



Wydział Mechaniczny Energetyki i Lotnictwa
Zakład Wytrzymałości Materiałów i Konstrukcji



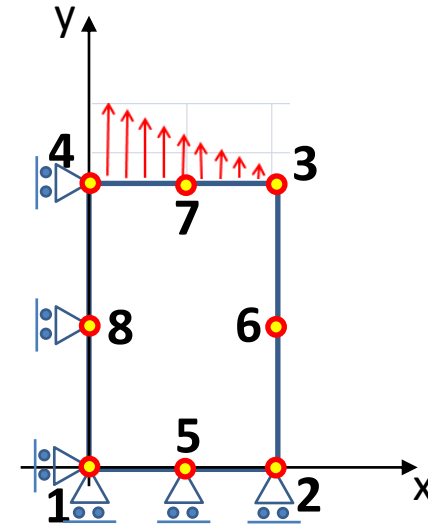
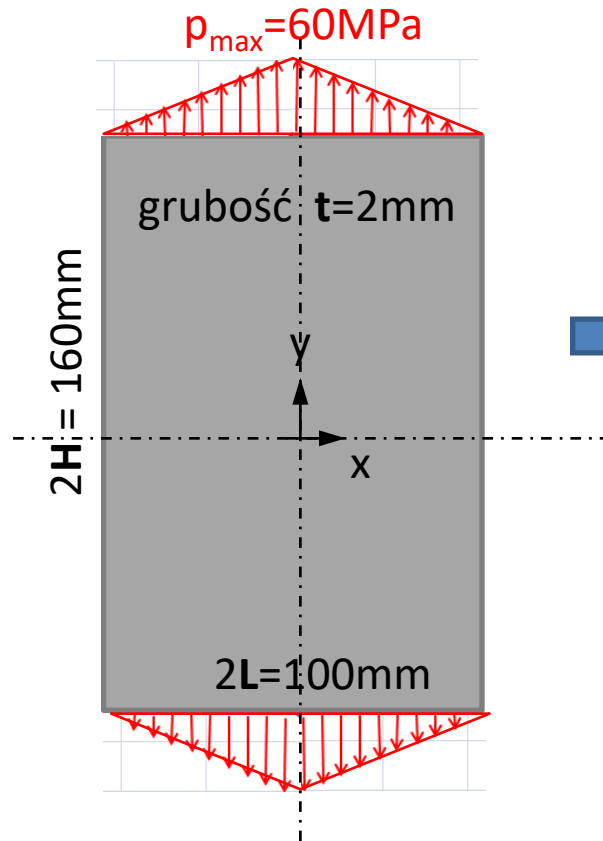
Metoda elementów skończonych (MES1)

Wykład 1e. Tarcza 2D modelowana elementami 8-węzłowymi

(przypomnienie z MES1)

10.2024

Przykład. 2D tarcza model MES z użyciem elementów 8-węzłowych



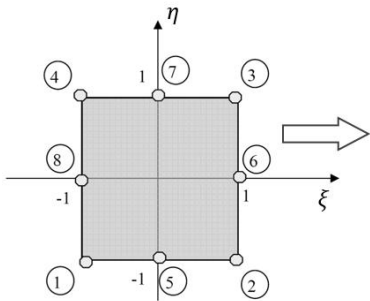
Model ćwiartki tarczy
o jednym elemencie skończonym

wektory współrzędnych węzłowych:

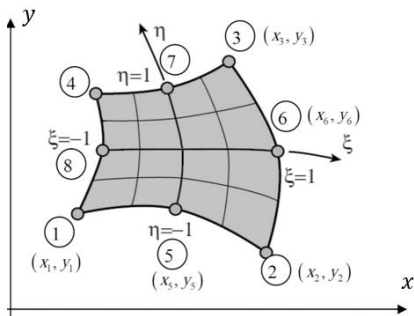
$$[x_i]_1 = [0, L, L, 0, \frac{1}{2}L, L, \frac{1}{2}L, 0]$$

$$[y_i]_1 = [0, 0, H, H, 0, \frac{1}{2}H, H, \frac{1}{2}H]$$

układ współrzędnych naturalnych



układ współrzędnych kartecjańskich



funkcje kształtu elementu i ich pochodne w układzie naturalnym:

$$\begin{aligned}
 N_1(\xi, \eta) &= -\frac{1}{4}(1-\xi)(1-\eta)(1+\xi+\eta) \\
 N_2(\xi, \eta) &= -\frac{1}{4}(1+\xi)(1-\eta)(1-\xi+\eta) \\
 N_3(\xi, \eta) &= -\frac{1}{4}(1+\xi)(1+\eta)(1-\xi-\eta) \\
 N_4(\xi, \eta) &= -\frac{1}{4}(1-\xi)(1+\eta)(1+\xi-\eta) \\
 N_5(\xi, \eta) &= \frac{1}{2}(1-\xi^2)(1-\eta) \\
 N_6(\xi, \eta) &= \frac{1}{2}(1+\xi)(1-\eta^2) \\
 N_7(\xi, \eta) &= \frac{1}{2}(1-\xi^2)(1+\eta) \\
 N_8(\xi, \eta) &= \frac{1}{2}(1-\xi)(1-\eta^2)
 \end{aligned}$$

i	$N_i(\xi, 1)$
1	0
2	0
3	$\frac{1}{2}(1+\xi)\xi$
4	$-\frac{1}{2}(1-\xi)\xi$
5	0
6	0
7	$1-\xi^2$
8	0

i	$\frac{\partial N_i}{\partial \xi}$	$\frac{\partial N_i}{\partial \eta}$
1	$\frac{1}{4}(1-\eta)(2\xi+\eta)$	$\frac{1}{4}(1-\xi)(\xi+2\eta)$
2	$\frac{1}{4}(1-\eta)(2\xi-\eta)$	$\frac{1}{4}(1+\xi)(2\eta-\xi)$
3	$\frac{1}{4}(1+\eta)(2\xi+\eta)$	$\frac{1}{4}(1+\xi)(\xi+2\eta)$
4	$\frac{1}{4}(1+\eta)(2\xi-\eta)$	$\frac{1}{4}(1-\xi)(2\eta-\xi)$
5	$-(1-\eta)\xi$	$-\frac{1}{2}(1-\xi^2)$
6	$\frac{1}{2}(1-\eta^2)$	$-(1+\xi)\eta$
7	$-(1+\eta)\xi$	$\frac{1}{2}(1-\xi^2)$
8	$\frac{1}{2}(1-\eta^2)$	$-(1-\xi)$

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

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

10 × 1

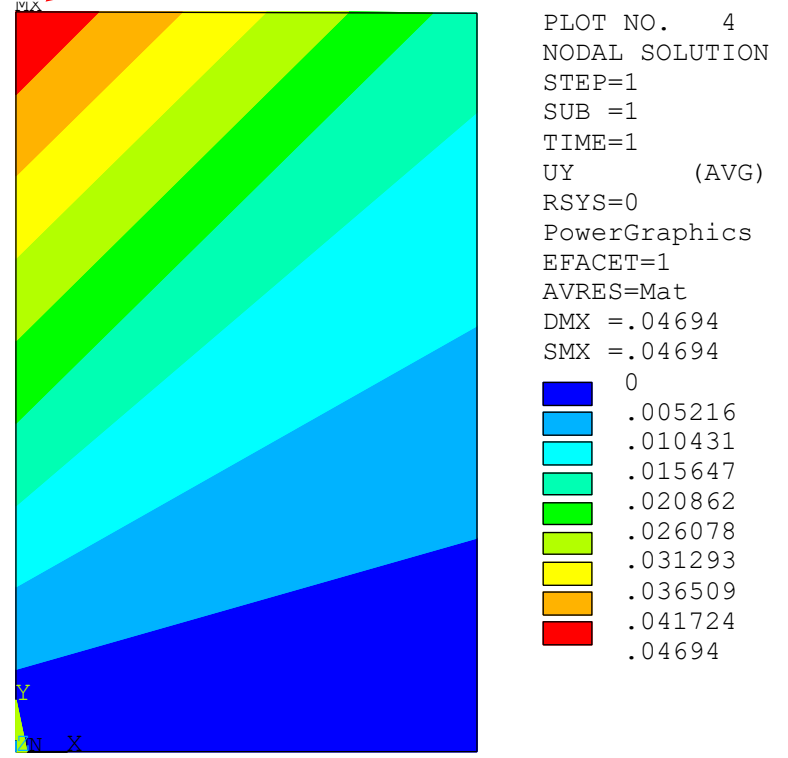
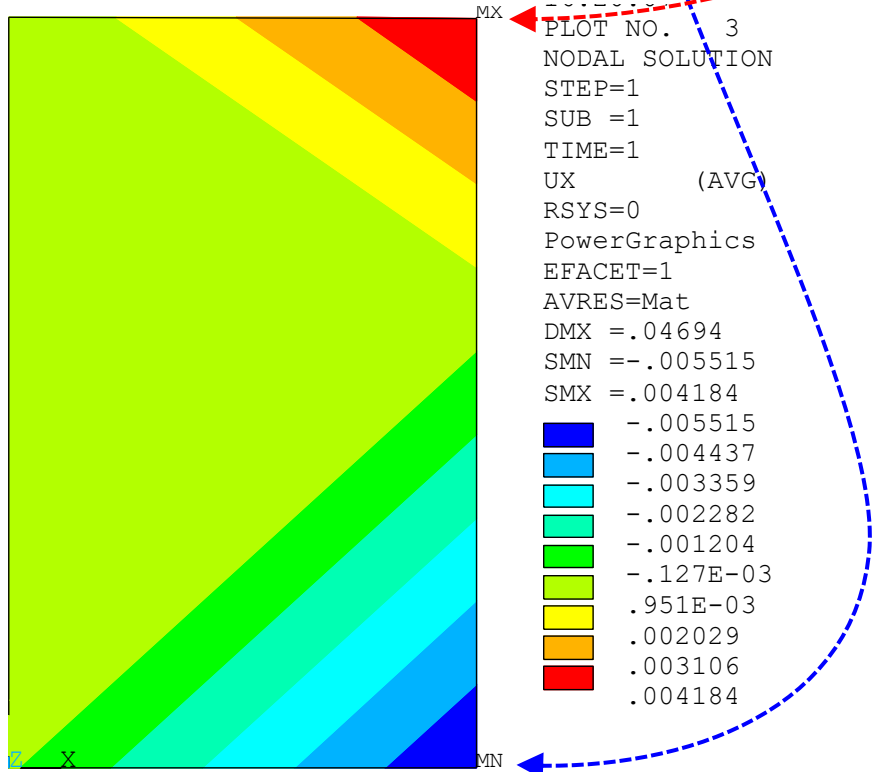
10 × 10

10 × 1

F		q	
0		-0.00523	u2
0		0.004468	u3
0		0.0181	v3
1000	N	0.046933	v4
0		-0.00353	u5
0		-0.01009	u6
0		0.013534	v6
0		0.001708	u7
2000	N	0.035171	v7
0		0.020224	v8

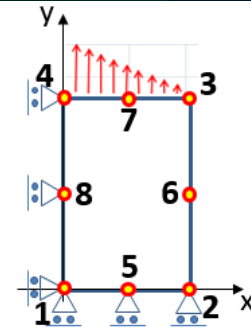
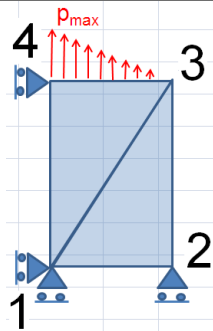
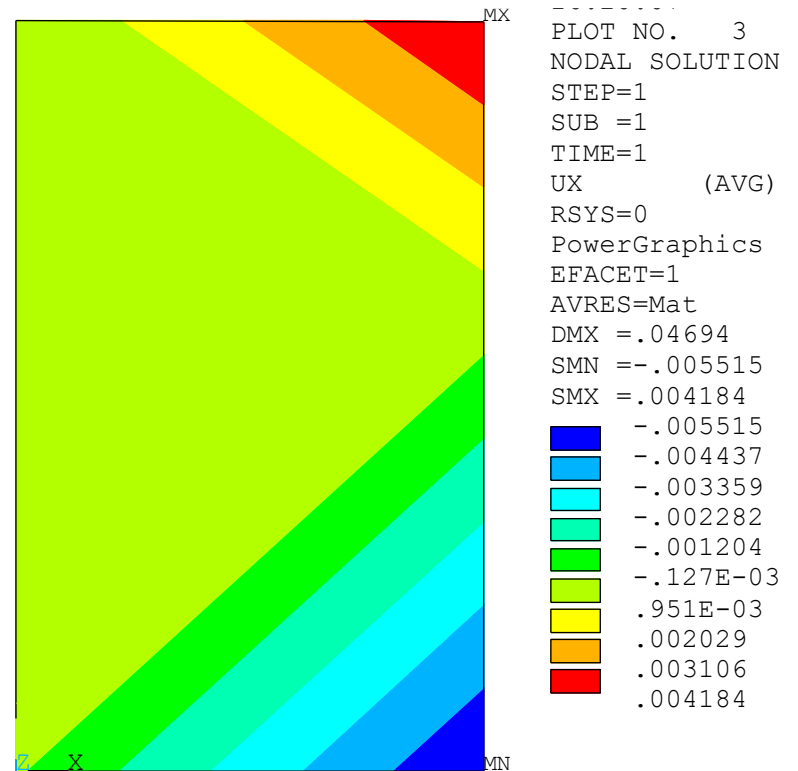
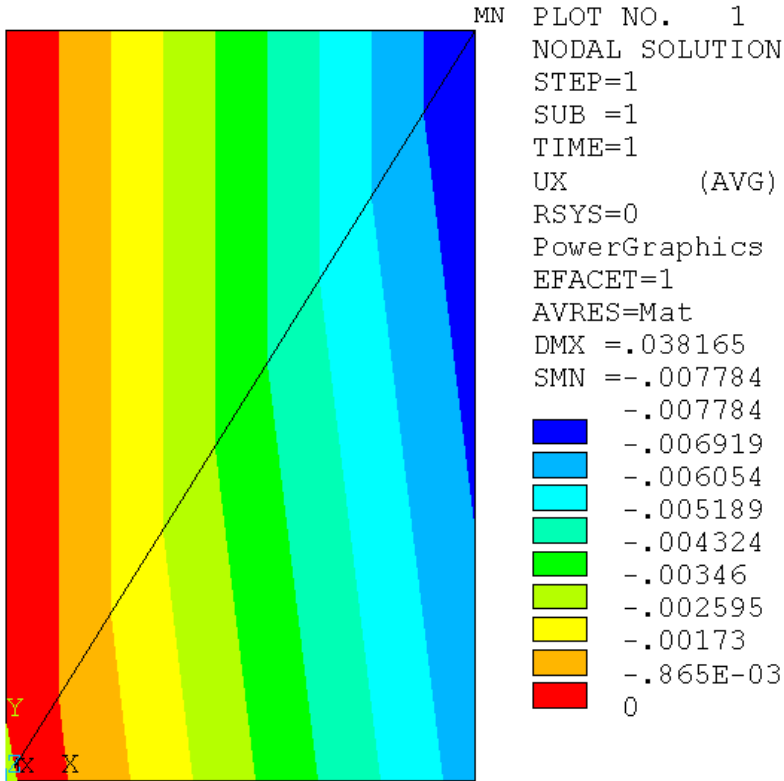
UX displacement

UY displacement



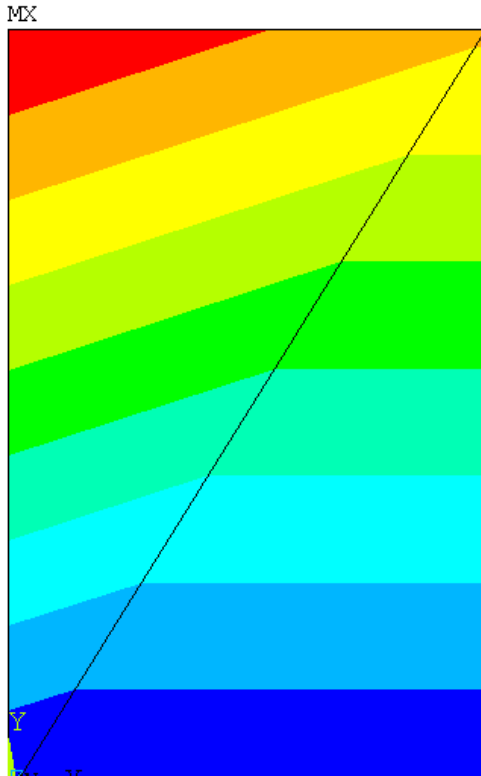
Przemieszczenia na kierunku X

UX displacement

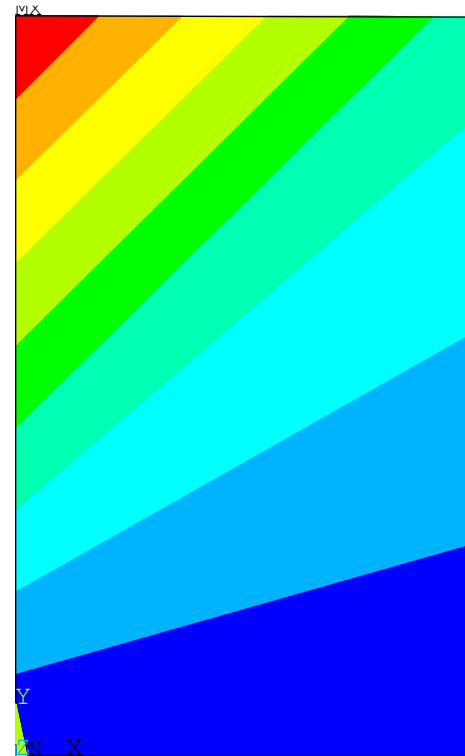


Przemieszczenia na kierunek Y

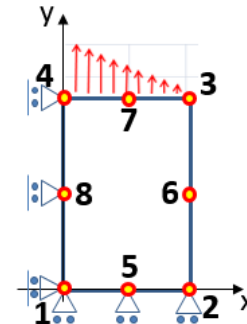
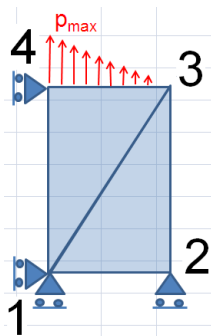
UY displacement



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

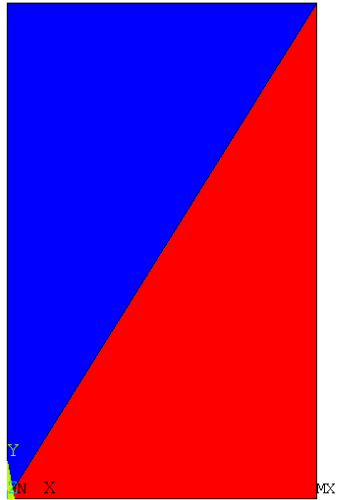


PLOT NO. 4
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.04694
 SMX =.04694
 0
 .005216
 .010431
 .015647
 .020862
 .026078
 .031293
 .036509
 .041724
 .04694



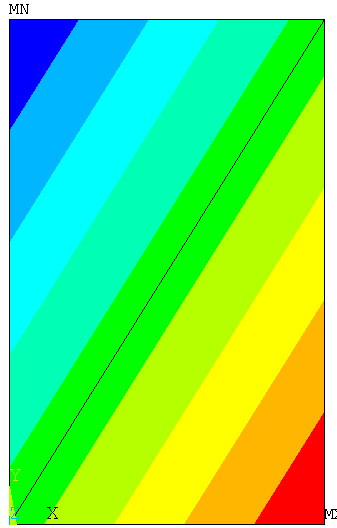
Odształcenia na kierunku X

ϵ_x strain



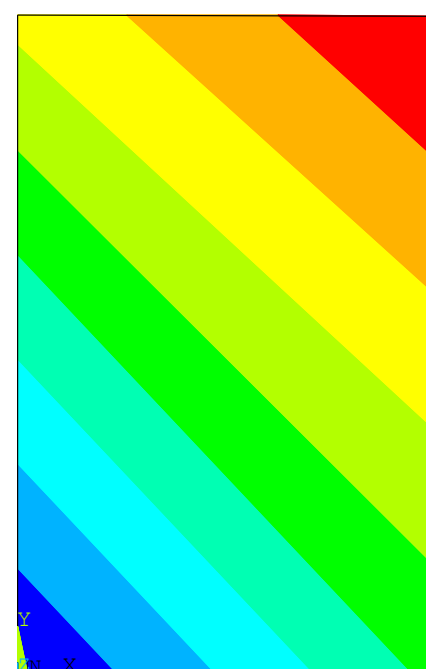
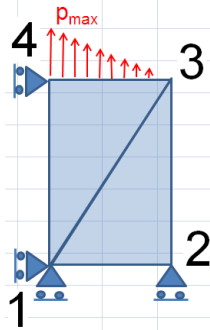
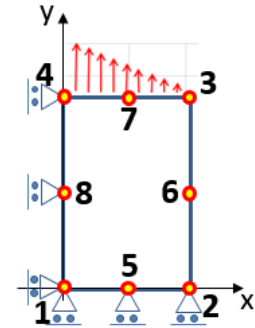
PLOT NO. 7
ELEMENT SOLUTION
STEP=1
SUB =1
TIME=1
EPELX (NOAVG)
RSYS=0
PowerGraphics
EFACET=1
DMX =.038165
SMN =-.156E-03
SMX =-.130E-03

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



PLOT NO. 12
NODAL SOLUTION
STEP=1
SUB =1
TIME=1
EPELX (AVG)
RSYS=0
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.038165
SMN =-.156E-03
SMX =-.130E-03

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

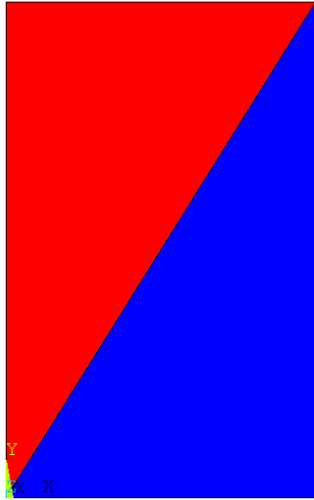


PLOT NO. 12
ELEMENT SOLUTION
STEP=1
SUB =1
TIME=1
EPELX (NOAVG)
RSYS=0
PowerGraphics
EFACET=1
DMX =.04694
SMN =-.313E-03
SMX =.157E-05

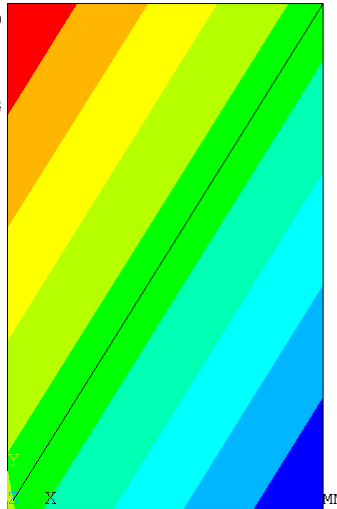
Blue	-.313E-03
Light Blue	-.278E-03
Cyan	-.243E-03
Light Green	-.208E-03
Green	-.173E-03
Light Green	-.138E-03
Yellow-Green	-.103E-03
Yellow	-.682E-04
Orange	-.333E-04
Red	.157E-05

Odkształcenia na kierunku Y

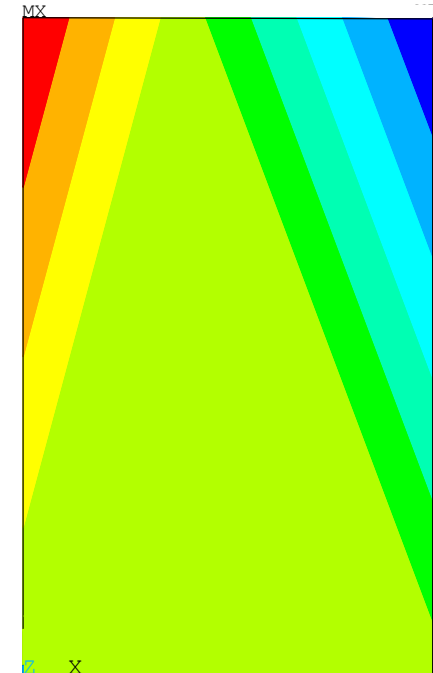
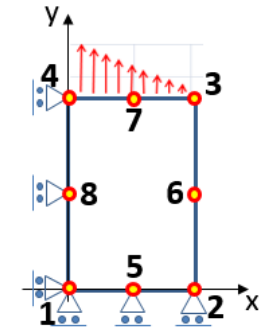
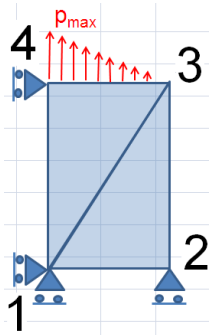
ϵ_y strain



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



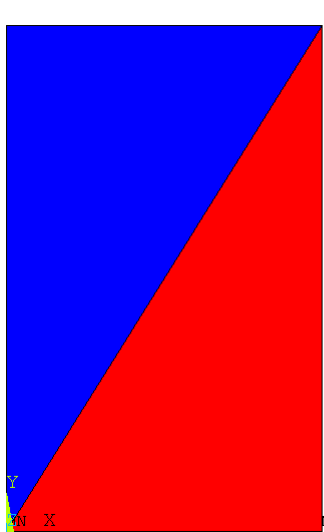
PLOT NO. 13
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 EPELY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.038165
 SMN =.380E-03
 SMX =.477E-03
 .380E-03
 .391E-03
 .402E-03
 .412E-03
 .423E-03
 .434E-03
 .445E-03
 .456E-03
 .466E-03
 .477E-03



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

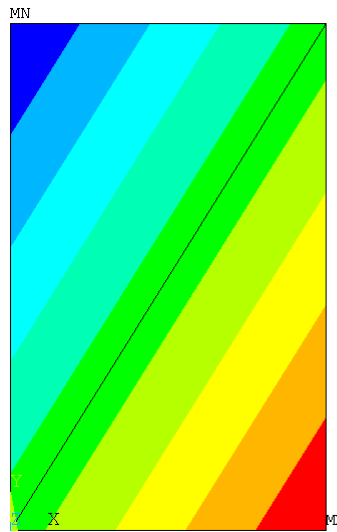
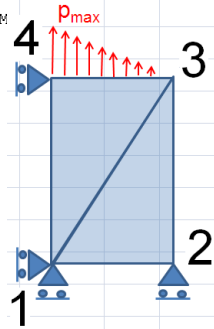
Odształcenia postaciowe

γ_{xy} strain



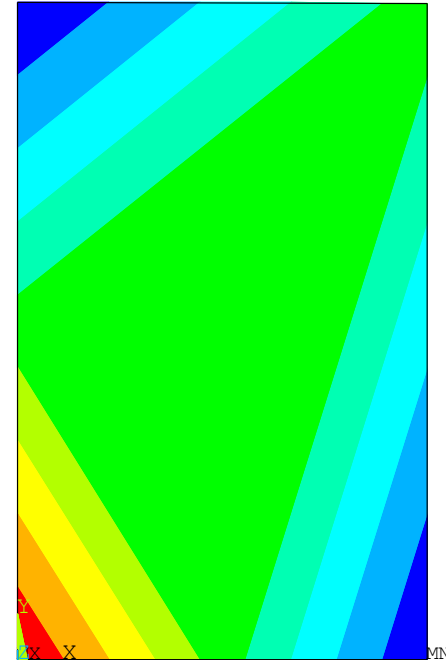
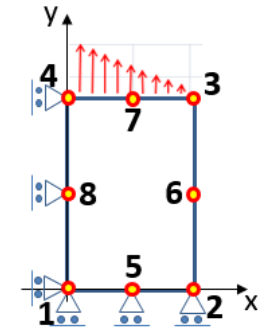
PLOT NO. 1
ELEMENT SOLUTION
STEP=1
SUB =1
TIME=1
EPELXY (NOAVG)
RSYS=0
PowerGraphics
EFACET=1
DMX =.038165
SMN =-.155E-03
SMX =-.160E-04

Blue	-.155E-03
Light Blue	-.140E-03
Cyan	-.124E-03
Green	-.109E-03
Light Green	-.933E-04
Yellow	-.779E-04
Orange	-.624E-04
Red	-.470E-04
Dark Red	-.315E-04
Red	-.160E-04



PLOT NO. 14
NODAL SOLUTION
STEP=1
SUB =1
TIME=1
EPELXY (AVG)
RSYS=0
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.038165
SMN =-.155E-03
SMX =-.160E-04

Blue	-.155E-03
Light Blue	-.140E-03
Cyan	-.124E-03
Green	-.109E-03
Light Green	-.933E-04
Yellow	-.779E-04
Orange	-.624E-04
Red	-.470E-04
Dark Red	-.315E-04
Red	-.160E-04

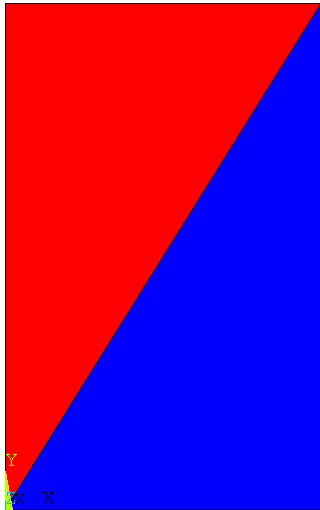


PLOT NO. 14
ELEMENT SOLUTION
STEP=1
SUB =1
TIME=1
EPELXY (NOAVG)
RSYS=0
PowerGraphics
EFACET=1
DMX =.04694
SMN =-.259E-03
SMX =.105E-03

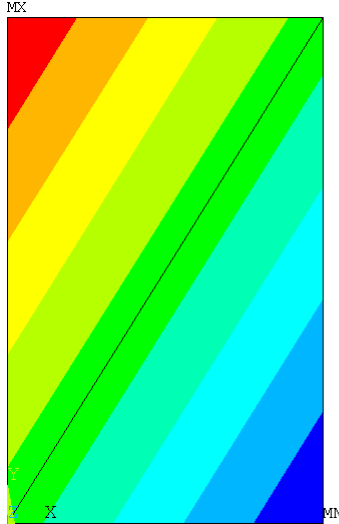
Blue	-.259E-03
Light Blue	-.219E-03
Cyan	-.178E-03
Green	-.138E-03
Light Green	-.974E-04
Yellow	-.569E-04
Orange	-.164E-04
Red	.241E-04
Dark Red	.646E-04
Red	.105E-03

Naprężenia na kierunku X

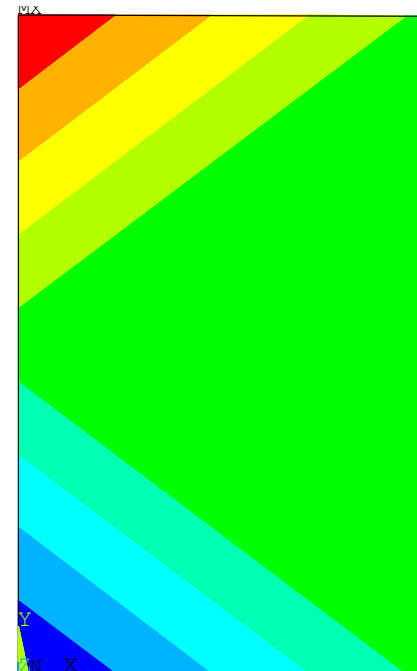
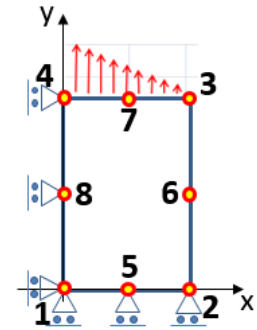
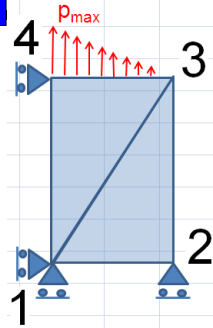
σ_x stress



PLOT NO. 3
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAV)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.038165
 SMN =-.263011
 SMX =.263011
 -.263011
 -.204564
 -.146117
 -.08767
 -.029223
 .029223
 .08767
 .146117
 .204564
 .263011



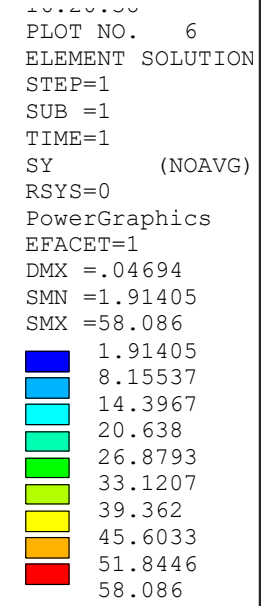
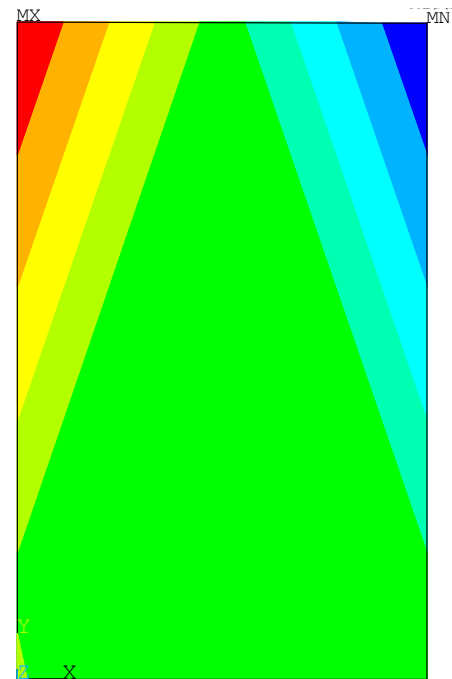
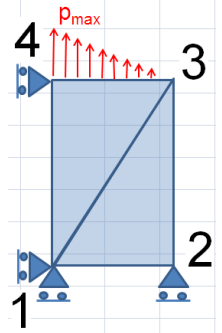
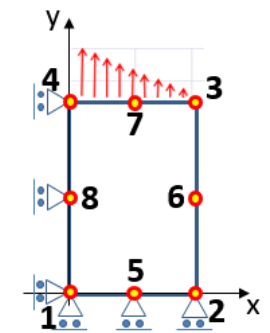
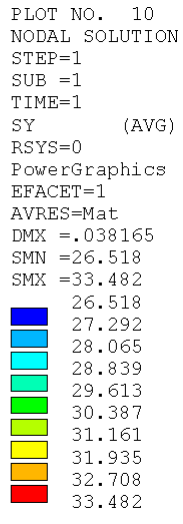
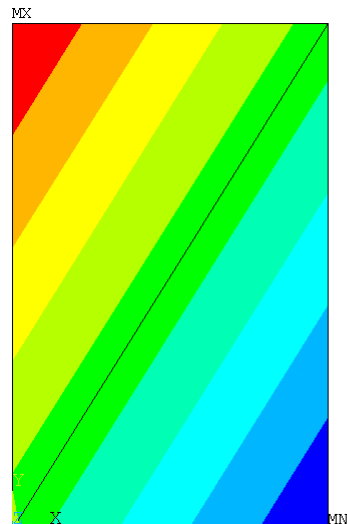
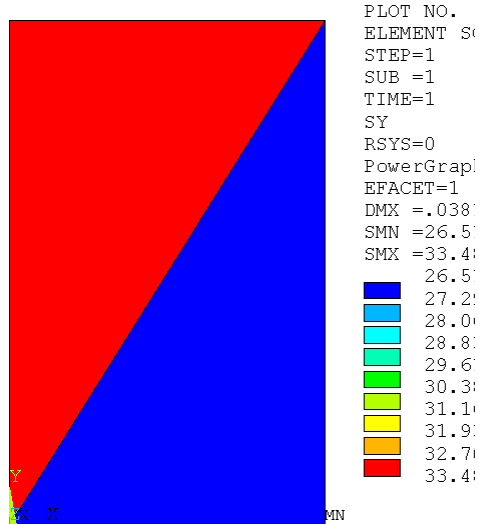
PLOT NO. 9
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.038165
 SMN =-.263011
 SMX =.263011
 -.263011
 -.204564
 -.146117
 -.08767
 -.029223
 .029223
 .08767
 .146117
 .204564
 .263011



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
 -12.8298
 -9.97872
 -7.12766
 -4.2766
 -1.42553
 1.42553
 4.2766
 7.12766
 9.97872
 12.8298

Naprężenia na kierunku Y

σ_y stress



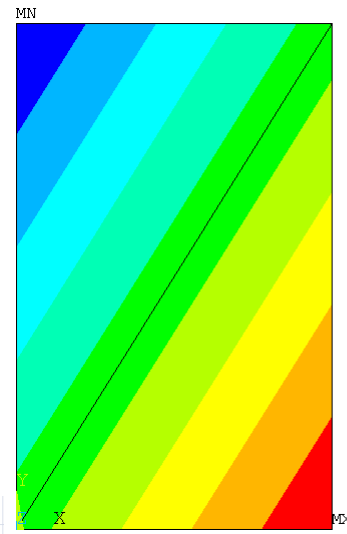
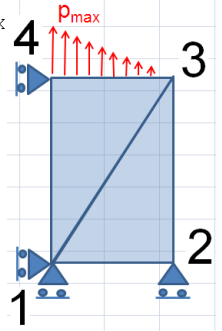
Naprężenia styczne

τ_{xy} stress



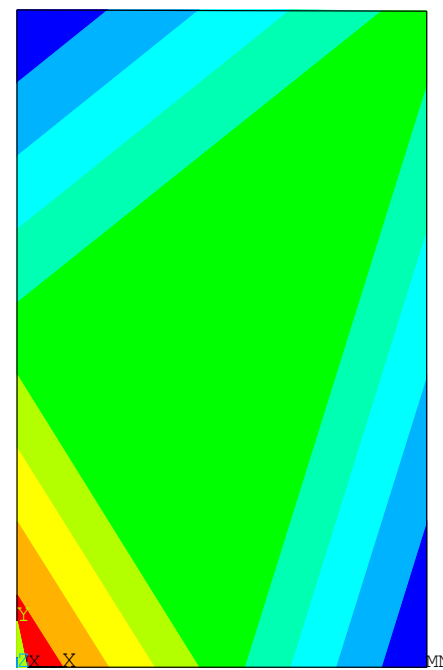
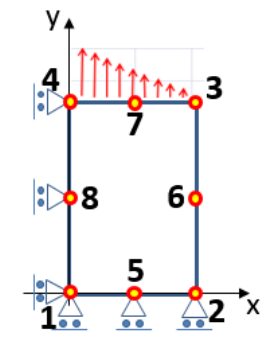
PLOT NO. 5
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.038165
 SMN =-4.074
 SMX =-.420818

Blue	-4.074
Light Blue	-3.668
Cyan	-3.262
Green	-2.856
Light Green	-2.45
Yellow-Green	-2.044
Yellow	-1.638
Orange	-1.233
Red-Orange	-.826679
Red	-.420818



PLOT NO. 11
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.038165
 SMN =-4.074
 SMX =-.420818

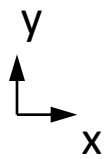
Blue	-4.074
Light Blue	-3.668
Cyan	-3.262
Green	-2.856
Light Green	-2.45
Yellow-Green	-2.044
Yellow	-1.638
Orange	-1.233
Red-Orange	-.826679
Red	-.420818



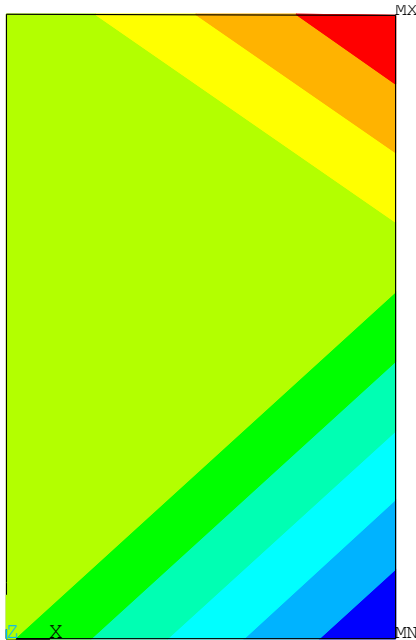
PLOT NO. 7
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.04694
 SMN =-6.81074
 SMX =2.7595

Blue	-6.81074
Light Blue	-5.74738
Cyan	-4.68402
Green	-3.62066
Light Green	-2.5573
Yellow-Green	-1.49394
Yellow	-.430576
Orange	.632784
Red-Orange	1.69614
Red	2.7595

Wpływ dyskretyzacji na jakość wyników (elementy 8węzłowe)



1

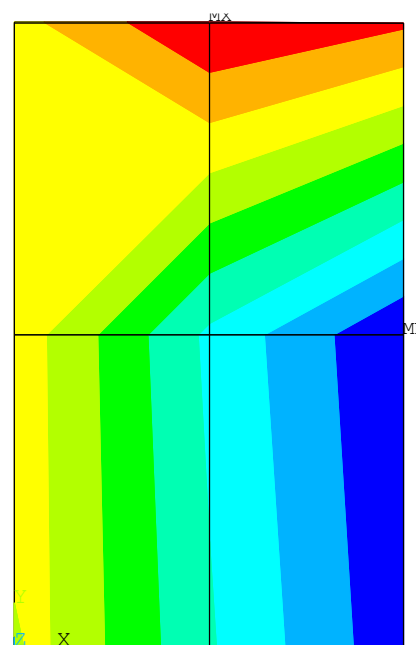


```

.....
PLOT NO.   3
NODAL SOLUTION
STEP=1
SUB  =1
TIME=1
UX          (AVG)
RSYS=0
PowerGraphics
EFACET=1
AVRES=Mat
DMX  =.04694
SMN  =-.005515
SMX  =.004184
    .-.005515
    .-.004437
    .-.003359
    .-.002282
    .-.001204
    .-.127E-03
    .951E-03
    .002029
    .003106
    .004184
    
```

UX
[mm]

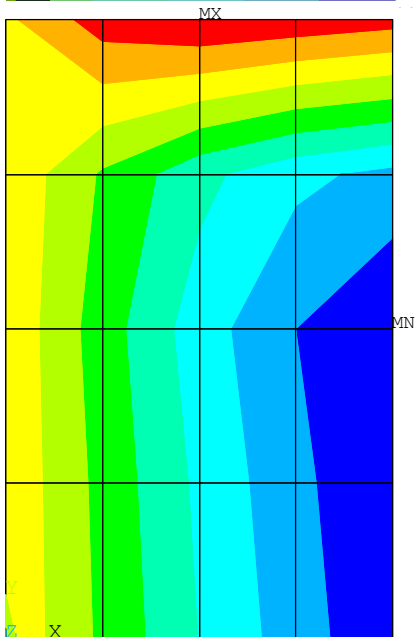
4



```

.....
PLOT NO.   1
NODAL SOLUTION
STEP=1
SUB  =1
TIME=1
UX          (AVG)
RSYS=0
PowerGraphics
EFACET=1
AVRES=Mat
DMX  =.046767
SMN  =-.009058
SMX  =.0032
    .-.009058
    .-.007696
    .-.006334
    .-.004972
    .-.00361
    .-.002248
    .-.886E-03
    .476E-03
    .001838
    .0032
    
```

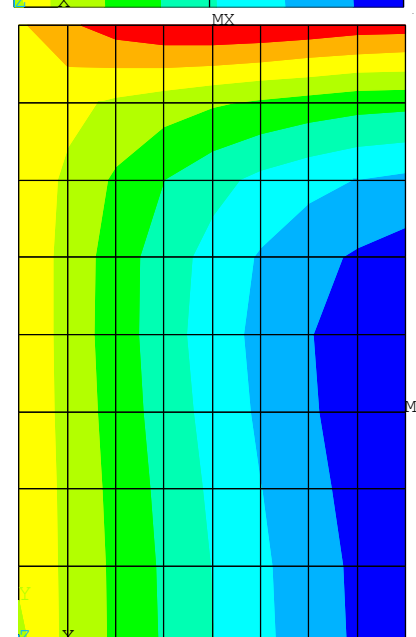
16



```

.....
PLOT NO.   1
NODAL SOLUTION
STEP=1
SUB  =1
TIME=1
UX          (AVG)
RSYS=0
PowerGraphics
EFACET=1
AVRES=Mat
DMX  =.047092
SMN  =-.008831
SMX  =.002854
    .-.008831
    .-.007533
    .-.006234
    .-.004936
    .-.003637
    .-.002339
    .-.001041
    .258E-03
    .001556
    .002854
    
```

64



```

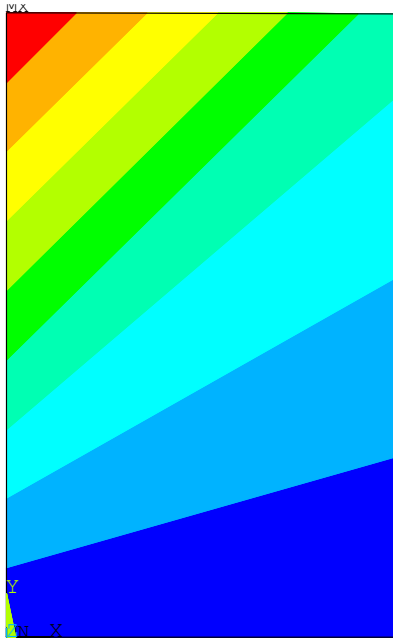
.....
PLOT NO.   1
NODAL SOLUTION
STEP=1
SUB  =1
TIME=1
UX          (AVG)
RSYS=0
PowerGraphics
EFACET=1
AVRES=Mat
DMX  =.047175
SMN  =-.008909
SMX  =.002836
    .-.008909
    .-.007604
    .-.006299
    .-.004994
    .-.003689
    .-.002384
    .-.001079
    .226E-03
    .001531
    .002836
    
```

Wpływ dyskretyzacji na jakość wyników (elementy 8węzłowe)

y

x

1

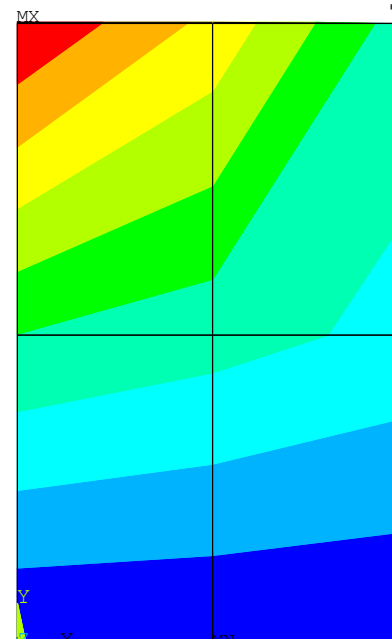


PLOT NO. 4
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.04694
 SMX =.04694

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

UY
 [mm]

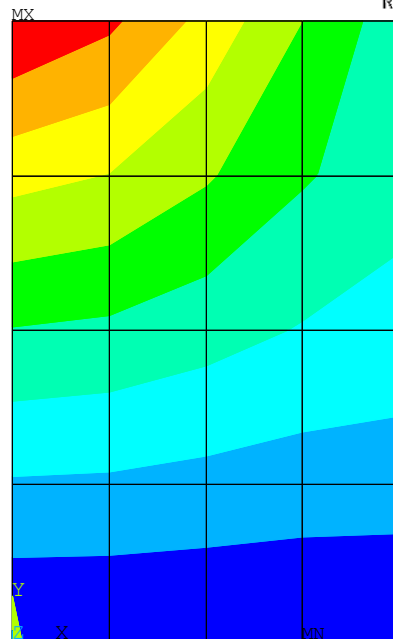
4



17:10:30
 PLOT NO. 2
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.046767
 SMX =.046767

0
.005196
.010393
.015589
.020785
.025982
.031178
.036374
.041571
.046767

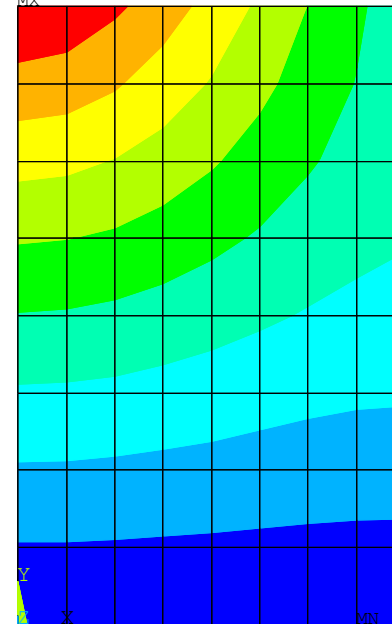
16



17:14:12
 PLOT NO. 2
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.047092
 SMX =.047092

0
.005232
.010465
.015697
.02093
.026162
.031395
.036627
.04186
.047092

64



17:10:01
 PLOT NO. 2
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UY (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.047175
 SMX =.047175

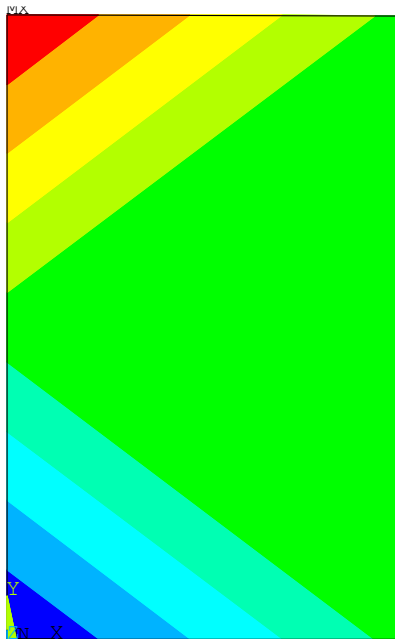
0
.005242
.010483
.015725
.020967
.026208
.03145
.036692
.041933
.047175

Wpływ dyskretyzacji na jakość wyników (elementy 8węzłowe)

y

x

1

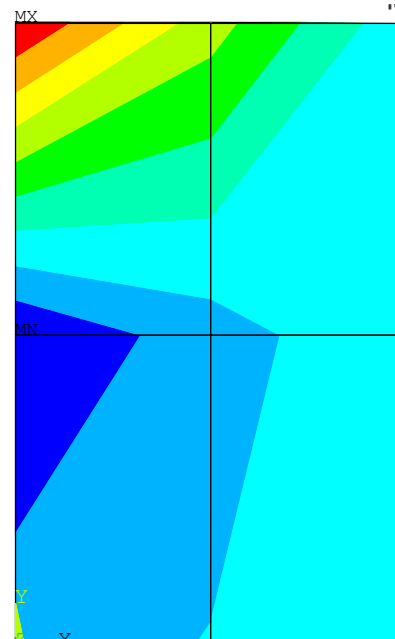


PLOT NO. 5
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.04694
 SMN =-12.8298
 SMX =12.8298

█	-12.8298
█	-9.97872
█	-7.12766
█	-4.2766
█	-1.42553
█	1.42553
█	4.2766
█	7.12766
█	9.97872
█	12.8298

σ_x
 [MPa]
 NODAL SOLUTION

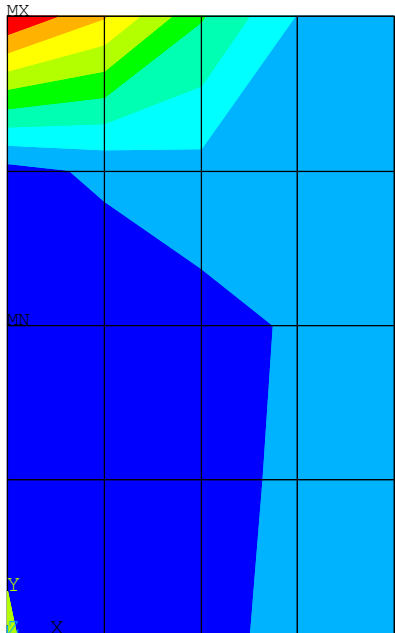
4



17:10:40
 PLOT NO. 3
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.046767
 SMN =-9.09511
 SMX =21.89

█	-9.09511
█	-5.65232
█	-2.20952
█	1.23327
█	4.67606
█	8.11886
█	11.5617
█	15.0044
█	18.4472
█	21.89

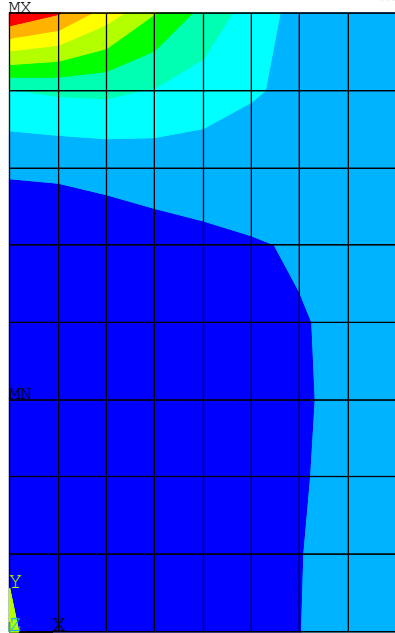
16



17:10:40
 PLOT NO. 3
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.047092
 SMN =-5.09635
 SMX =28.663

█	-5.09635
█	-1.34531
█	2.40573
█	6.15677
█	9.90781
█	13.6589
█	17.4099
█	21.1609
█	24.912
█	28.663

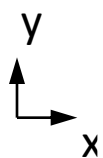
64



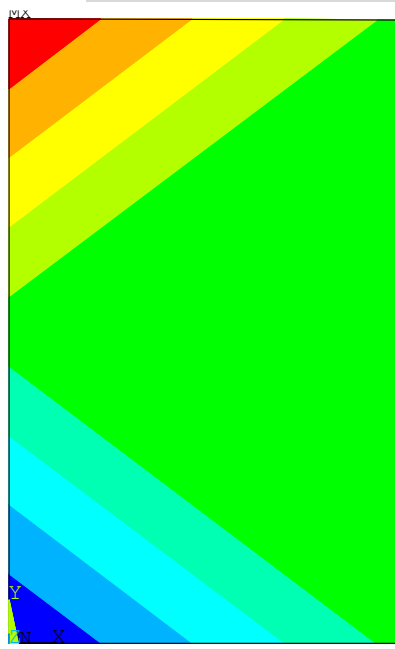
17:10:40
 PLOT NO. 3
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =.047175
 SMN =-4.80315
 SMX =32.5558

█	-4.80315
█	-1.652148
█	3.49885
█	7.64985
█	11.8009
█	15.9518
█	20.1028
█	24.2538
█	28.4048
█	32.5558

Wpływ dyskretyzacji na jakość wyników (elementy 8węzłowe)

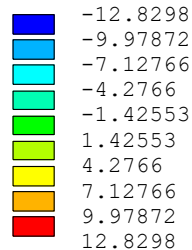


1

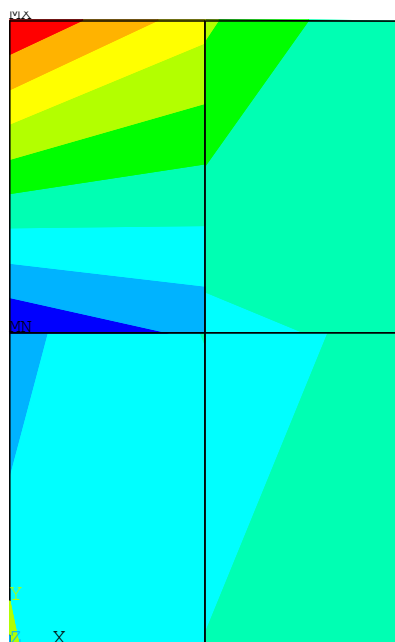


PLOT NO. 5
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.04694
 SMN =-12.8298
 SMX =12.8298

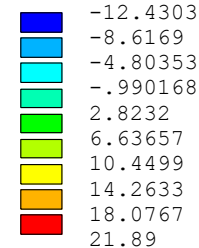
σ_x
 [MPa]
 ELEMENT SOLUTION



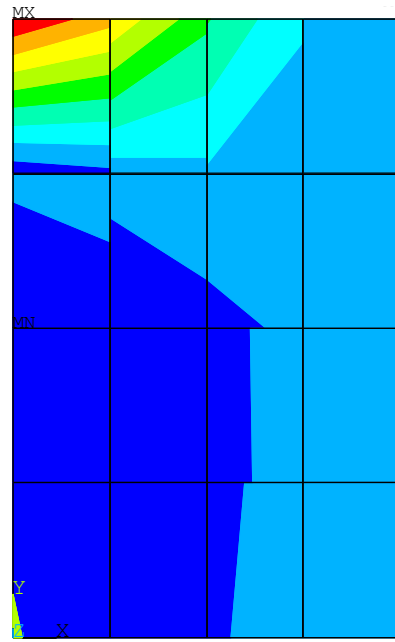
4



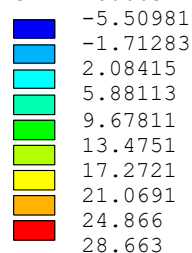
PLOT NO. 9
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.046767
 SMN =-12.4303
 SMX =21.89



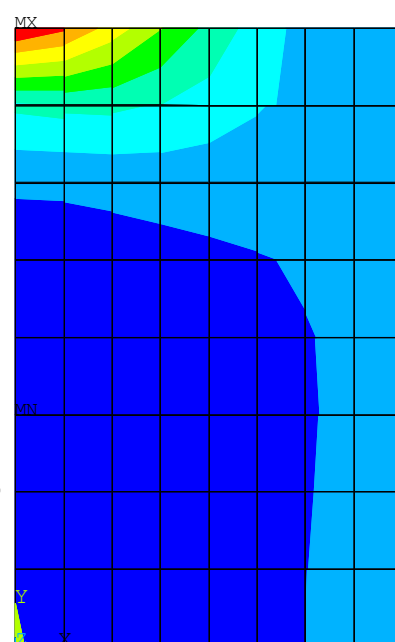
16



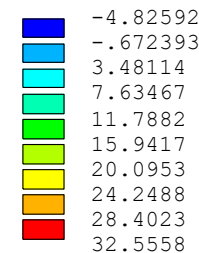
PLOT NO. 6
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.047092
 SMN =-5.50981
 SMX =28.663



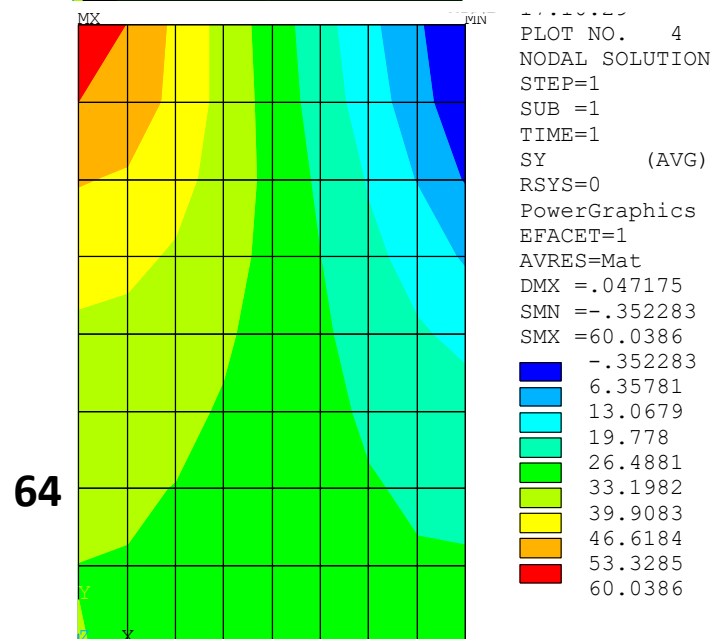
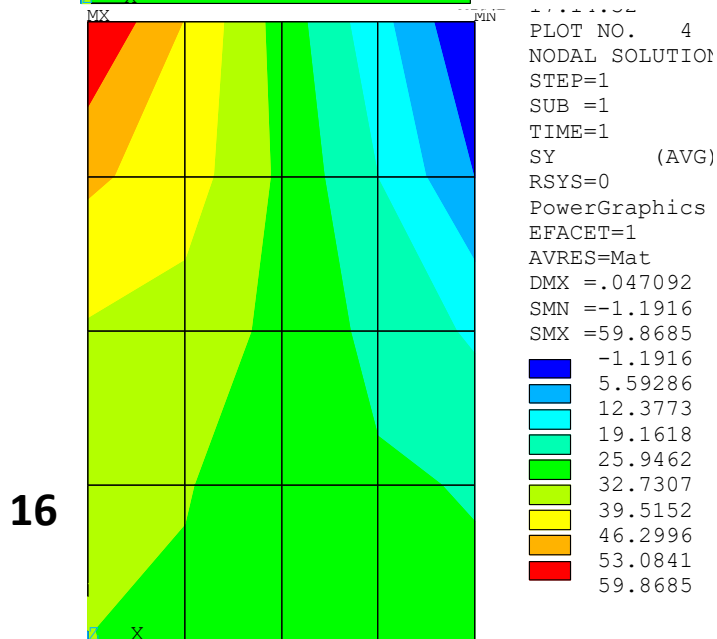
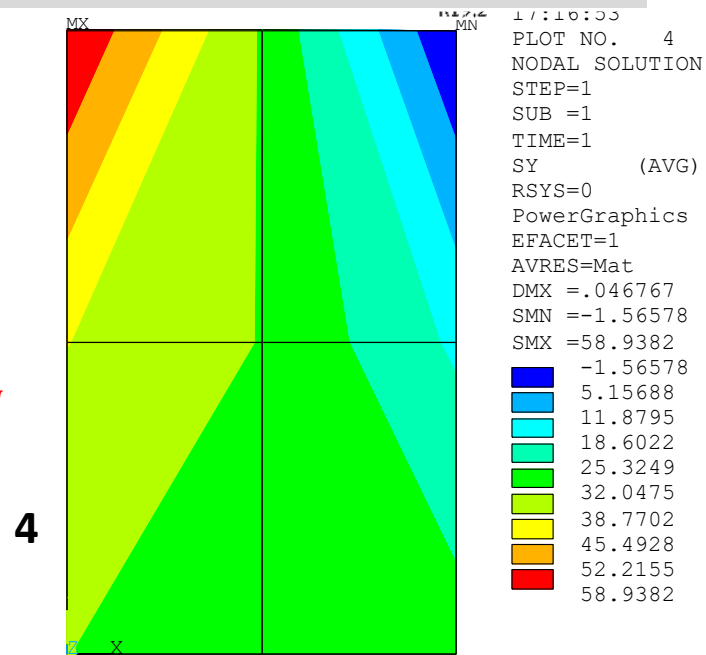
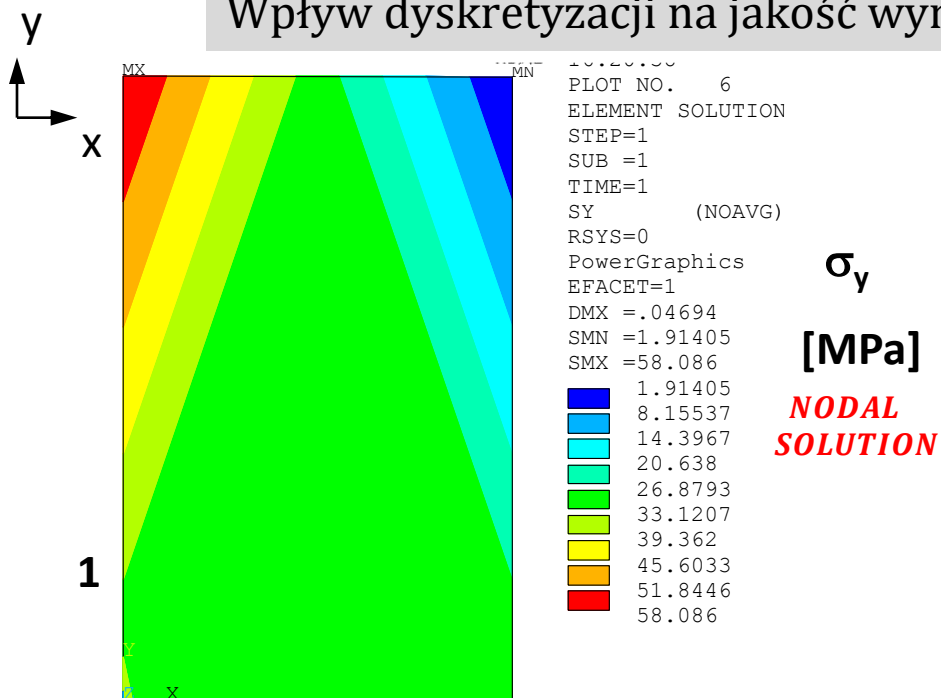
64



PLOT NO. 6
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SX (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.047175
 SMN =-4.82592
 SMX =32.5558



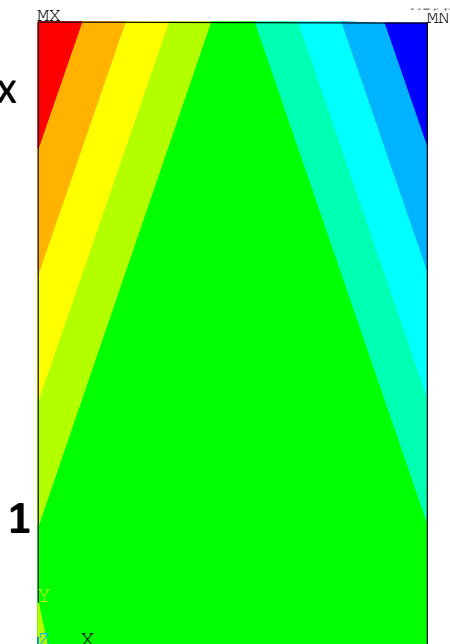
Wpływ dyskretyzacji na jakość wyników (elementy 8węzłowe)



Wpływ dyskretyzacji na jakość wyników (elementy 8węzłowe)

y

x



17:20:30
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

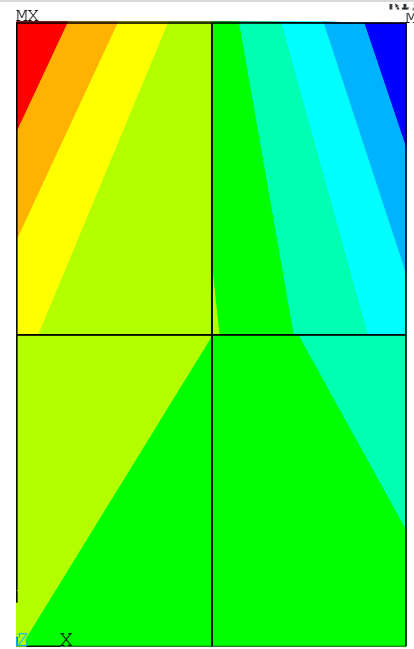
1.91405
8.15537
14.3967
20.638
26.8793
33.1207
39.362
45.6033
51.8446
58.086

σ_y

[MPa]

ELEMENT SOLUTION

4

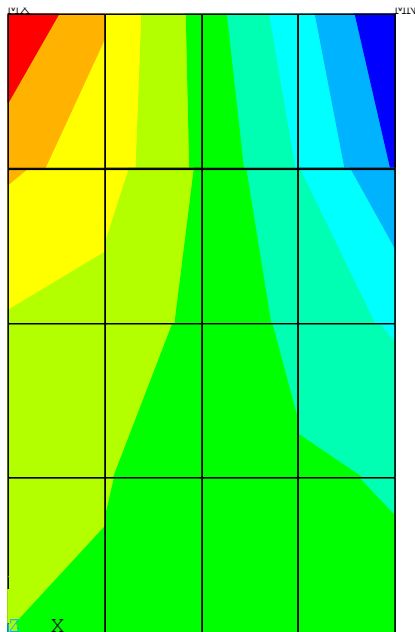


17:17:42
PLOT NO. 10
ELEMENT SOLUTION
STEP=1
SUB =1
TIME=1
SY (NOAVG)
RSYS=0
PowerGraphics
EFACET=1
DMX =.046767
SMN =-1.56578
SMX =58.9382

-1.56578
5.15688
11.8795
18.6022
25.3249
32.0475
38.7702
45.4928
52.2155
58.9382

16

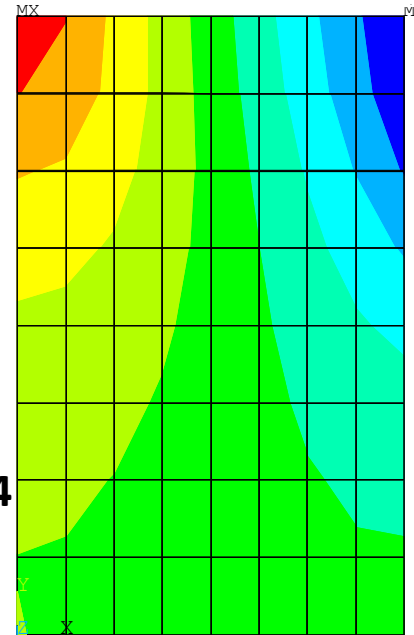
16



PLOT NO. 7
ELEMENT SOLUTION
STEP=1
SUB =1
TIME=1
SY (NOAVG)
RSYS=0
PowerGraphics
EFACET=1
DMX =.047092
SMN =-1.1916
SMX =59.8685

-1.1916
5.59286
12.3773
19.1618
25.9462
32.7307
39.5152
46.2996
53.0841
59.8685

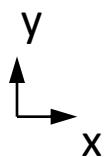
64



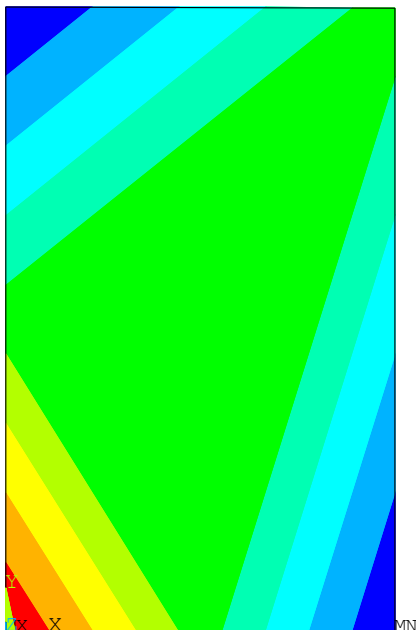
PLOT NO. 7
ELEMENT SOLUTION
STEP=1
SUB =1
TIME=1
SY (NOAVG)
RSYS=0
PowerGraphics
EFACET=1
DMX =.047175
SMN =-.352283
SMX =60.0386

-.352283
6.35781
13.0679
19.778
26.4881
33.1982
39.9083
46.6184
53.3285
60.0386

Wpływ dyskretyzacji na jakość wyników (elementy 8węzłowe)

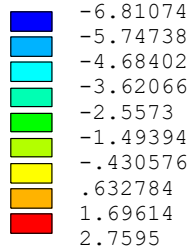


1

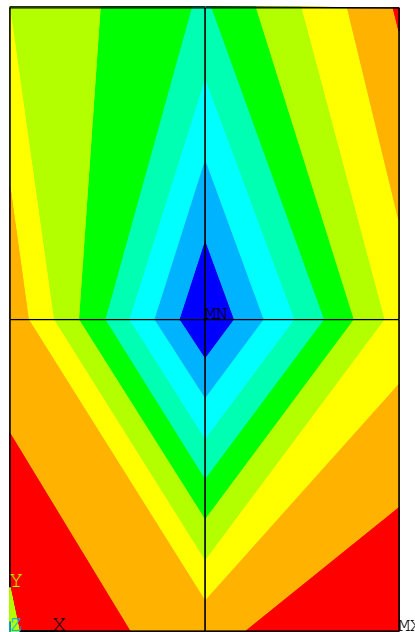


PLOT NO. 7
ELEMENT SOLUTION
STEP=1
SUB =1
TIME=1
SXY (NOAVG)
RSYS=0
PowerGraphics
EFACET=1
DMX =.04694
SMN =-6.81074
SMX =2.7595

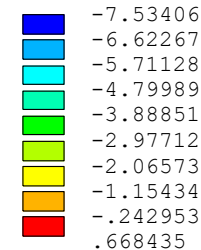
τ_{xy}
[MPa]
NODAL SOLUTION



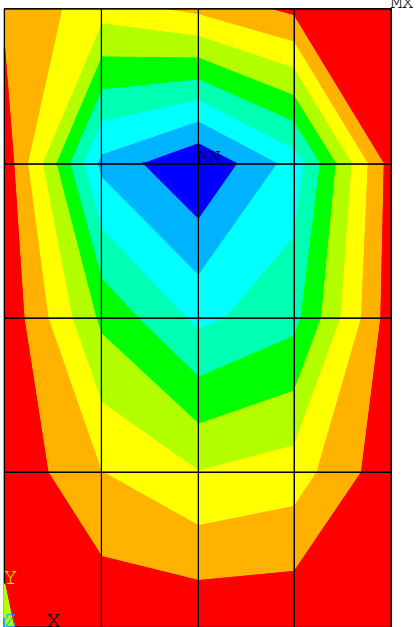
4



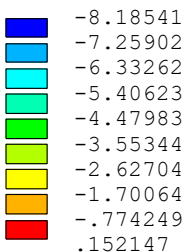
PLOT NO. 5
NODAL SOLUTION
STEP=1
SUB =1
TIME=1
SXY (AVG)
RSYS=0
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.046767
SMN =-7.53406
SMX =.668435



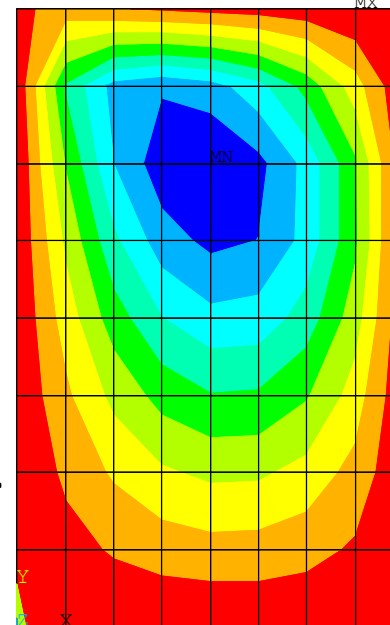
16



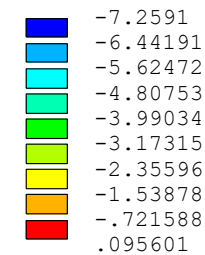
PLOT NO. 5
NODAL SOLUTION
STEP=1
SUB =1
TIME=1
SXY (AVG)
RSYS=0
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.047092
SMN =-8.18541
SMX =.152147



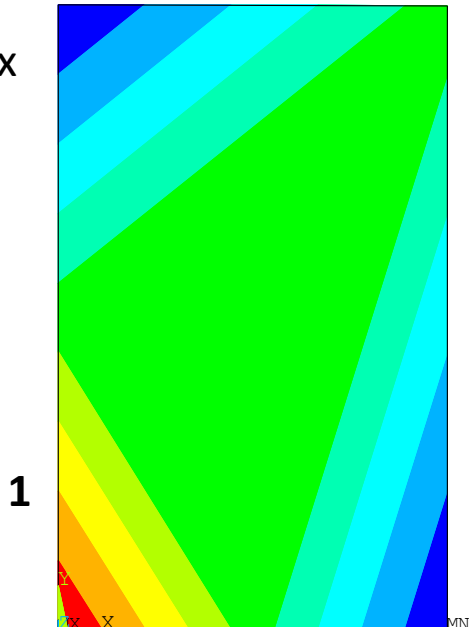
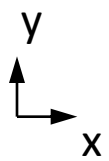
64



PLOT NO. 5
NODAL SOLUTION
STEP=1
SUB =1
TIME=1
SXY (AVG)
RSYS=0
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.047175
SMN =-7.2591
SMX =.095601



Wpływ dyskretyzacji na jakość wyników (elementy 8węzłowe)

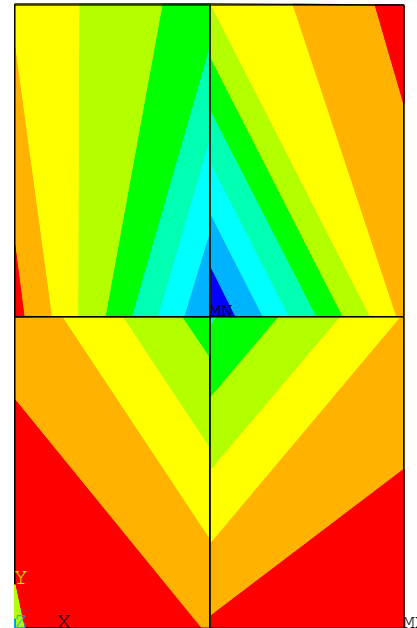


PLOT NO. 7
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.04694
 SMN =-6.81074
 SMX =2.7595

Blue	-6.81074
Light Blue	-5.74738
Cyan	-4.68402
Green	-3.62066
Light Green	-2.5573
Yellow-Green	-1.49394
Yellow	-.430576
Orange	.632784
Red-Orange	1.69614
Red	2.7595

τ_{xy}
 [MPa]
 ELEMENT SOLUTION

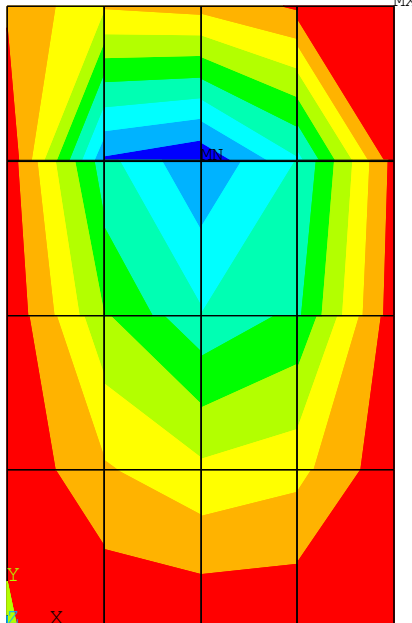
1



PLOT NO. 11
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.046767
 SMN =-10.4579
 SMX =.668435

Blue	-10.4579
Light Blue	-9.22163
Cyan	-7.98537
Green	-6.74912
Light Green	-5.51286
Yellow-Green	-4.2766
Yellow	-3.04034
Orange	-1.80408
Red-Orange	-.567824
Red	.668435

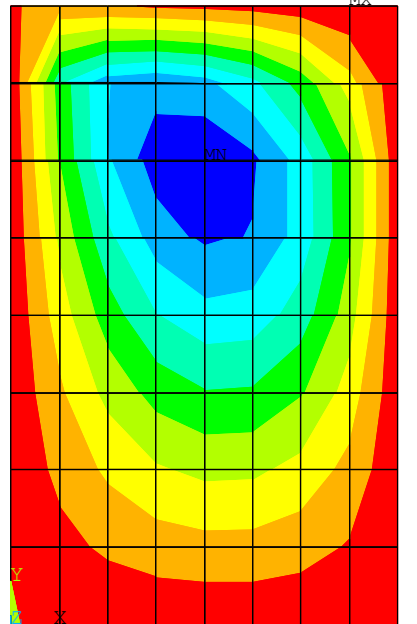
4



PLOT NO. 8
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.047092
 SMN =-8.78477
 SMX =.152147

Blue	-8.78477
Light Blue	-7.79178
Cyan	-6.79879
Green	-5.8058
Light Green	-4.81281
Yellow-Green	-3.81982
Yellow	-2.82683
Orange	-1.83383
Red-Orange	-.840844
Red	.152147

16



PLOT NO. 8
 ELEMENT SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SXY (NOAVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 DMX =.047175
 SMN =-7.33453
 SMX =.163931

Blue	-7.33453
Light Blue	-6.50137
Cyan	-5.66821
Green	-4.83505
Light Green	-4.00188
Yellow-Green	-3.16872
Yellow	-2.33556
Orange	-1.50239
Red-Orange	-.669232
Red	.163931

64