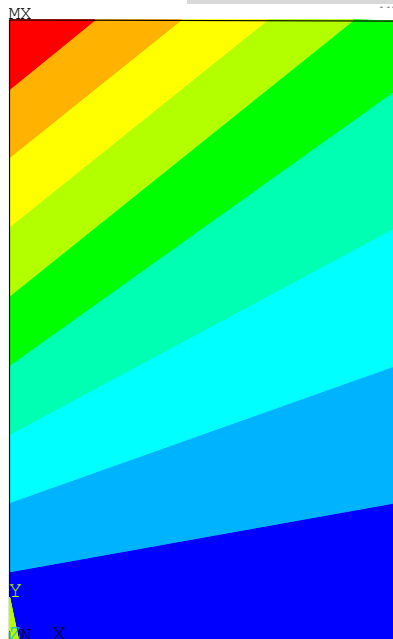
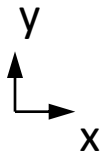
Blue	-.009151
Light Blue	-.007909
Cyan	-.006666
Green	-.005424
Light Green	-.004181
Yellow	-.002938
Orange	-.001696
Red	-.453E-03
Dark Red	.789E-03
Black	.002032



PLOT NO. 23
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.047071
 SMN =-.008957

Blue	-.008957
Light Blue	-.007671
Cyan	-.006385
Green	-.005099
Light Green	-.003813
Yellow	-.002527
Orange	-.001241
Red	.452E-04
Dark Red	.001331
Black	.002617

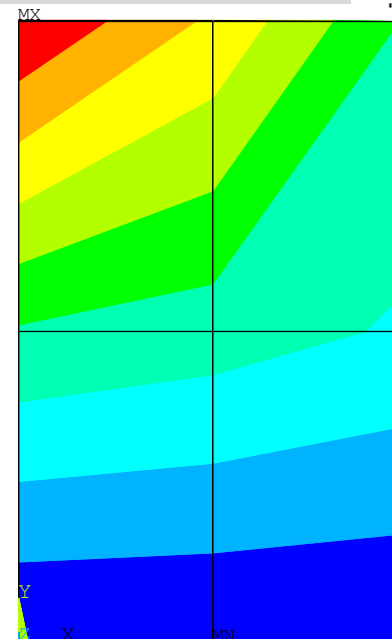
Wpływ dyskretyzacji na jakość wyników



00:00:10
 PLOT NO. 2
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.045711
 SMX =.045711

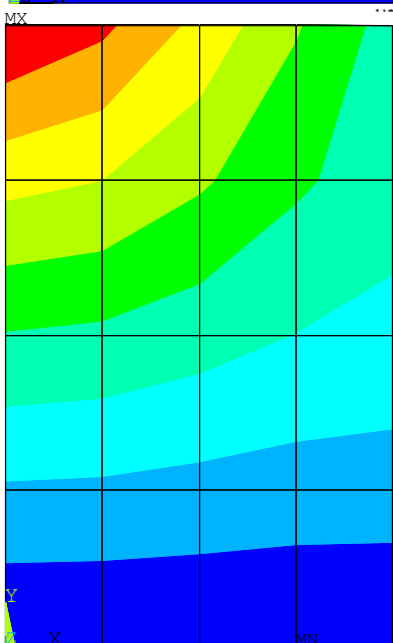
0
.005079
.010158
.015237
.020316
.025395
.030474
.035553
.040632
.045711

UY
 [mm]



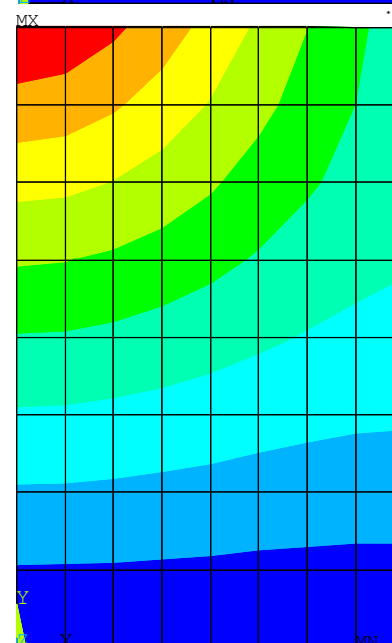
00:00:23
 PLOT NO. 11
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.046436
 SMX =.046436

0
.00516
.010319
.015479
.020638
.025798
.030957
.036117
.041276
.046436



00:00:21
 PLOT NO. 16
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.046861
 SMX =.046861

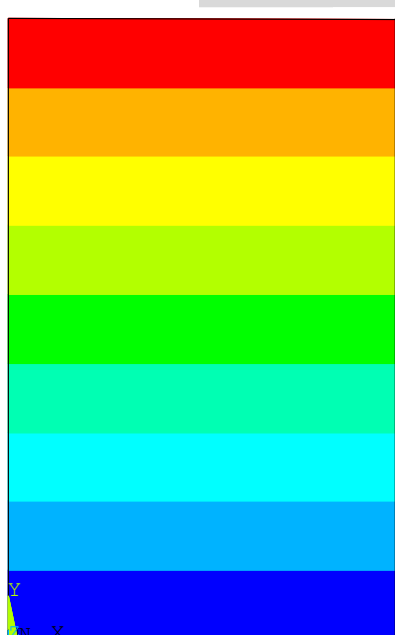
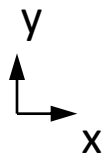
0
.005207
.010414
.01562
.020827
.026034
.031241
.036448
.041654
.046861



00:00:19
 PLOT NO. 24
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.047071
 SMX =.047071

0
.00523
.01046
.01569
.02092
.026151
.031381
.036611
.041841
.047071

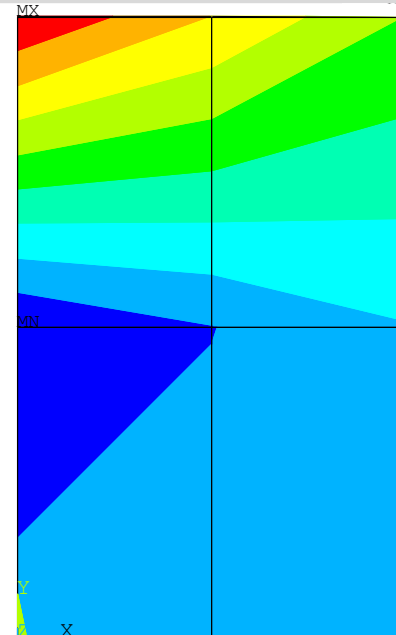
Wpływ dyskretyzacji na jakość wyników



00.00.00
 PLOT NO. 6
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.045711
 SMN =-7.81349
 SMX =7.81349

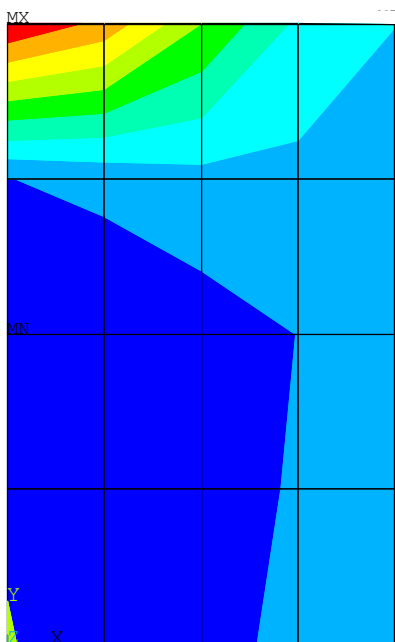
σ_x
 [MPa]
 NODAL SOLUTION

- -7.81349
- -6.07716
- -4.34083
- -2.6045
- -.868165
- .868165
- 2.6045
- 4.34083
- 6.07716
- 7.81349



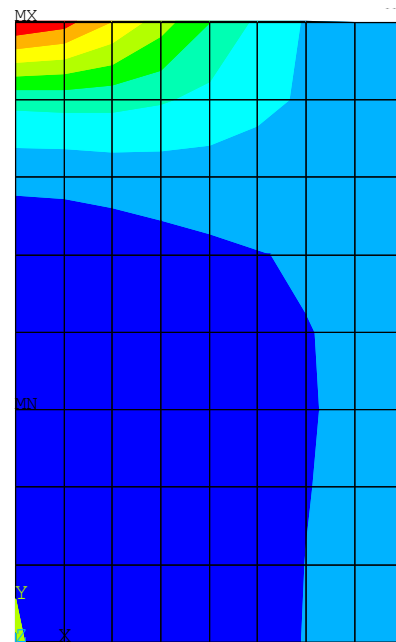
00.00.00
 PLOT NO. 31
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.046436
 SMN =-5.95909
 SMX =14.5388

- -5.95909
- -3.68154
- -1.404
- .873548
- 3.15109
- 5.42864
- 7.70619
- 9.98373
- 12.2613
- 14.5388



00.00.00
 PLOT NO. 20
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.046861
 SMN =-4.63339
 SMX =24.1699

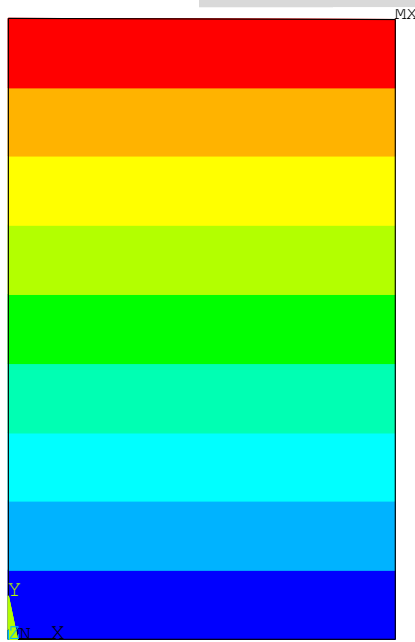
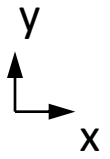
- -4.63339
- -1.43302
- 1.76735
- 4.96772
- 8.16809
- 11.3685
- 14.5688
- 17.7692
- 20.9696
- 24.1699



00.00.00
 PLOT NO. 25
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.047071
 SMN =-4.69728
 SMX =30.1917

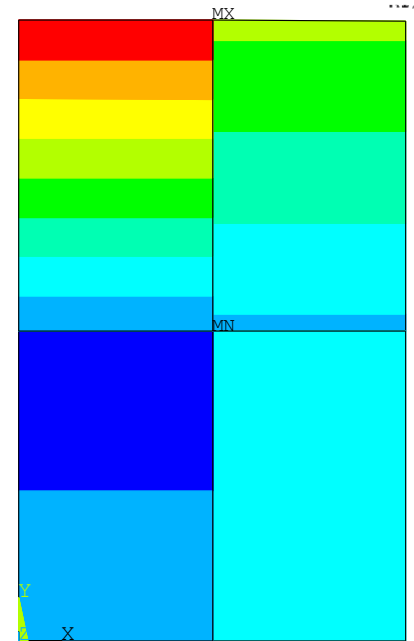
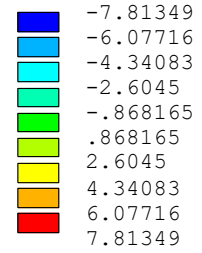
- -4.69728
- -.820734
- 3.05582
- 6.93237
- 10.8089
- 14.6855
- 18.562
- 22.4386
- 26.3151
- 30.1917

Wpływ dyskretyzacji na jakość wyników

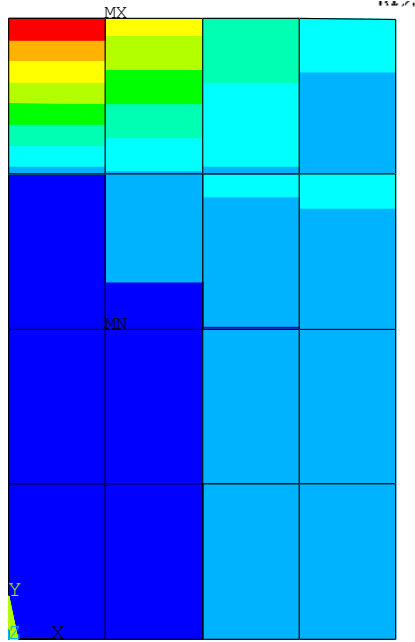
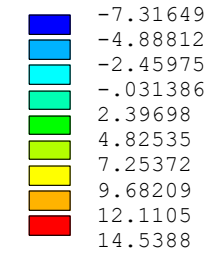


00:00:06
 PLOT NO. 6
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.045711
 SMN =-7.81349
 SMX =7.81349

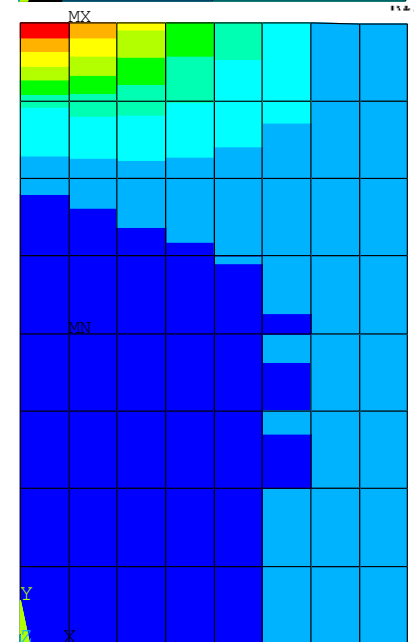
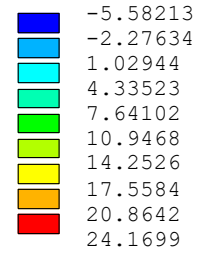
σ_x
 [MPa]
 ELEMENT SOLUTION



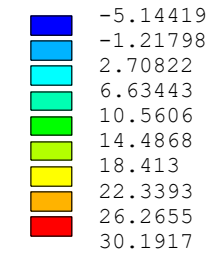
00:00:12
 PLOT NO. 12
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.046436
 SMN =-7.31649
 SMX =14.5388



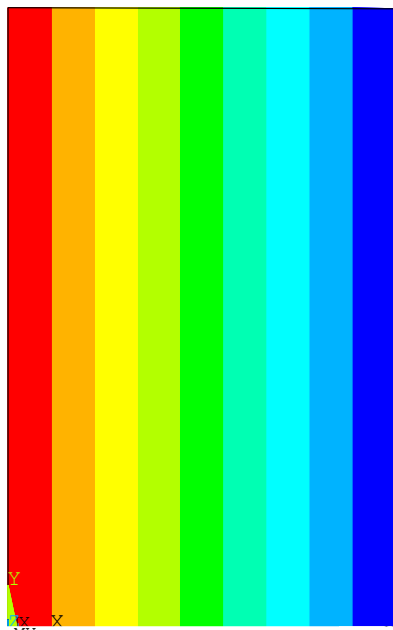
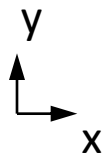
00:00:31
 PLOT NO. 17
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.046861
 SMN =-5.58213
 SMX =24.1699



00:00:40
 PLOT NO. 28
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.047071
 SMN =-5.14419
 SMX =30.1917



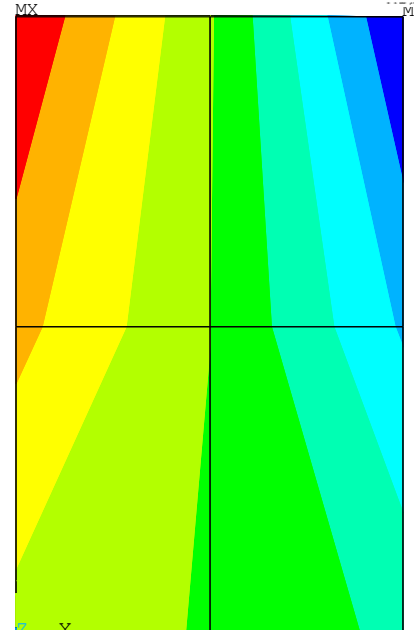
Wpływ dyskretyzacji na jakość wyników



PLOT NO. 7
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.045711
 SMN =20.0025
 SMX =39.9975

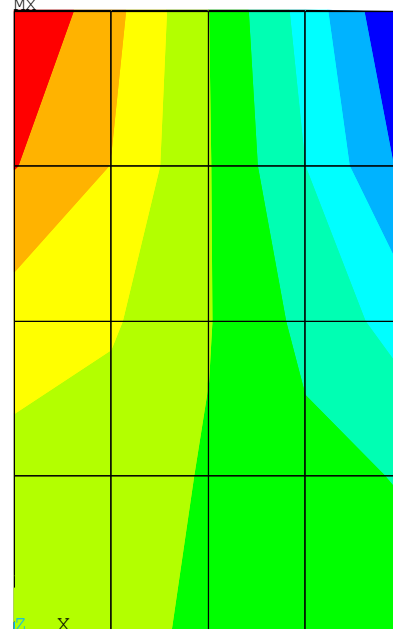
σ_y
 [MPa]
NODAL SOLUTION

- 20.0025
- 22.2242
- 24.4459
- 26.6675
- 28.8892
- 31.1108
- 33.3325
- 35.5541
- 37.7758
- 39.9975



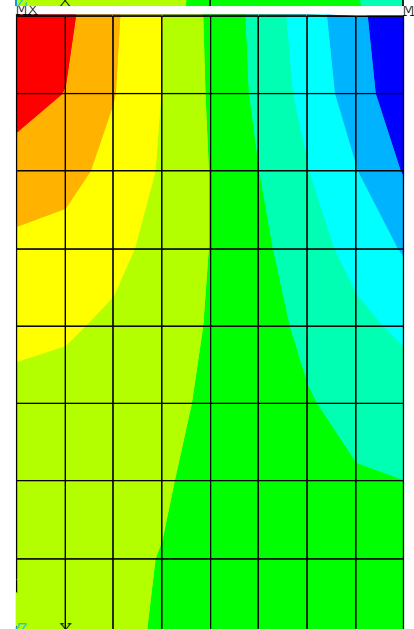
PLOT NO. 32
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.046436
 SMN =9.68398
 SMX =47.7465

- 9.68398
- 13.9132
- 18.1423
- 22.3715
- 26.6007
- 30.8298
- 35.059
- 39.2882
- 43.5173
- 47.7465



PLOT NO. 21
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.046861
 SMN =3.04724
 SMX =52.8834

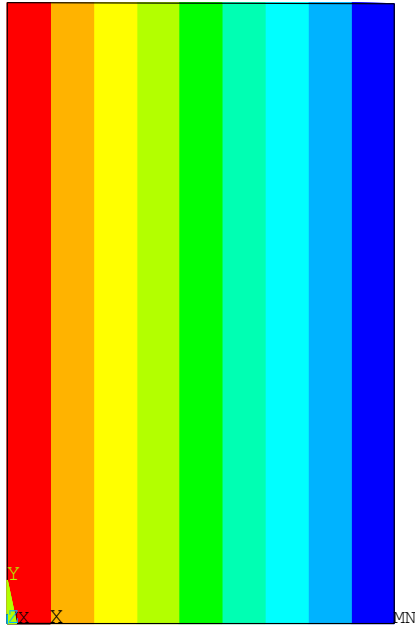
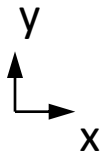
- 3.04724
- 8.5846
- 14.122
- 19.6593
- 25.1967
- 30.734
- 36.2714
- 41.8087
- 47.3461
- 52.8834



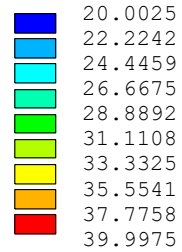
PLOT NO. 26
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.047071
 SMN =.427497
 SMX =56.1359

- .427497
- 6.61732
- 12.8071
- 18.997
- 25.1868
- 31.3766
- 37.5664
- 43.7562
- 49.946
- 56.1359

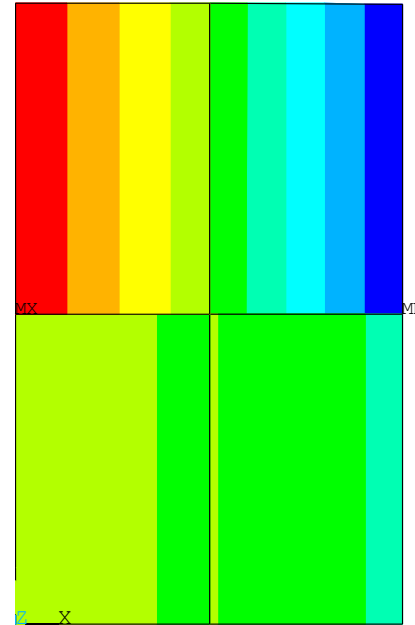
Wpływ dyskretyzacji na jakość wyników



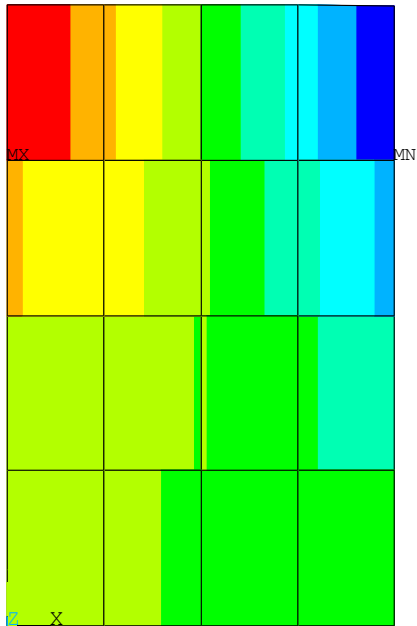
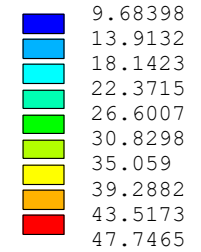
PLOT NO. 7
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.045711
 SMN =20.0025
 SMX =39.9975



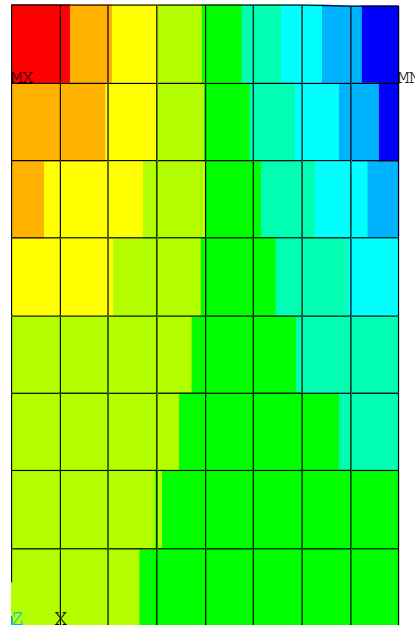
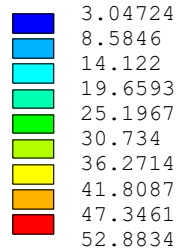
σ_y
 [MPa]
 ELEMNT
 SOLUTION



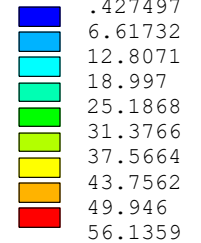
PLOT NO. 13
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.046436
 SMN =9.68398
 SMX =47.7465



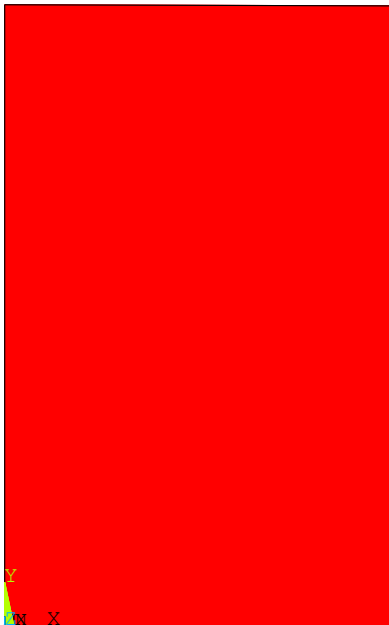
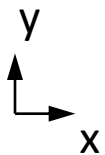
PLOT NO. 18
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.046861
 SMN =3.04724
 SMX =52.8834



PLOT NO. 29
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.047071
 SMN =.427497
 SMX =56.1359

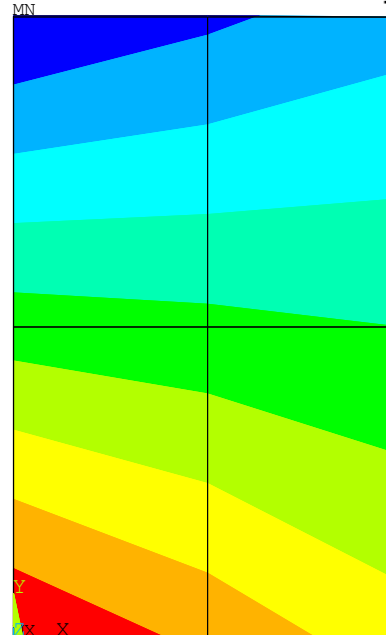


Wpływ dyskretyzacji na jakość wyników



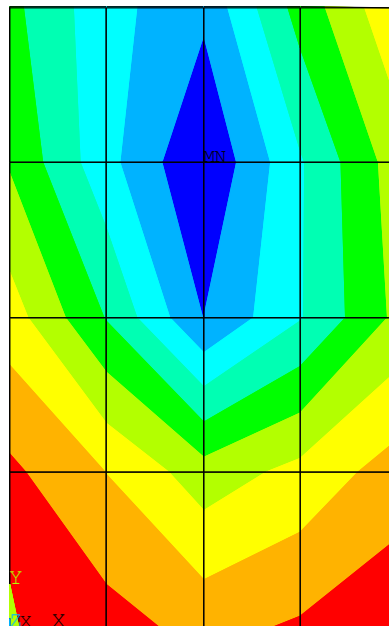
PLOT NO. 8
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.045711
 SMN =-4.16719
 SMX =-4.16719

τ_{xy}
 [MPa]
 NODAL
 SOLUTION



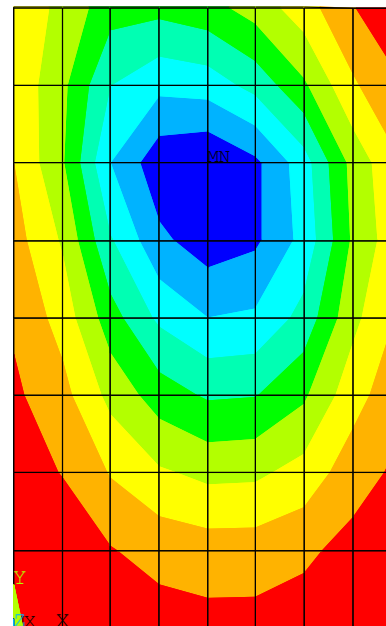
PLOT NO. 33
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.046436
 SMN =-4.70816
 SMX =-1.65009

Blue	-4.70816
Light Blue	-4.36837
Cyan	-4.02859
Green	-3.6888
Light Green	-3.34902
Yellow-Green	-3.00923
Yellow	-2.66944
Orange	-2.32966
Red-Orange	-1.98987
Red	-1.65009



PLOT NO. 22
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.046861
 SMN =-5.49877
 SMX =-.425279

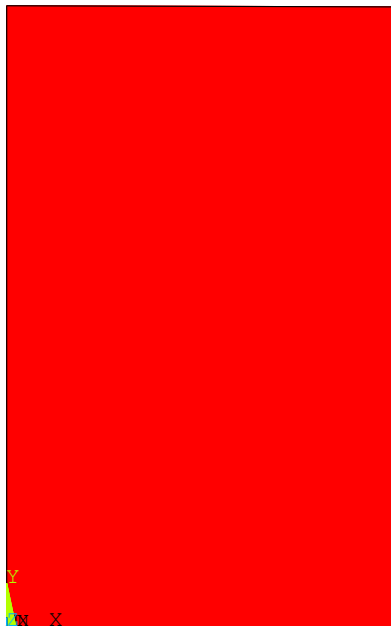
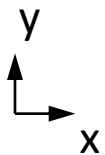
Blue	-5.49877
Light Blue	-4.93504
Cyan	-4.37132
Green	-3.8076
Light Green	-3.24388
Yellow-Green	-2.68016
Yellow	-2.11644
Orange	-1.55272
Red-Orange	-.989
Red	-.425279



PLOT NO. 27
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.047071
 SMN =-6.68
 SMX =-.106963

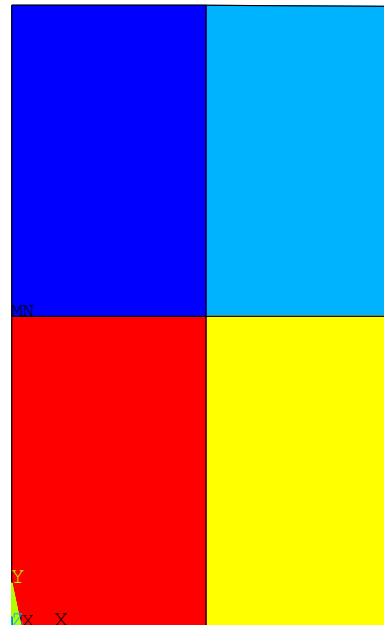
Blue	-6.68
Light Blue	-5.94966
Cyan	-5.21933
Green	-4.48899
Light Green	-3.75865
Yellow-Green	-3.02831
Yellow	-2.29798
Orange	-1.56764
Red-Orange	-.837301
Red	-.106963

Wpływ dyskretyzacji na jakość wyników



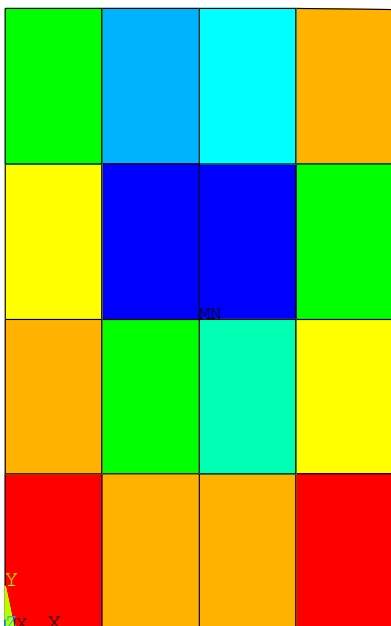
PLOT NO. 8
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.045711
 SMN =-4.16719
 SMX =-4.16719

τ_{xy}
 [MPa]
 ELEMENT
 SOLUTION



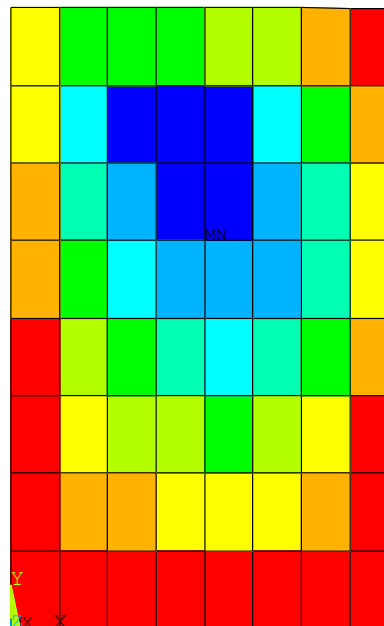
PLOT NO. 14
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.046436
 SMN =-4.70816
 SMX =-1.65009

Blue	-4.70816
Light Blue	-4.36837
Cyan	-4.02859
Green	-3.6888
Light Green	-3.34902
Yellow-Green	-3.00923
Yellow	-2.66944
Orange	-2.32966
Light Orange	-1.98987
Red	-1.65009



PLOT NO. 19
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.046861
 SMN =-6.33246
 SMX =-.425279

Blue	-6.33246
Light Blue	-5.6761
Cyan	-5.01975
Green	-4.3634
Light Green	-3.70704
Yellow-Green	-3.05069
Yellow	-2.39434
Orange	-1.73799
Light Orange	-1.08163
Red	-.425279



PLOT NO. 30
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.047071
 SMN =-6.83544
 SMX =-.106963

Blue	-6.83544
Light Blue	-6.08783
Cyan	-5.34022
Green	-4.59261
Light Green	-3.84501
Yellow-Green	-3.0974
Yellow	-2.34979
Orange	-1.60218
Light Orange	-.854572
Red	-.106963