

Naročnik:

Luka Koper d.d.

Naprava:

HIDRAVLIČNA RAMPA 120t

Poročilo:

TRDNOSTNA ANALIZA

Datum:

18.11.2021

Pripravil:

Janez Lukančič, dipl. inž. str.

Klemen Ambrož, mag. inž. str.

## KAZALO:

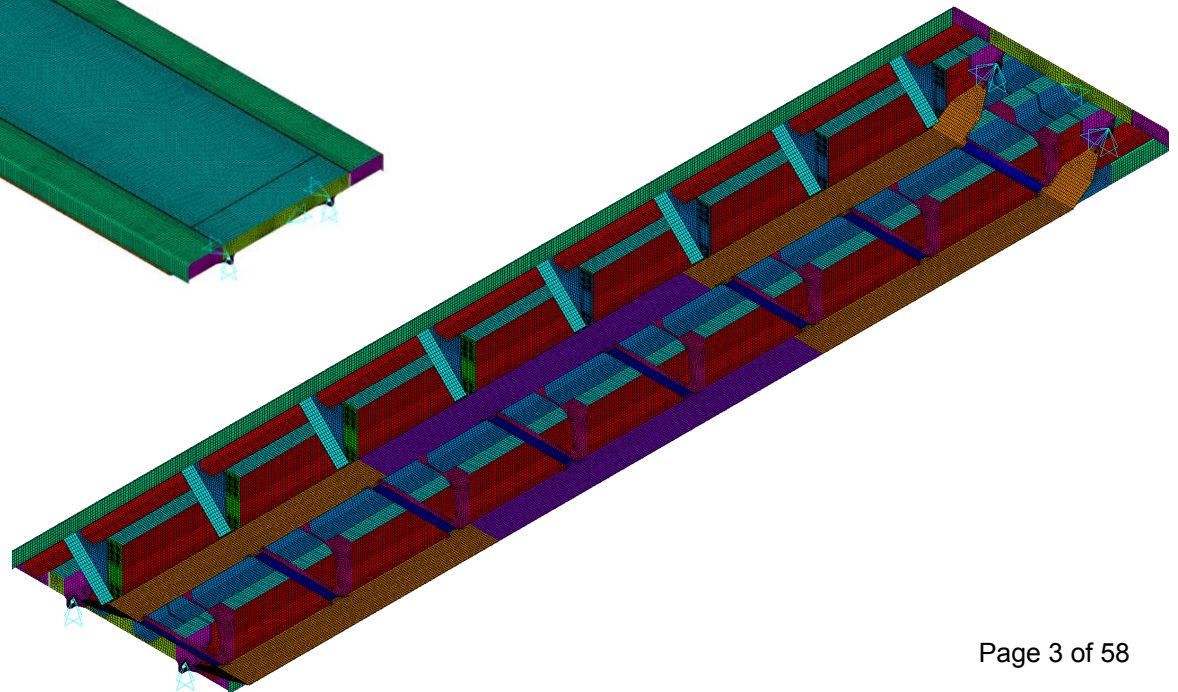
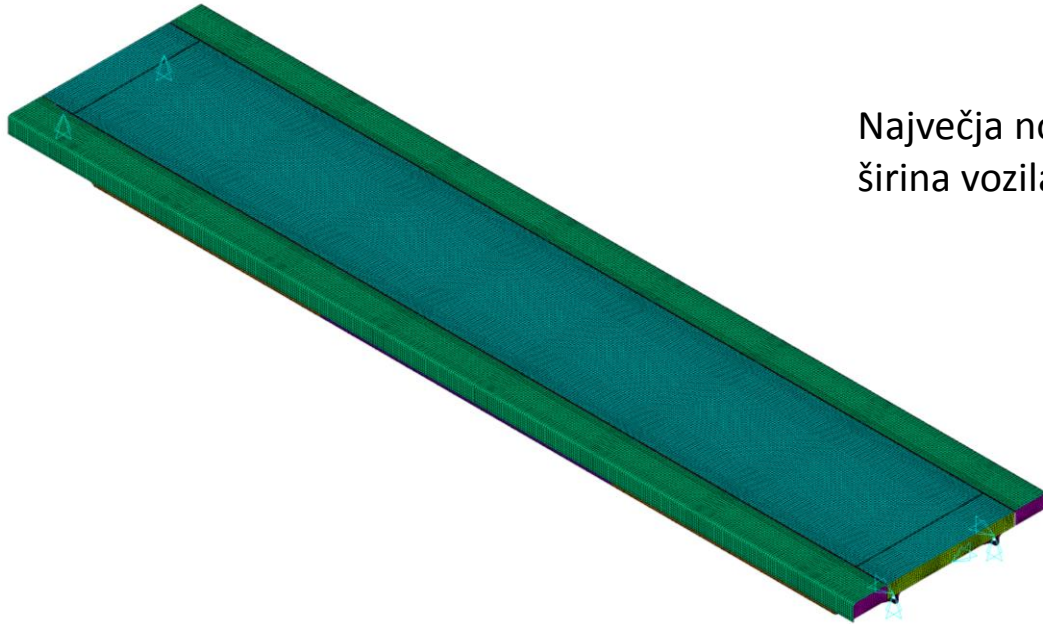
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# MKE MODEL

## PREGLED POSAMEZNIH POZICIJ

**Material: S355**

Največja nosilnost Hidravlične rampe je 120t. Največja širina vozila 3,5m. Vožnja dovoljena po sredini rampe.

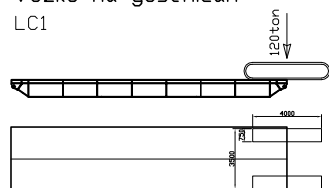


# OBREMENILNI PRIMERI

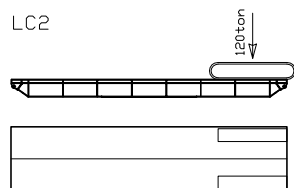


Vozilo na gosenicah

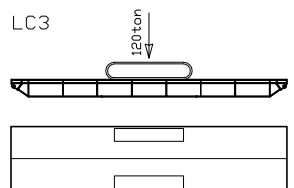
LC1



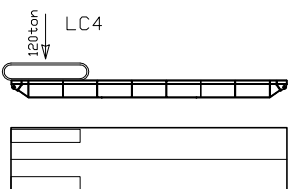
LC2



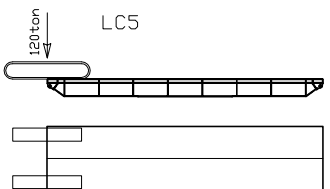
LC3



LC4

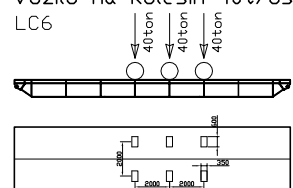


LC5

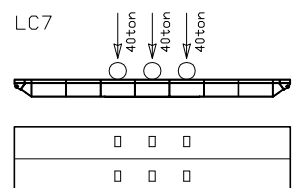


Vozilo na kolesih 40t/os

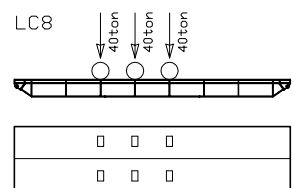
LC6



LC7

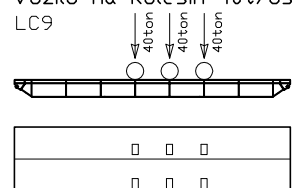


LC8

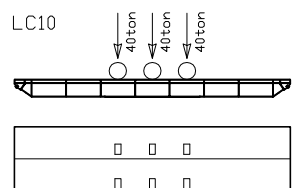


Vozilo na kolesih 40t/os

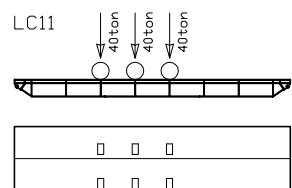
LC9



LC10

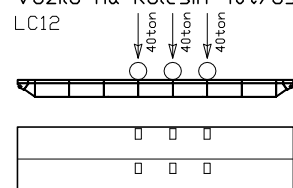


LC11

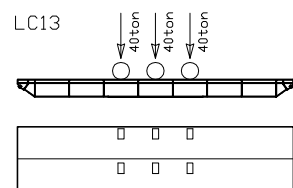


Vozilo na kolesih 40t/os

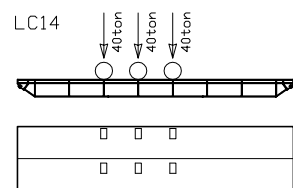
LC12



LC13

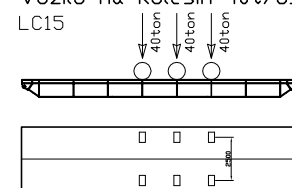


LC14

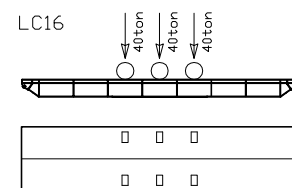


Vozilo na kolesih 40t/os

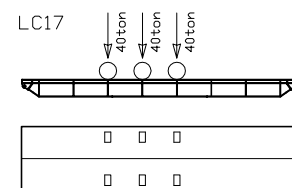
LC15



LC16

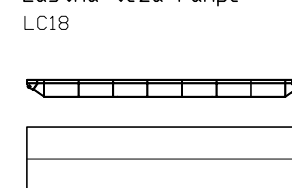


LC17



Lastna teža rampe

LC18

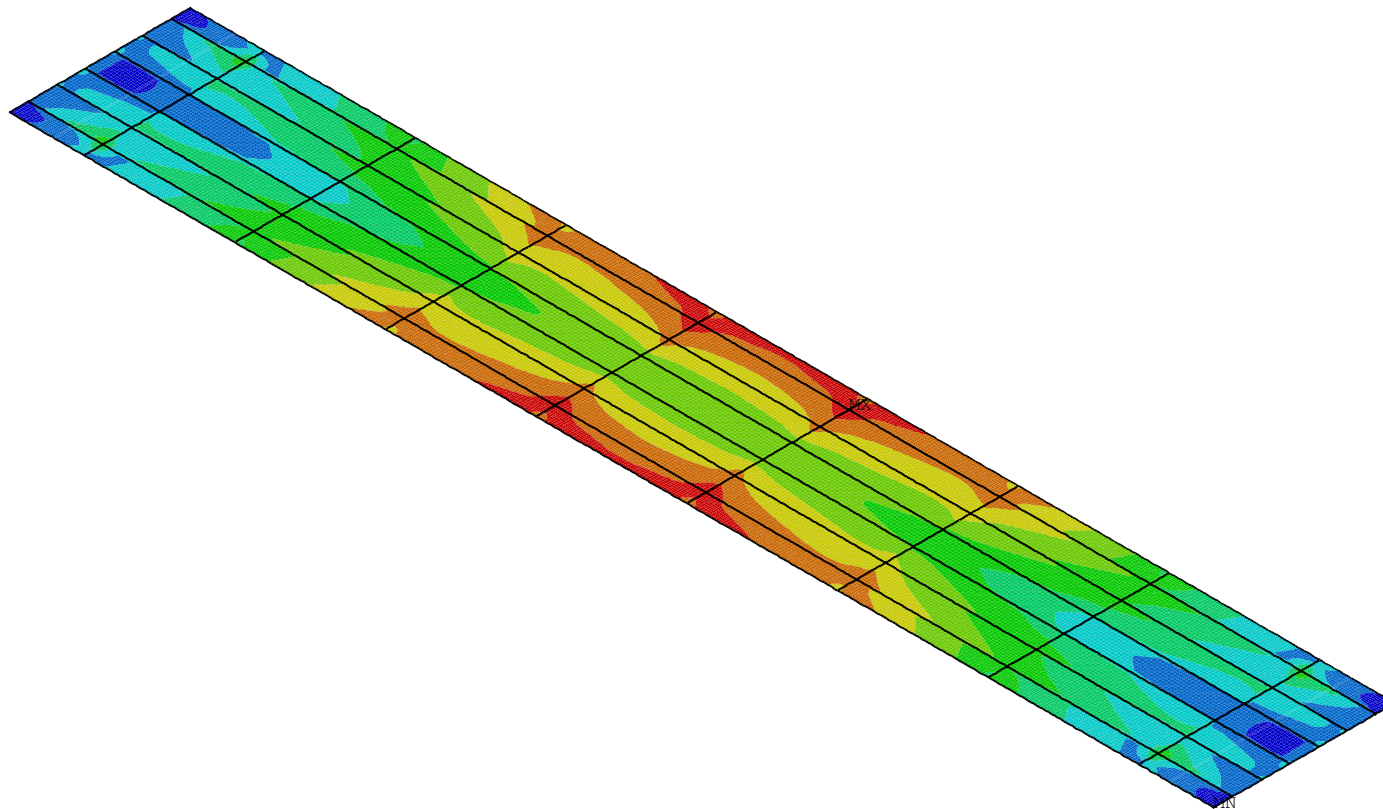


# NAPETOSTI

Von Mises

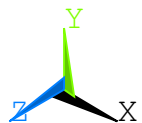
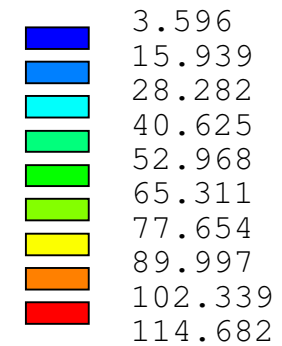
1

POSITION 1, MASS=6021kg      PLATE t=20mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



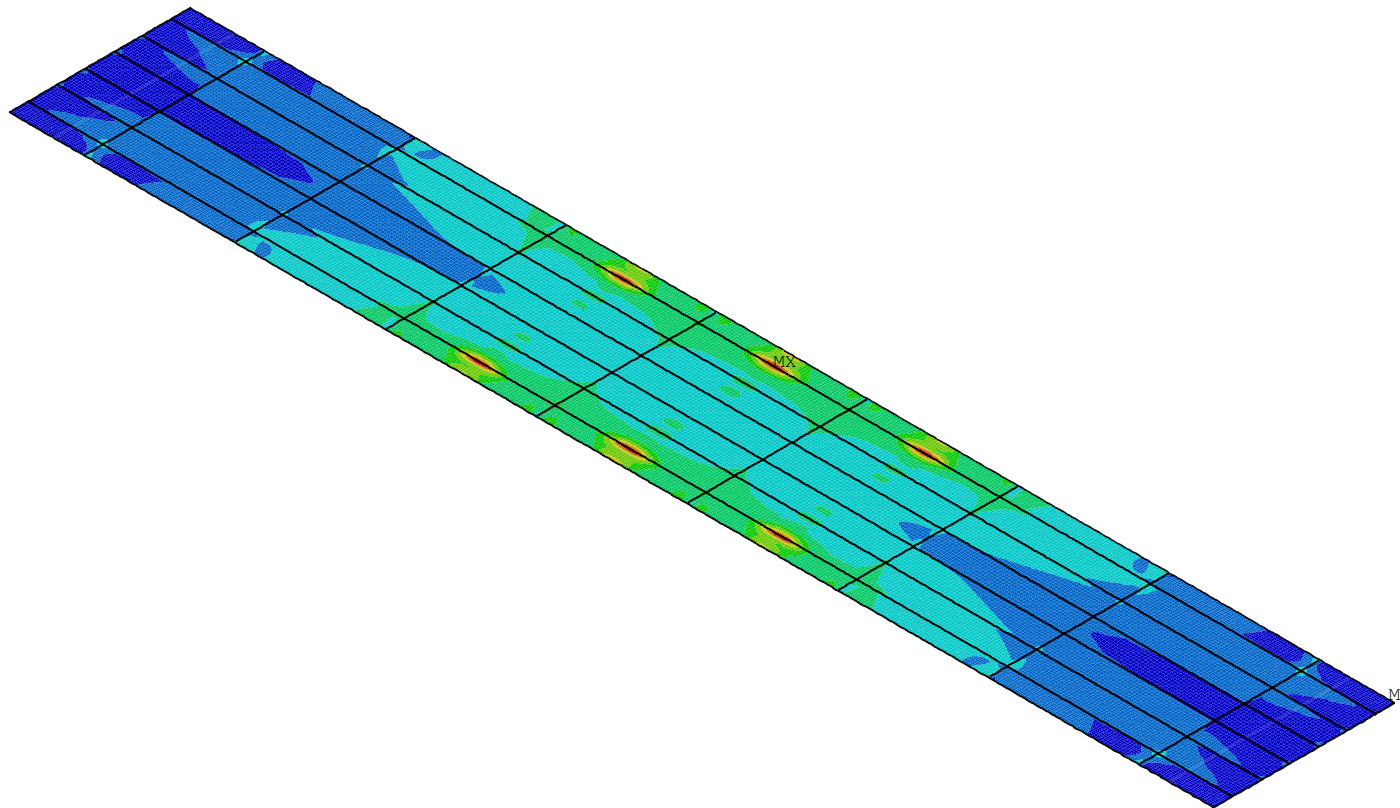
ANSYS 12.1  
NOV 9 2021  
09:30:08  
PLOT NO. 10  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXM (AVG)  
MIDDLE  
DMX =3.083  
SMN =3.596  
SMX =114.682

XV =1  
YV =1  
ZV =1  
DIST=7148  
YF =980  
CENTROID HIDDEN



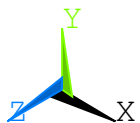
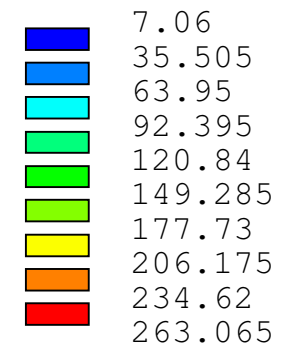
1

POSITION 1, MASS=6021kg      PLATE t=20mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (top plane)      LC 1 - 18



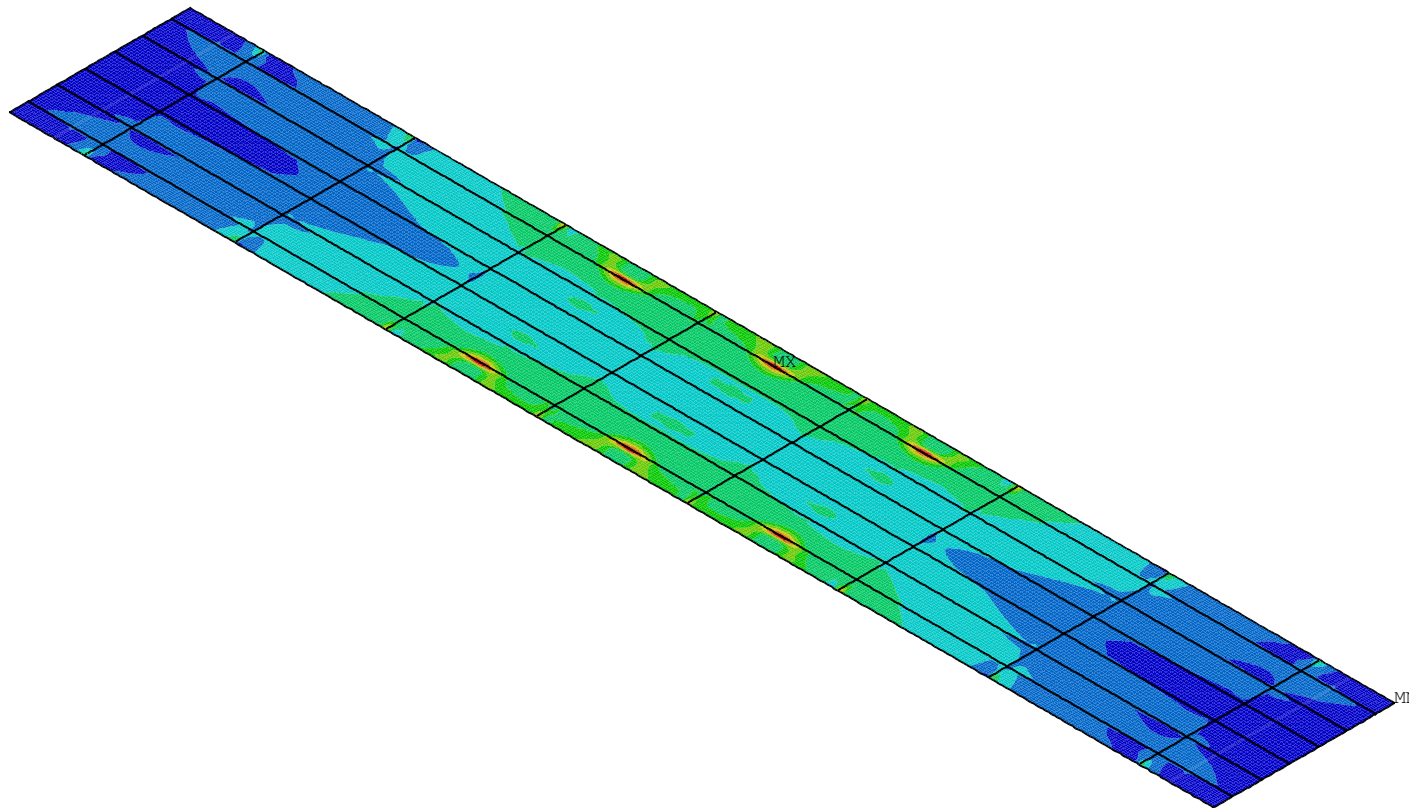
ANSYS 12.1  
NOV 9 2021  
09:30:09  
PLOT NO. 11  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXT (AVG)  
TOP  
DMX =3.083  
SMN =7.06  
SMX =263.065

XV =1  
YV =1  
ZV =1  
DIST=7148  
YF =980  
CENTROID HIDDEN



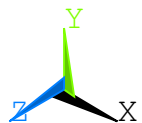
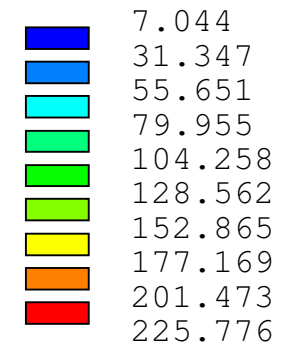
1

POSITION 1, MASS=6021kg      PLATE t=20mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



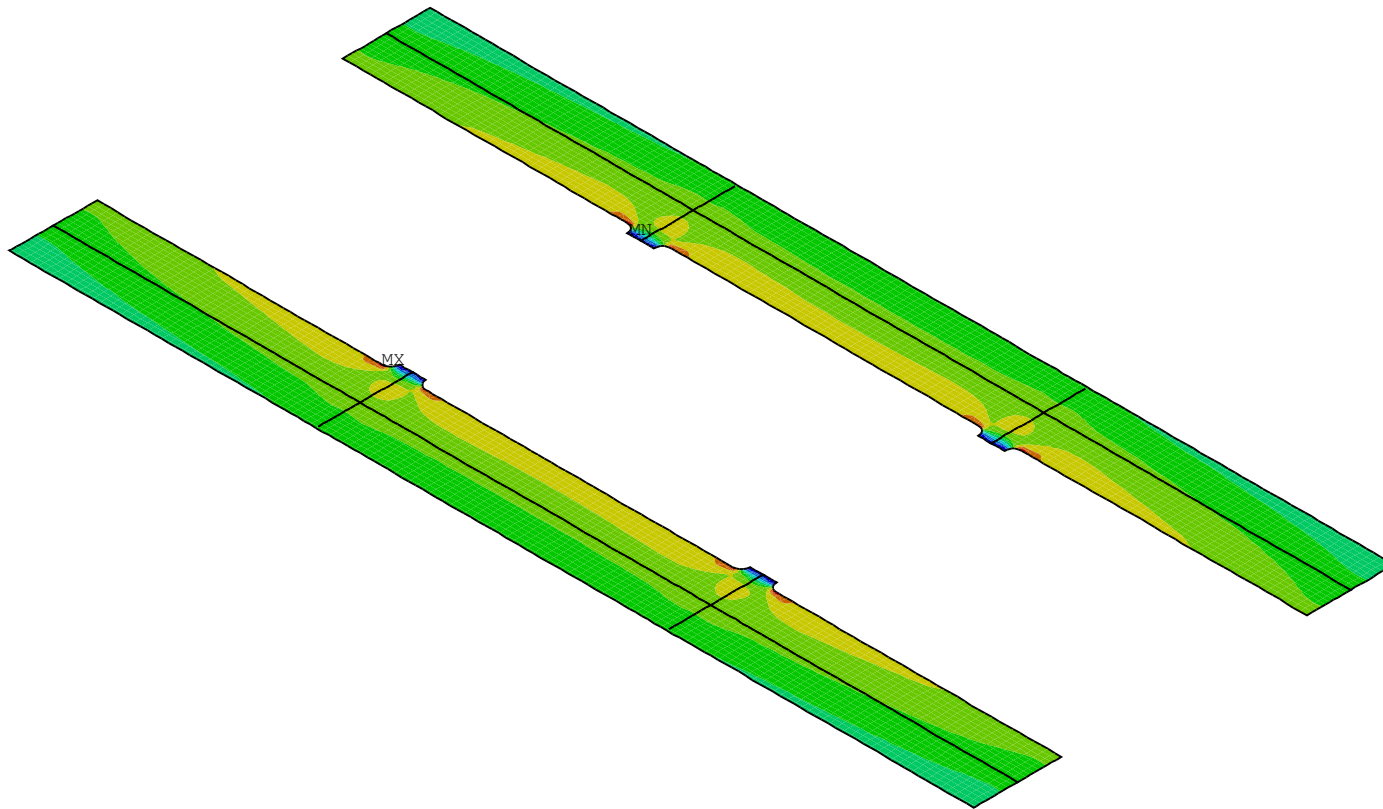
ANSYS 12.1  
NOV 9 2021  
09:30:09  
PLOT NO. 12  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXB (AVG)  
BOTTOM  
DMX =3.083  
SMN =7.044  
SMX =225.776

XV =1  
YV =1  
ZV =1  
DIST=7148  
YF =980  
CENTROID HIDDEN



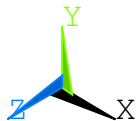
1

POSITION 2, MASS=1303kg      PLATE t=30mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



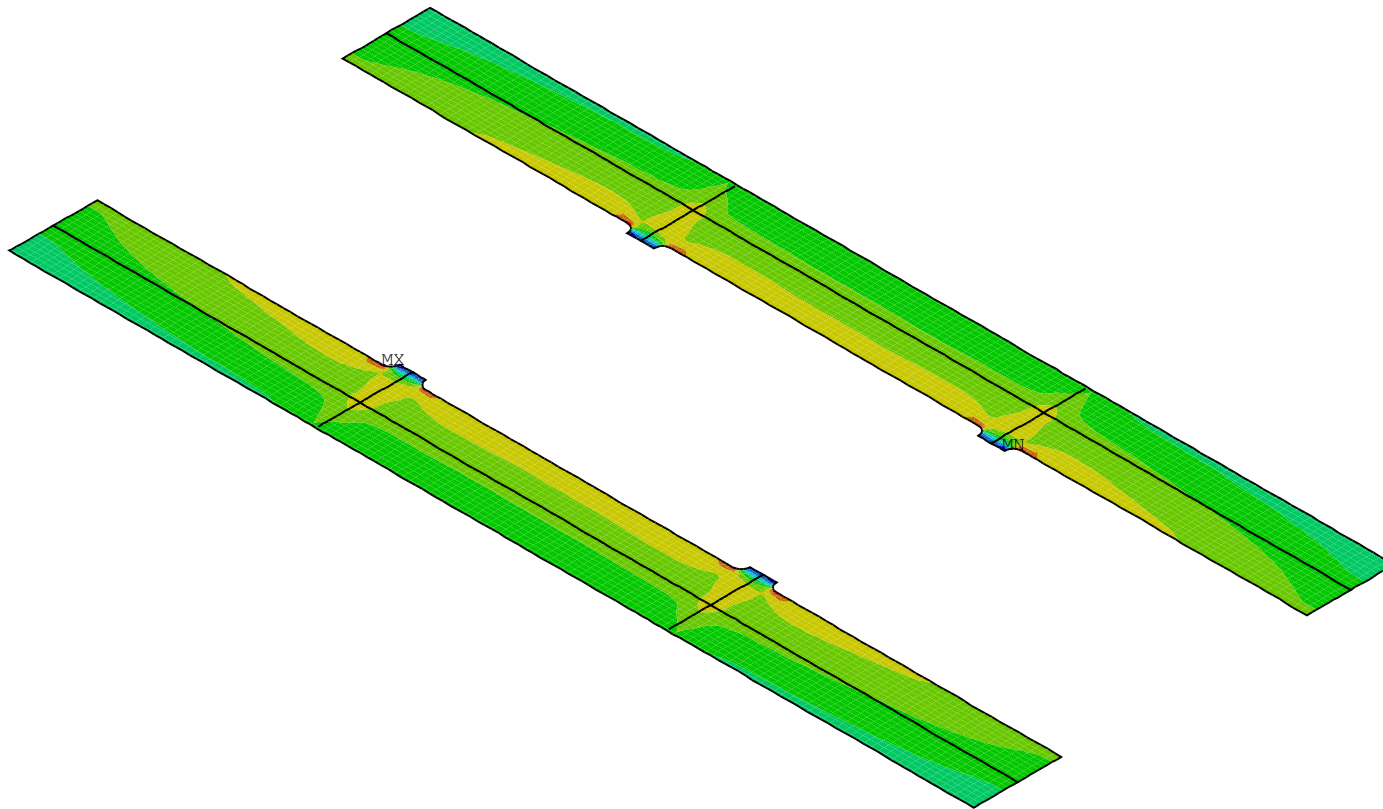
ANSYS 12.1  
NOV 9 2021  
09:30:12  
PLOT NO. 16  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXM (AVG)  
MIDDLE  
DMX =3.074  
SMN =36.825  
SMX =226.491

XV =1  
YV =1  
ZV =1  
DIST=3072  
CENTROID HIDDEN  
36.825  
57.899  
78.973  
100.047  
121.121  
142.195  
163.269  
184.343  
205.417  
226.491



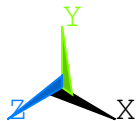
1

POSITION 2, MASS=1303kg      PLATE t=30mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (top plane)      LC 1 - 18



ANSYS 12.1  
NOV 9 2021  
09:30:12  
PLOT NO. 17  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXT (AVG)  
TOP  
DMX =3.074  
SMN =36.999  
SMX =233.909

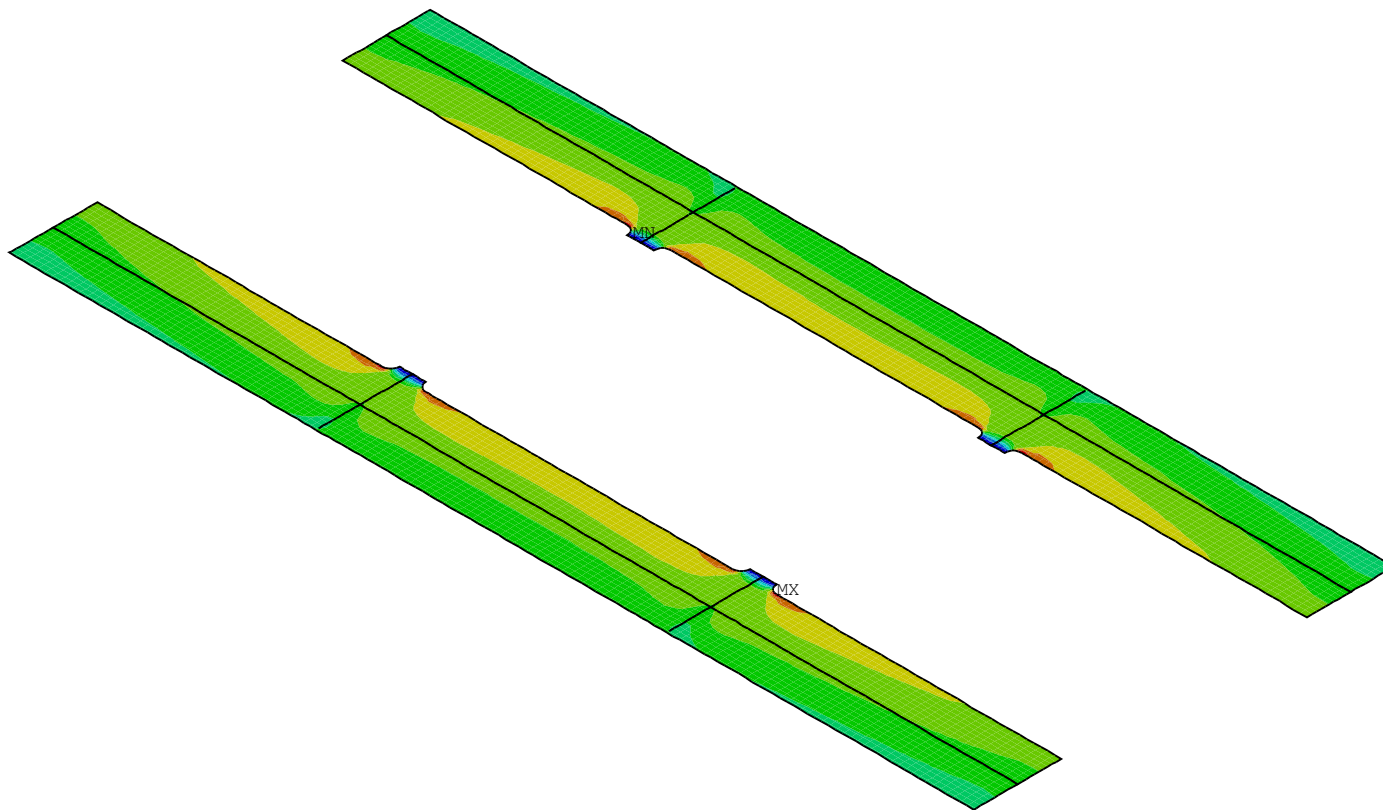
XV =1  
YV =1  
ZV =1  
DIST=3072  
CENTROID HIDDEN  
36.999  
58.877  
80.756  
102.635  
124.514  
146.393  
168.272  
190.151  
212.03  
233.909





1

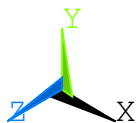
POSITION 2, MASS=1303kg      PLATE t=30mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



ANSYS 12.1  
NOV 9 2021  
09:30:12  
PLOT NO. 18  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXB (AVG)  
BOTTOM  
DMX =3.074  
SMN =33.569  
SMX =219.134

XV =1  
YV =1  
ZV =1  
DIST=3072  
CENTROID HIDDEN

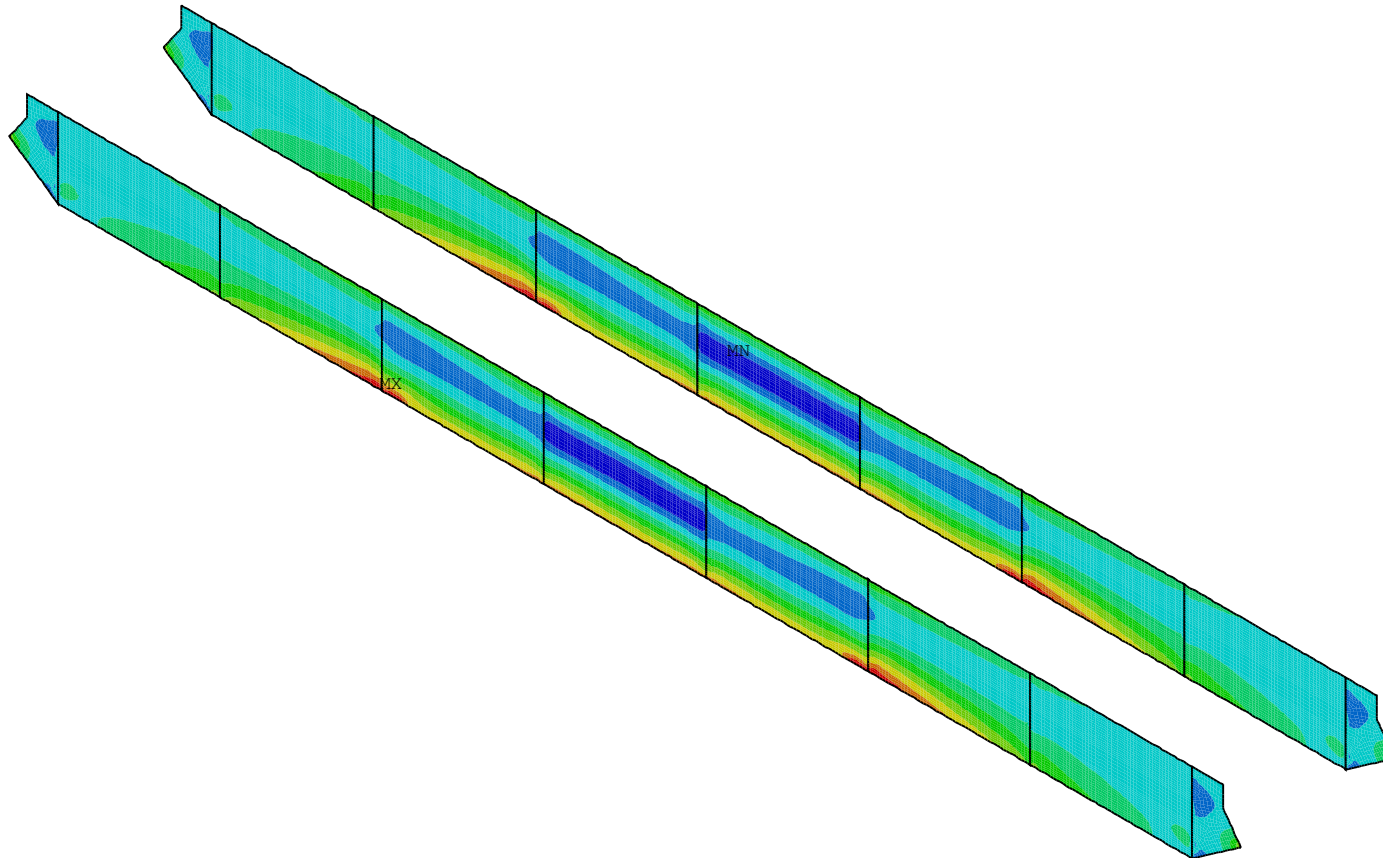
	33.569
	54.187
	74.805
	95.424
	116.042
	136.66
	157.279
	177.897
	198.515
	219.134





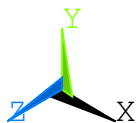
1

POSITION 3, MASS=3406kg      PLATE t=15mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



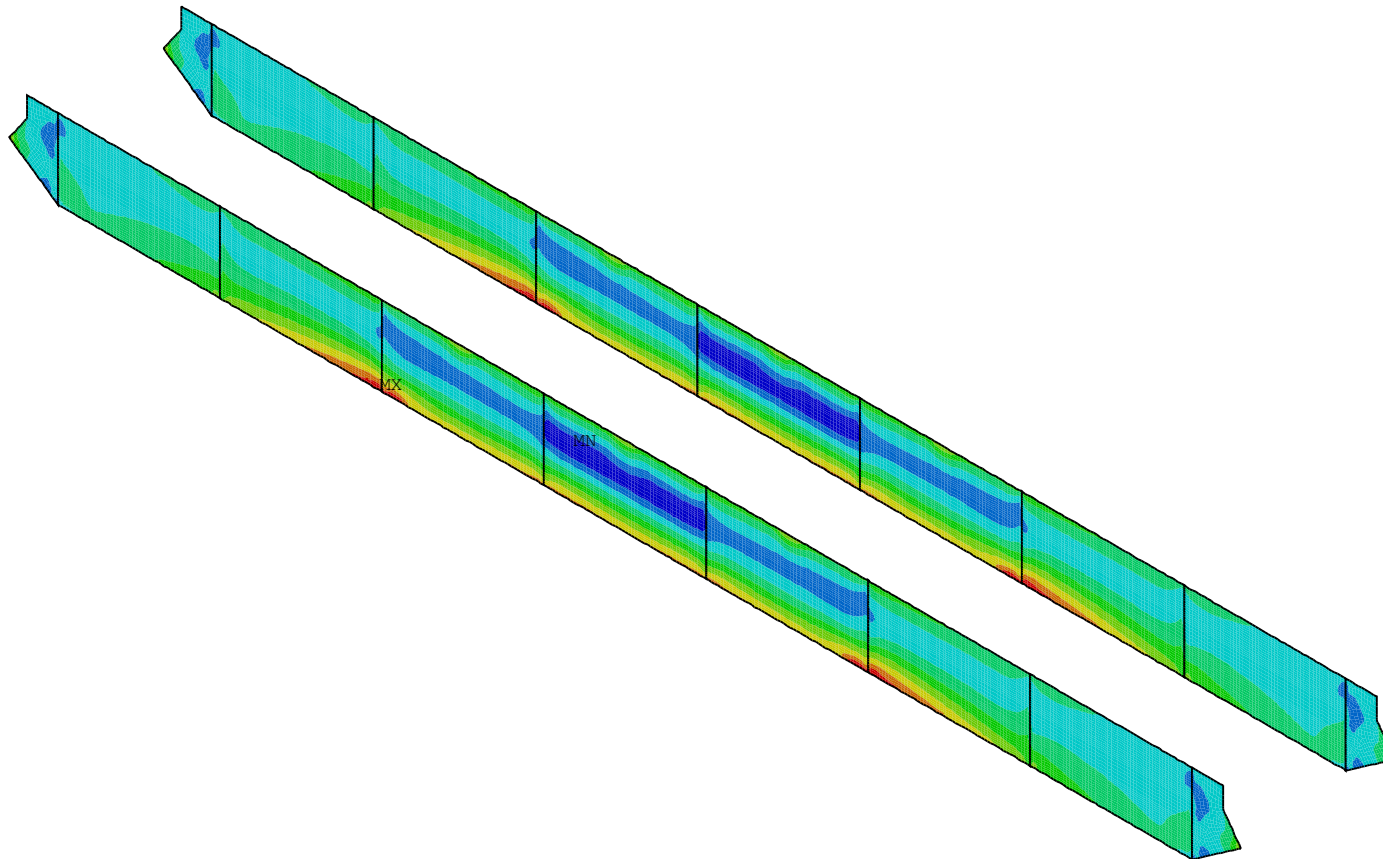
ANSYS 12.1  
NOV 9 2021  
09:30:18  
PLOT NO. 22  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXM (AVG)  
MIDDLE  
DMX =3.072  
SMN =12.69  
SMX =181.728

XV =1  
YV =1  
ZV =1  
DIST=6649  
YF =490  
CENTROID HIDDEN  
12.69  
31.472  
50.254  
69.036  
87.818  
106.6  
125.382  
144.164  
162.946  
181.728



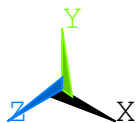
1

POSITION 3, MASS=3406kg      PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (top plane)      LC 1 - 18



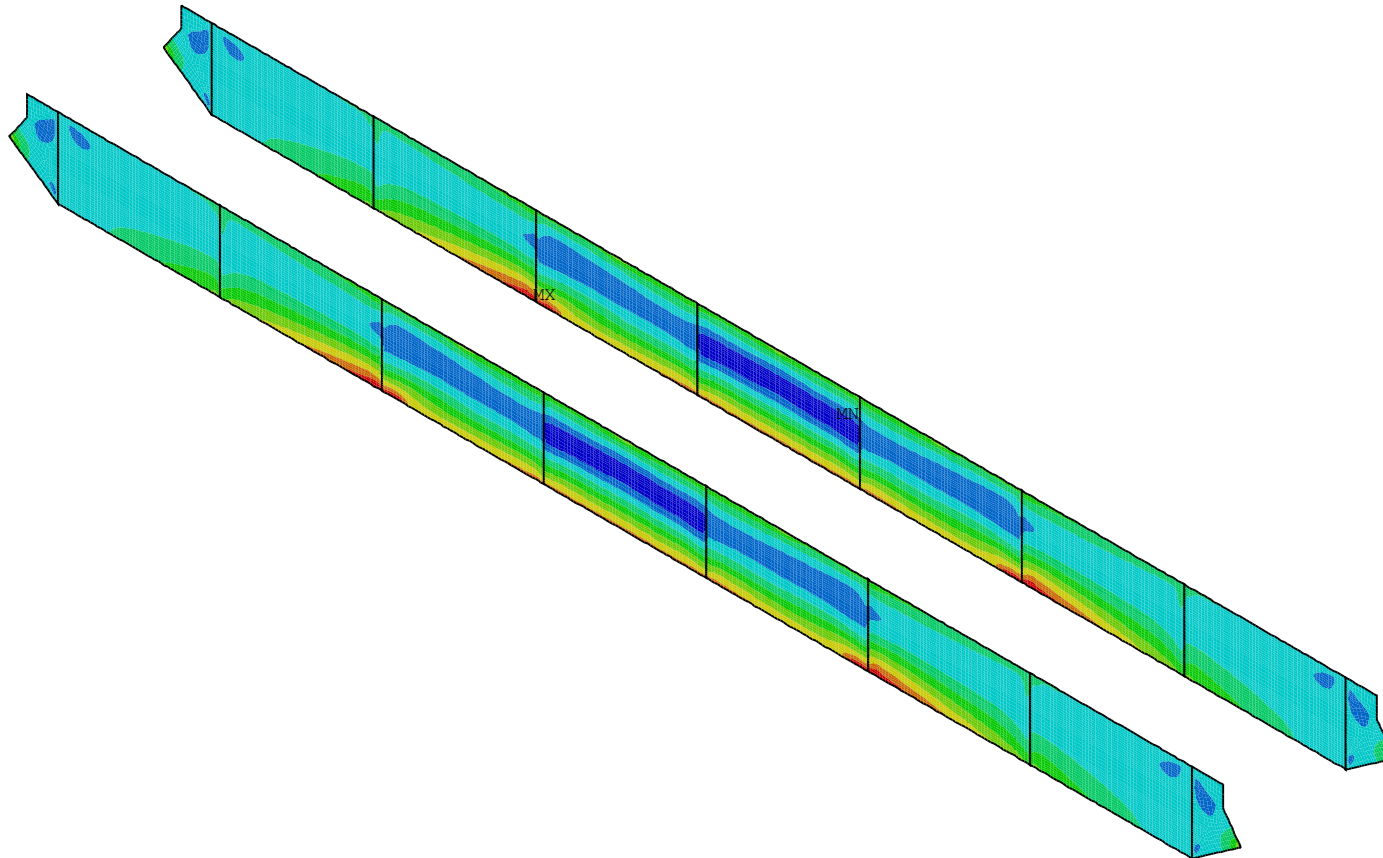
ANSYS 12.1  
 NOV 9 2021  
 09:30:19  
 PLOT NO. 23  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXT (AVG)  
 TOP  
 DMX =3.072  
 SMN =13.777  
 SMX =181.773

XV =1  
 YV =1  
 ZV =1  
 DIST=6649  
 YF =490  
 CENTROID HIDDEN  
 13.777  
 32.443  
 51.109  
 69.775  
 88.442  
 107.108  
 125.774  
 144.44  
 163.107  
 181.773



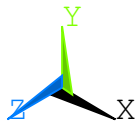
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POSITION 3, MASS=3406kg      PLATE t=15mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



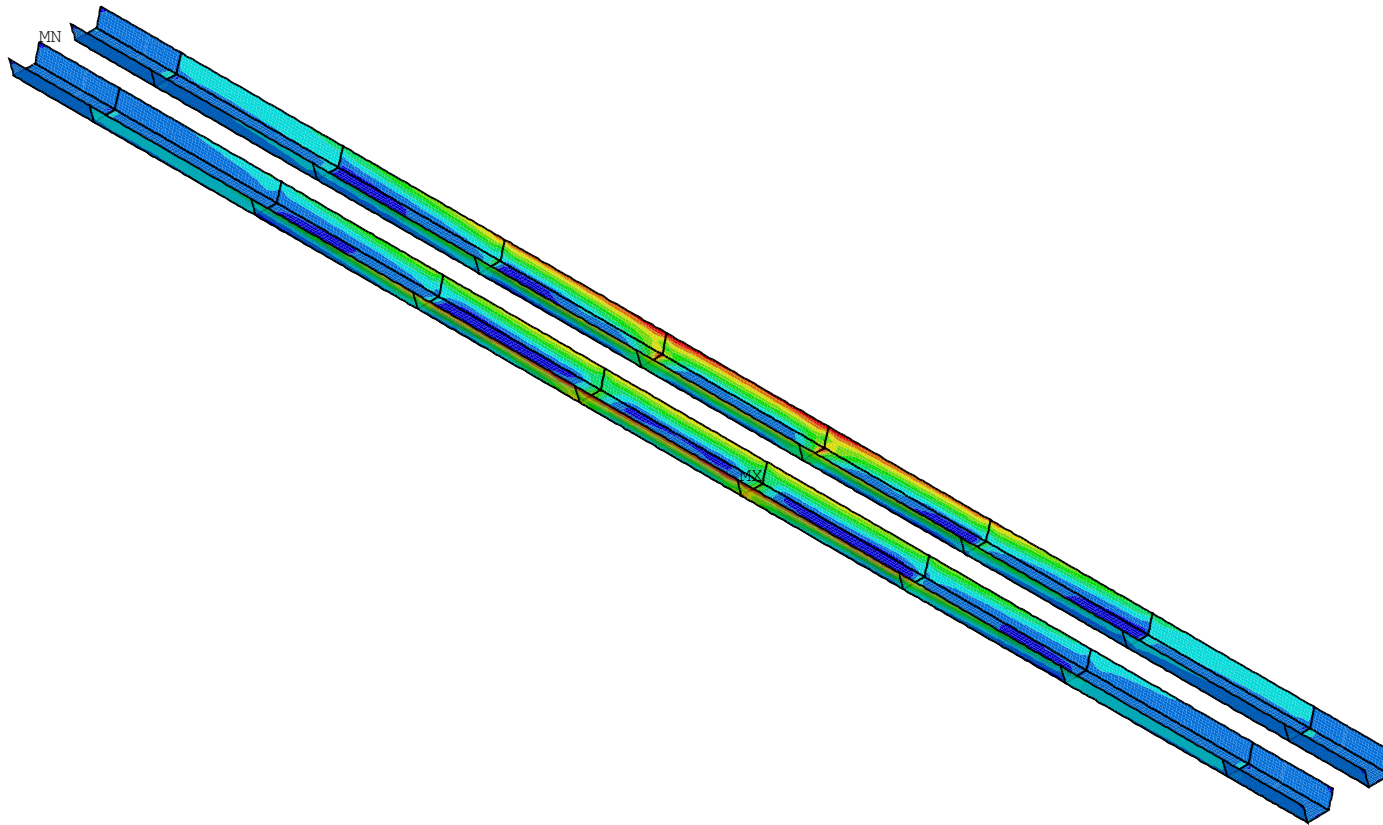
ANSYS 12.1  
NOV 9 2021  
09:30:20  
PLOT NO. 24  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXB (AVG)  
BOTTOM  
DMX =3.072  
SMN =13.226  
SMX =181.792

XV =1  
YV =1  
ZV =1  
DIST=6649  
YF =490  
CENTROID HIDDEN  
13.226  
31.955  
50.685  
69.414  
88.144  
106.874  
125.603  
144.333  
163.062  
181.792



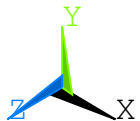
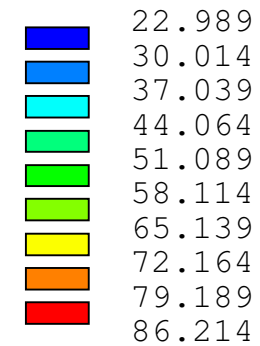
1

POSITION 4, MASS=2561kg      PLATE t=15mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



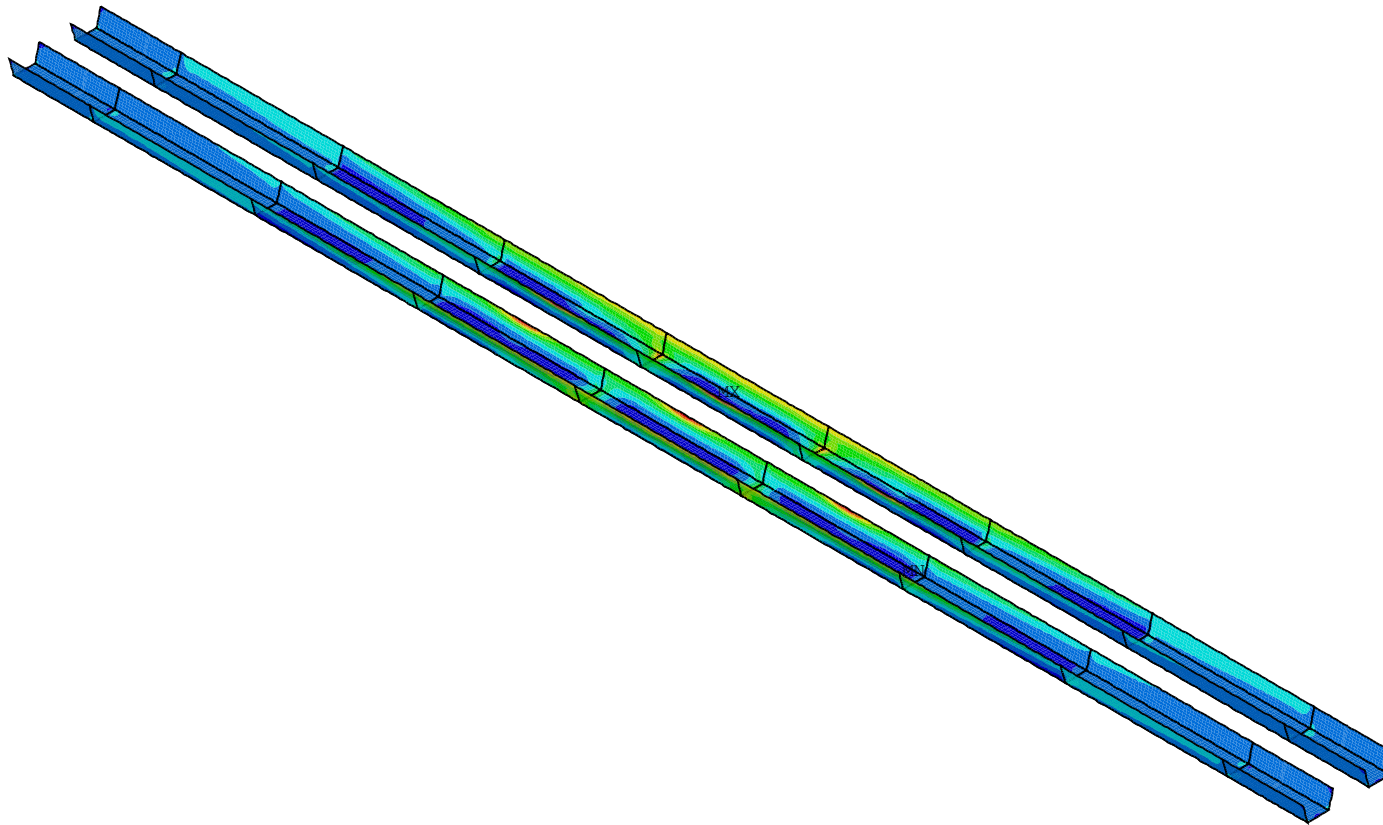
ANSYS 12.1  
NOV 9 2021  
09:30:25  
PLOT NO. 28  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXM (AVG)  
MIDDLE  
DMX =3.083  
SMN =22.989  
SMX =86.214

XV =1  
YV =1  
ZV =1  
DIST=6654  
YF =878.75  
CENTROID HIDDEN



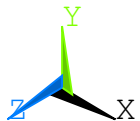
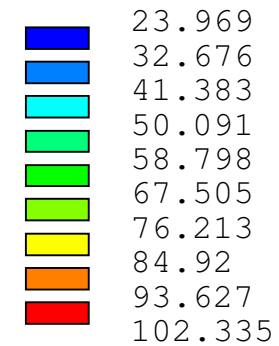
1

POSITION 4, MASS=2561kg      PLATE t=15mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (top plane)      LC 1 - 18



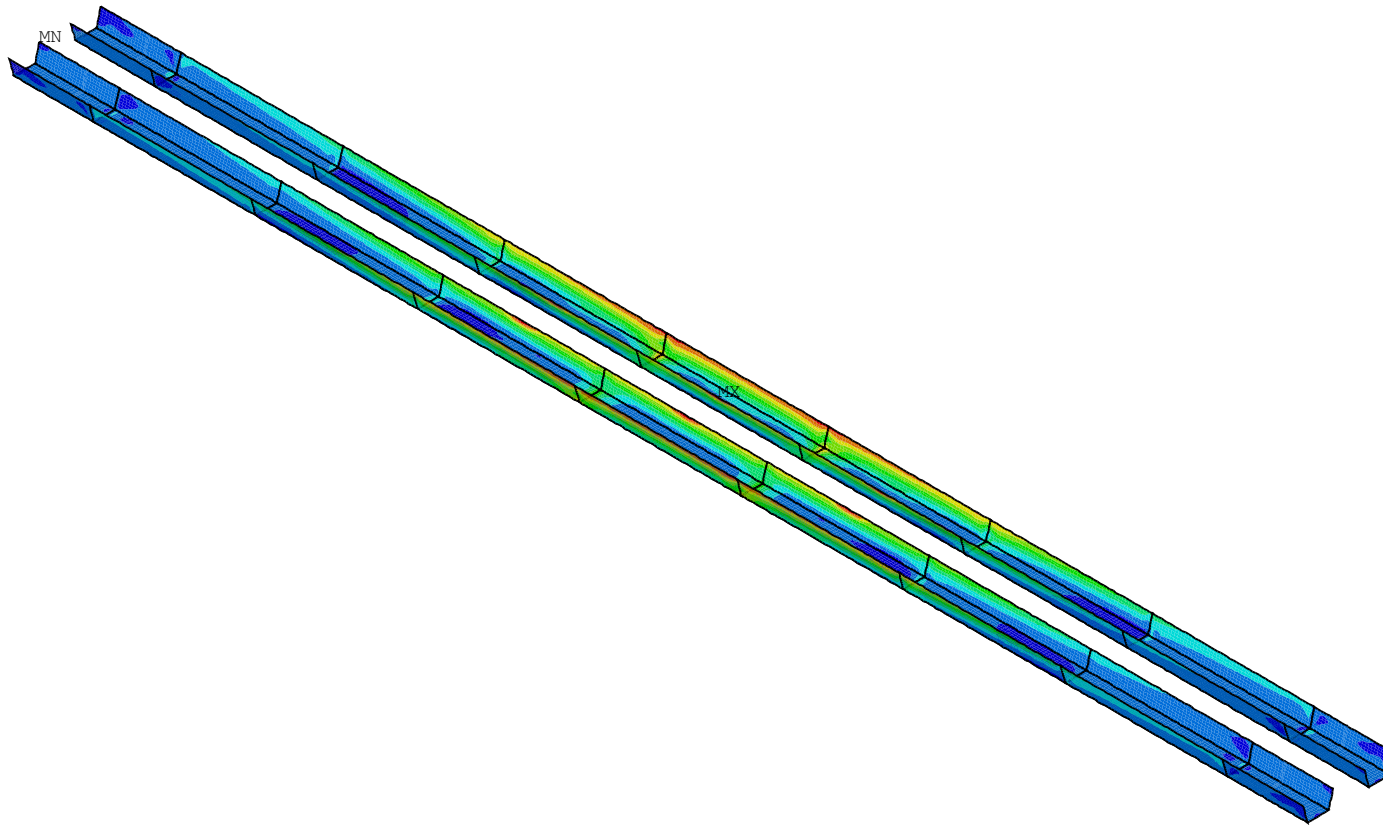
ANSYS 12.1  
NOV 9 2021  
09:30:25  
PLOT NO. 29  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXT (AVG)  
TOP  
DMX =3.083  
SMN =23.969  
SMX =102.335

XV =1  
YV =1  
ZV =1  
DIST=6654  
YF =878.75  
CENTROID HIDDEN



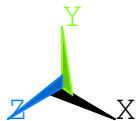
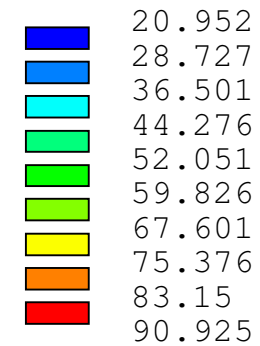
1

POSITION 4, MASS=2561kg      PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



ANSYS 12.1  
 NOV 9 2021  
 09:30:26  
 PLOT NO. 30  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXB (AVG)  
 BOTTOM  
 DMX =3.083  
 SMN =20.952  
 SMX =90.925

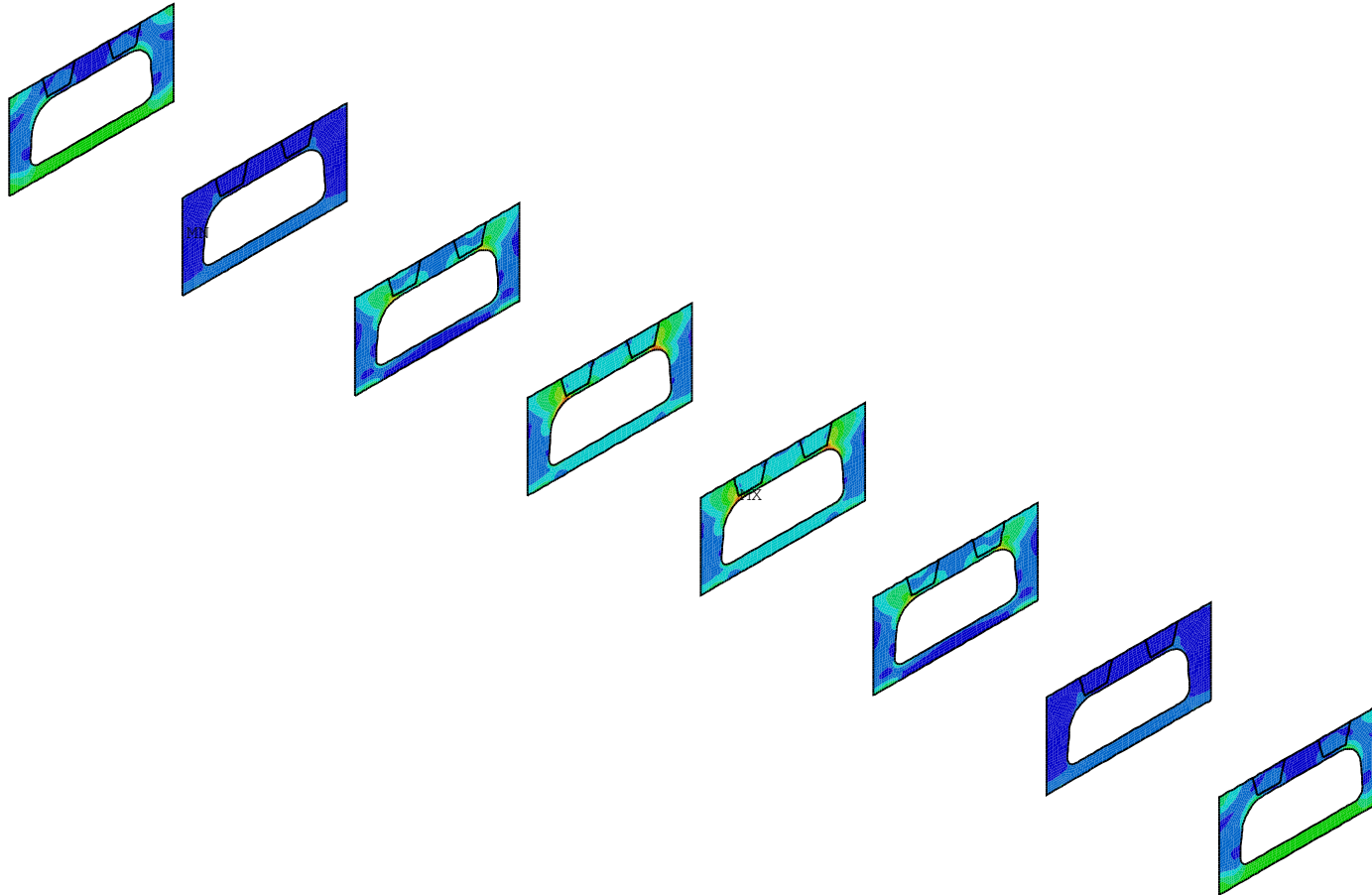
XV =1  
 YV =1  
 ZV =1  
 DIST=6654  
 YF =878.75  
 CENTROID HIDDEN





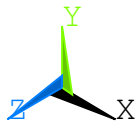
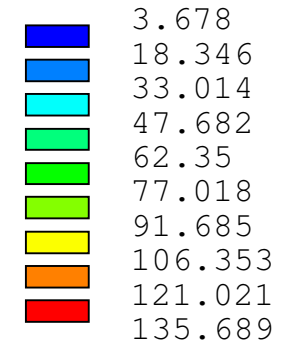
1

POSITION 5, MASS=1011kg PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



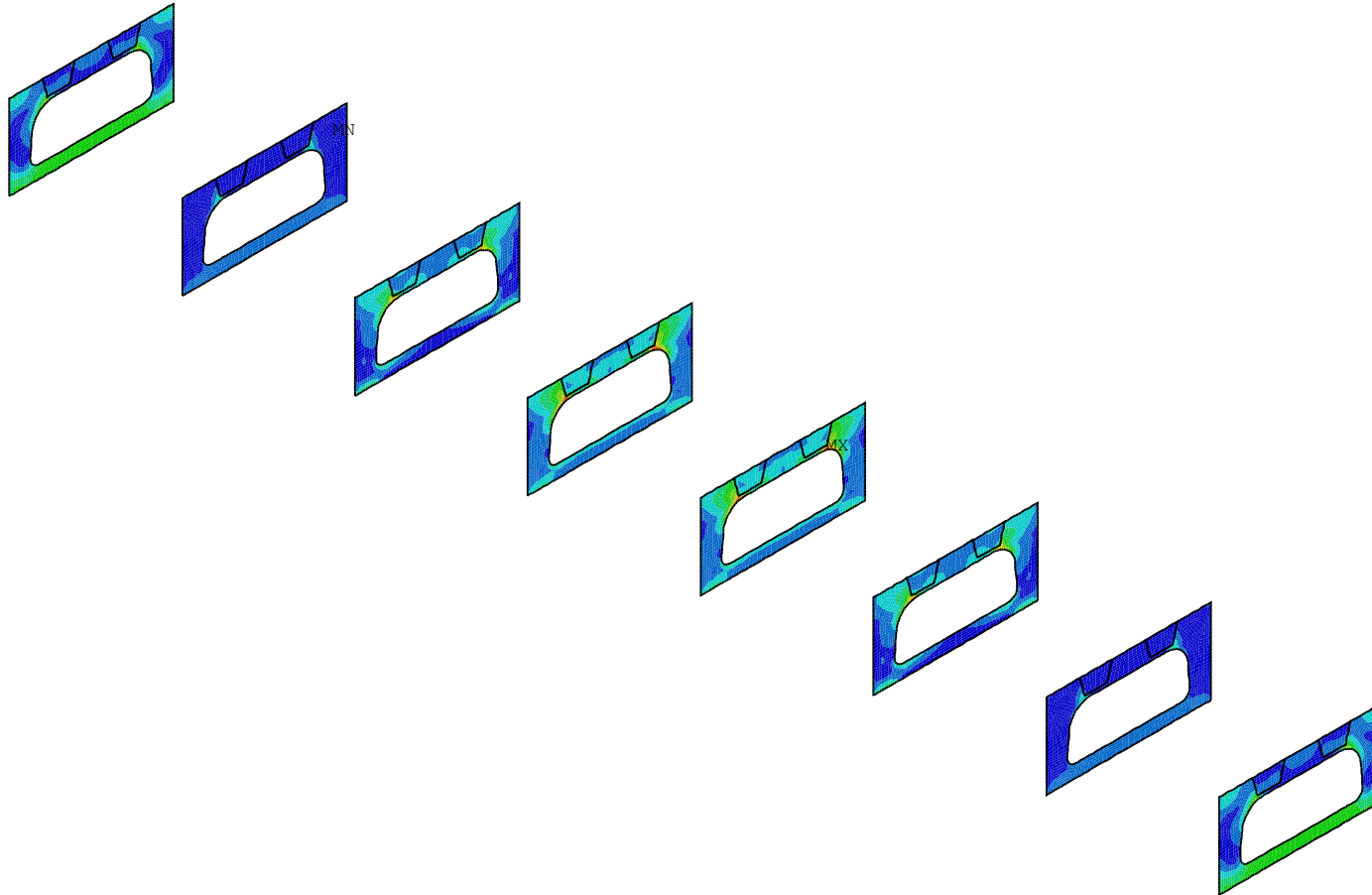
ANSYS 12.1  
 NOV 9 2021  
 09:30:29  
 PLOT NO. 34  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXM (AVG)  
 MIDDLE  
 DMX =3.025  
 SMN =3.678  
 SMX =135.689

XV =1  
 YV =1  
 ZV =1  
 DIST=6184  
 YF =490  
 CENTROID HIDDEN



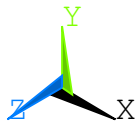
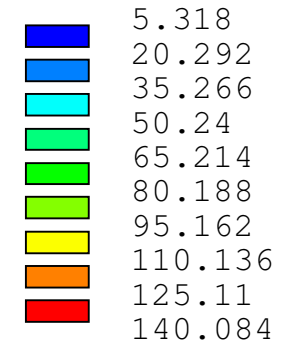
1

POSITION 5, MASS=1011kg      PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (top plane)      LC 1 - 18



ANSYS 12.1  
 NOV 9 2021  
 09:30:29  
 PLOT NO. 35  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXT (AVG)  
 TOP  
 DMX =3.025  
 SMN =5.318  
 SMX =140.084

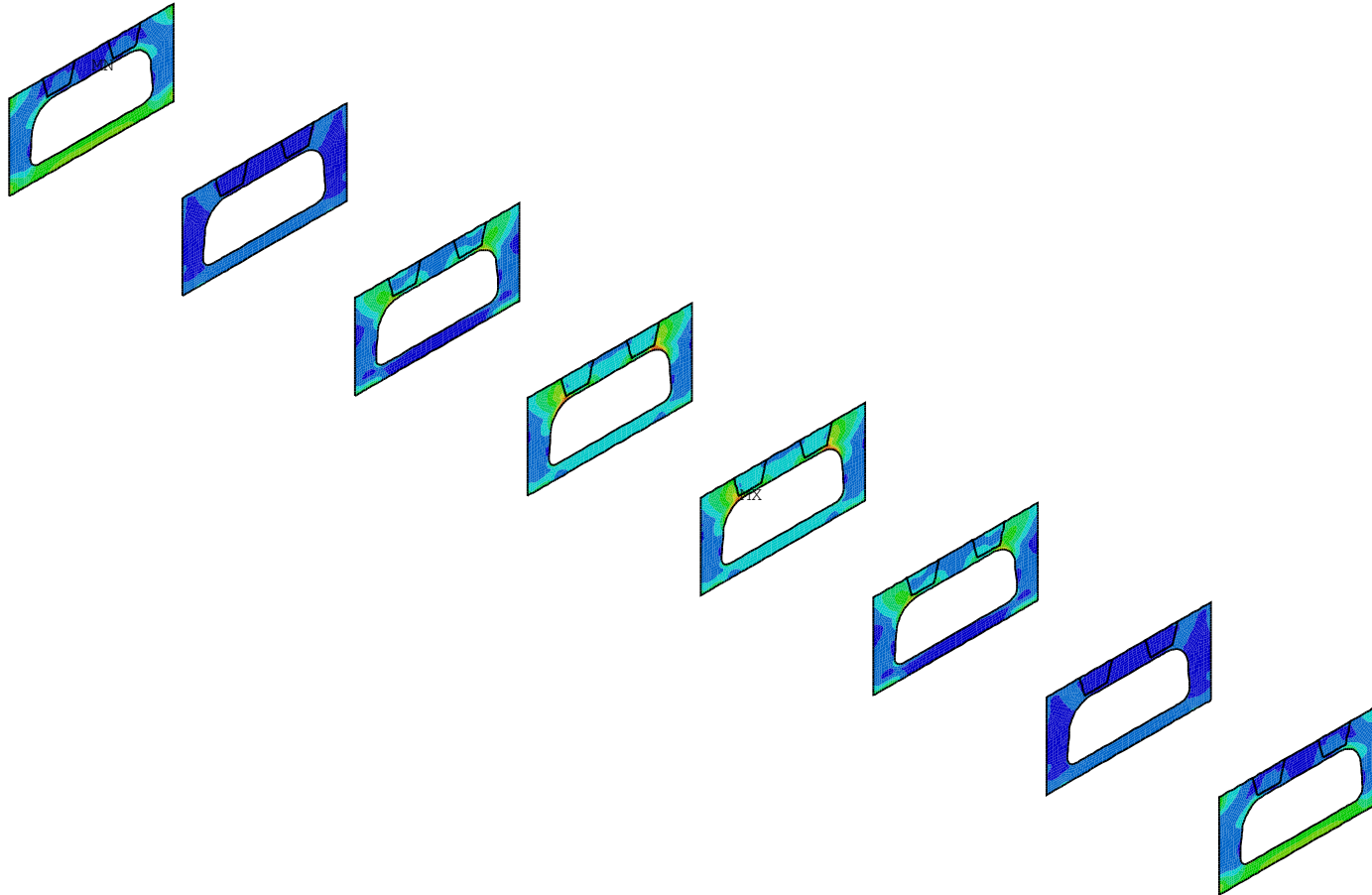
XV =1  
 YV =1  
 ZV =1  
 DIST=6184  
 YF =490  
 CENTROID HIDDEN





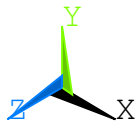
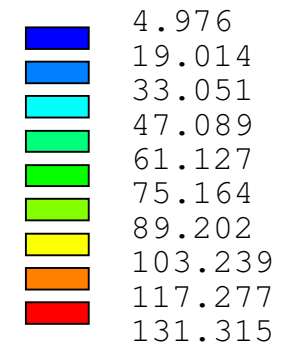
1

POSITION 5, MASS=1011kg      PLATE t=15mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



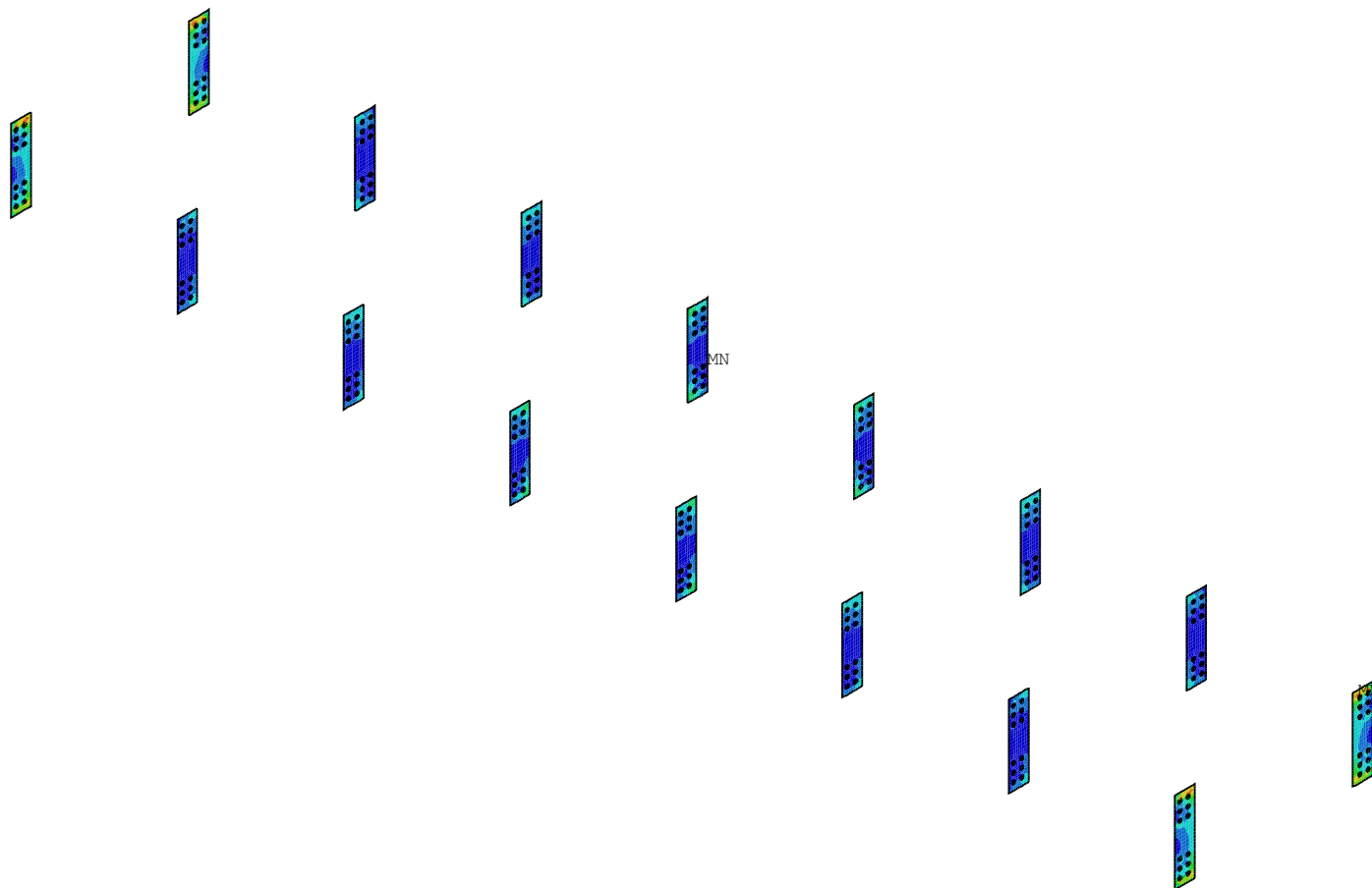
ANSYS 12.1  
NOV 9 2021  
09:30:30  
PLOT NO. 36  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXB (AVG)  
BOTTOM  
DMX =3.025  
SMN =4.976  
SMX =131.315

XV =1  
YV =1  
ZV =1  
DIST=6184  
YF =490  
CENTROID HIDDEN



1

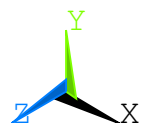
POSITION 6, MASS=426kg PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



ANSYS 12.1  
 NOV 9 2021  
 09:30:34  
 PLOT NO. 40  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXM (AVG)  
 MIDDLE  
 DMX =3.025  
 SMN =2.9  
 SMX =157.416

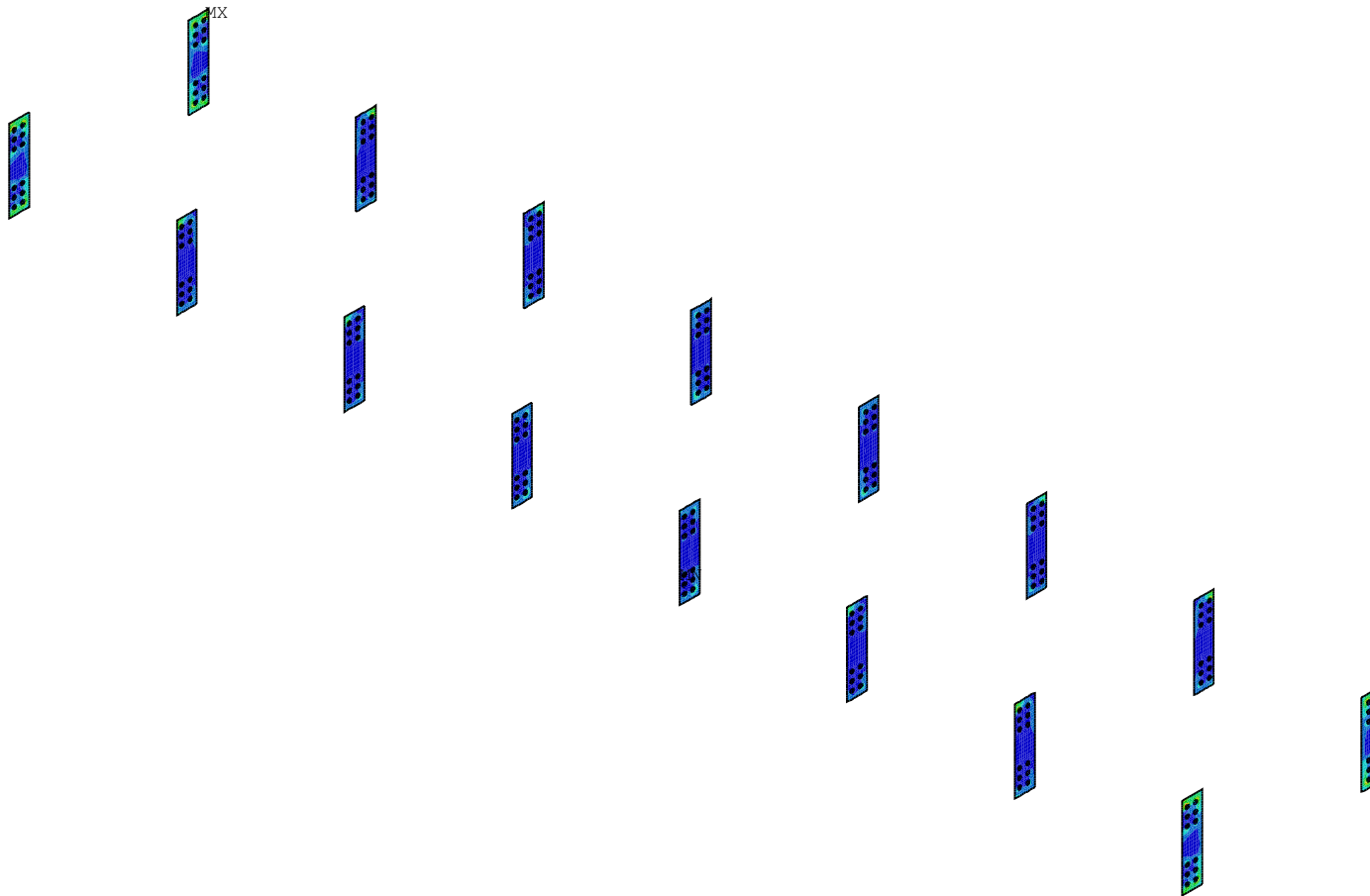
XV =1  
 YV =1  
 ZV =1  
 DIST=6368  
 YF =490  
 CENTROID HIDDEN

2.9
20.068
37.237
54.405
71.574
88.742
105.91
123.079
140.247
157.416



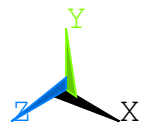
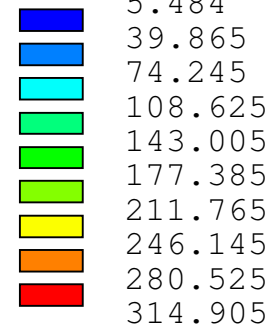
1

POSITION 6, MASS=426kg      PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (top plane)      LC 1 - 18



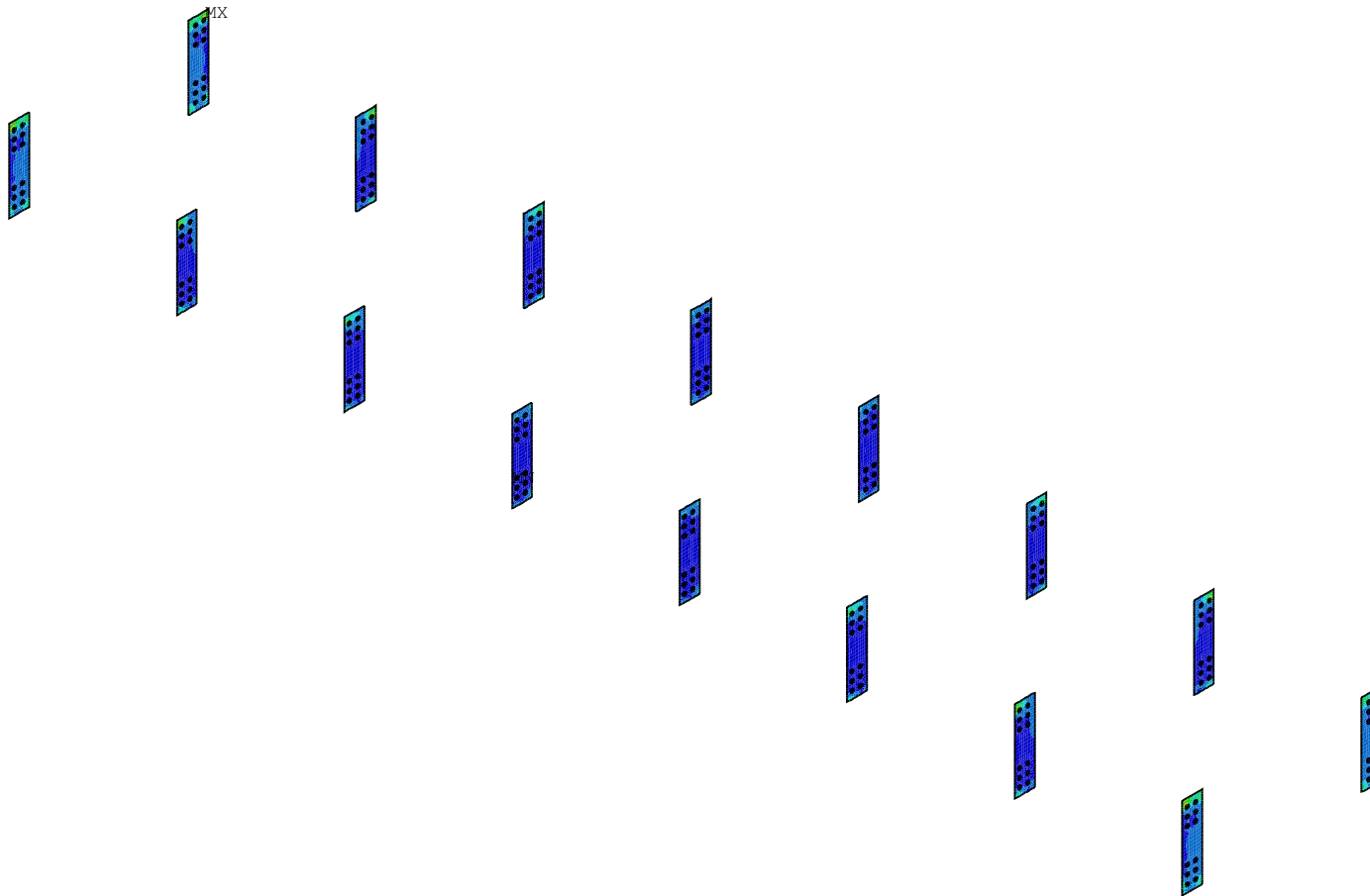
ANSYS 12.1  
 NOV 9 2021  
 09:30:34  
 PLOT NO. 41  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXT (AVG)  
 TOP  
 DMX =3.025  
 SMN =5.484  
 SMX =314.905

XV =1  
 YV =1  
 ZV =1  
 DIST=6368  
 YF =490  
 CENTROID HIDDEN  
 5.484  
 39.865  
 74.245  
 108.625  
 143.005  
 177.385  
 211.765  
 246.145  
 280.525  
 314.905



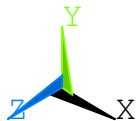
1

POSITION 6, MASS=426kg      PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



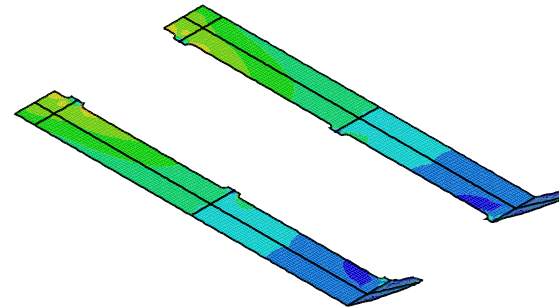
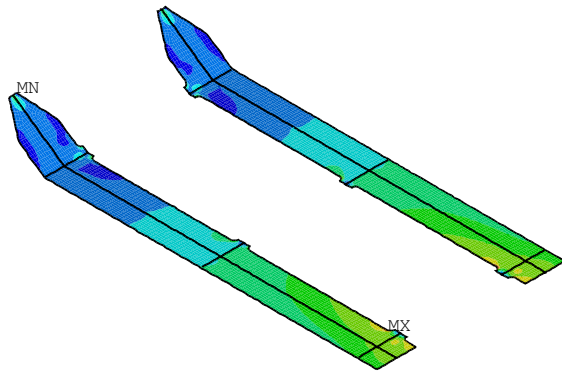
ANSYS 12.1  
 NOV 9 2021  
 09:30:35  
 PLOT NO. 42  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXB (AVG)  
 BOTTOM  
 DMX =3.025  
 SMN =4.849  
 SMX =314.731

XV =1  
 YV =1  
 ZV =1  
 DIST=6368  
 YF =490  
 CENTROID HIDDEN  
 4.849  
 39.28  
 73.712  
 108.143  
 142.574  
 177.006  
 211.437  
 245.869  
 280.3  
 314.731



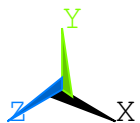
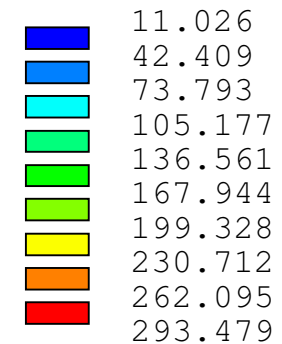
1

POSITION 7, MASS=1552kg      PLATE t=20mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



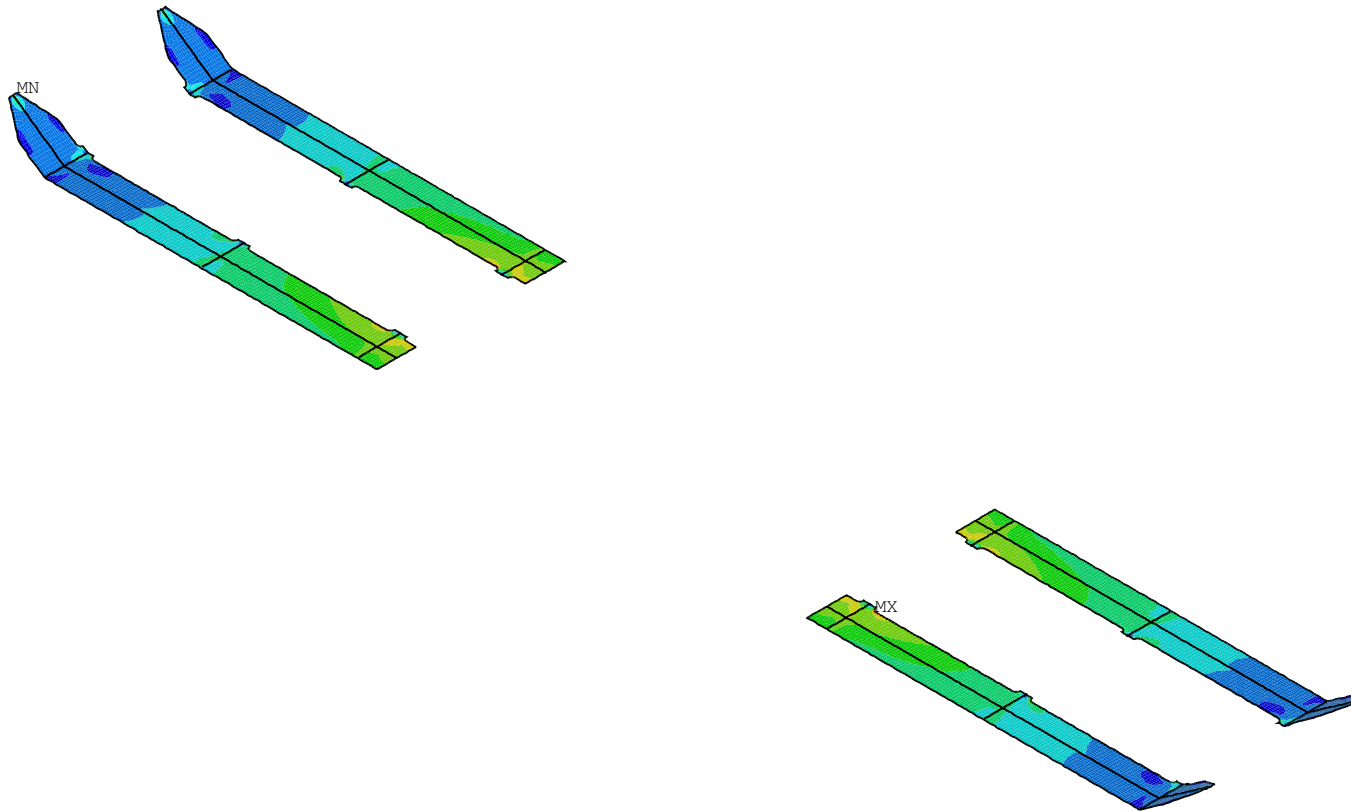
ANSYS 12.1  
 NOV 9 2021  
 09:30:38  
 PLOT NO. 46  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXM (AVG)  
 MIDDLE  
 DMX =2.669  
 SMN =11.026  
 SMX =293.479

XV =1  
 YV =1  
 ZV =1  
 DIST=6888  
 YF =229.431  
 CENTROID HIDDEN



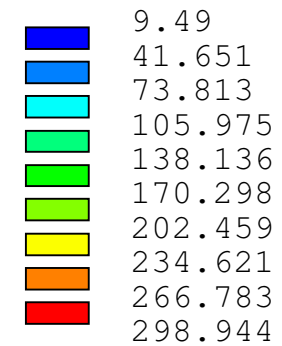
1

POSITION 7, MASS=1552kg      PLATE t=20mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (top plane)      LC 1 - 18



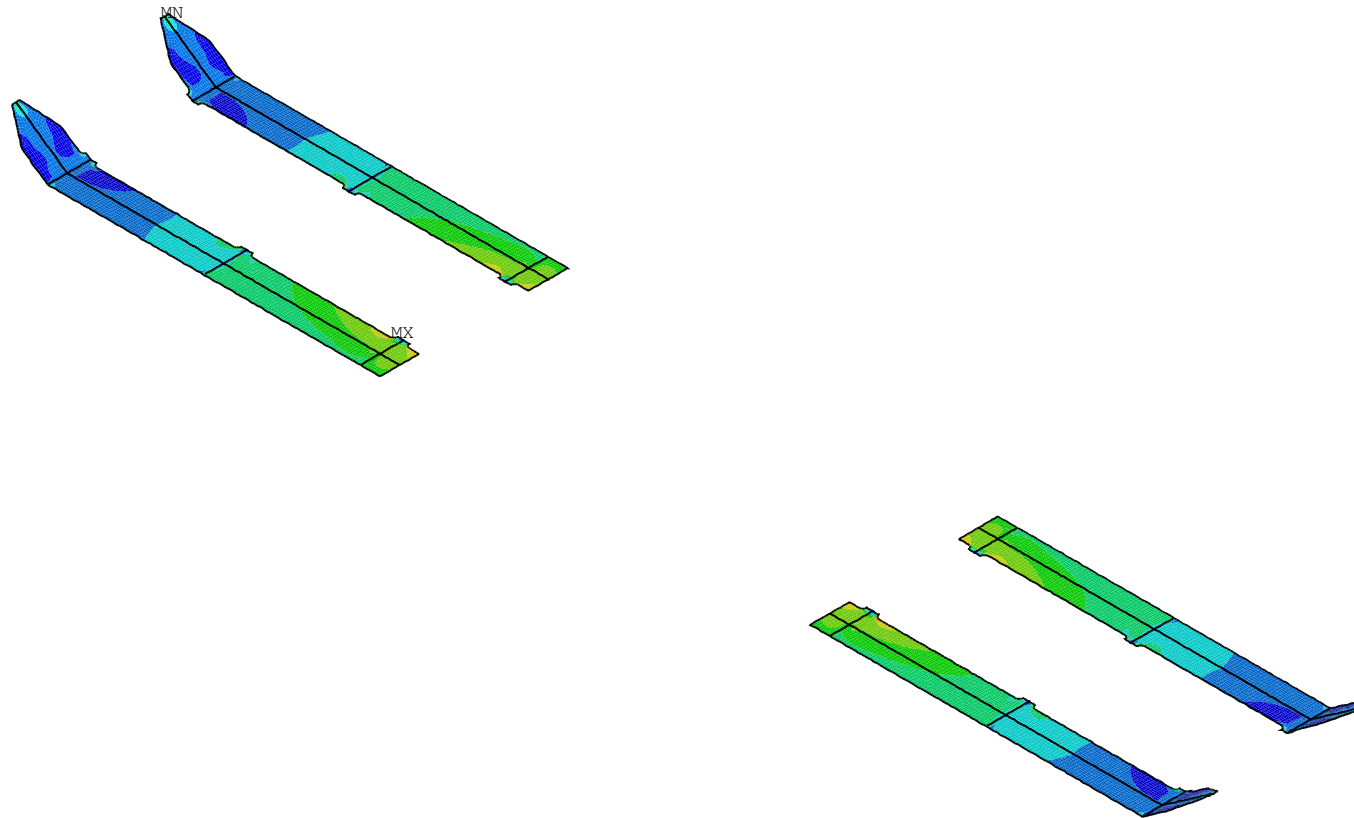
ANSYS 12.1  
 NOV 9 2021  
 09:30:38  
 PLOT NO. 47  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXT (AVG)  
 TOP  
 DMX =2.669  
 SMN =9.49  
 SMX =298.944

XV =1  
 YV =1  
 ZV =1  
 DIST=6888  
 YF =229.431  
 CENTROID HIDDEN



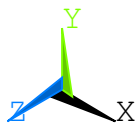
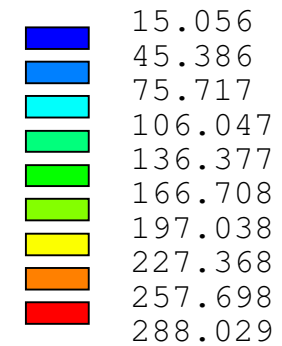
1

POSITION 7, MASS=1552kg      PLATE t=20mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



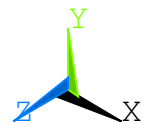
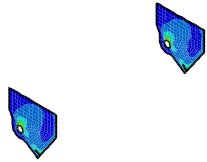
ANSYS 12.1  
 NOV 9 2021  
 09:30:38  
 PLOT NO. 48  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXB (AVG)  
 BOTTOM  
 DMX =2.669  
 SMN =15.056  
 SMX =288.029

XV =1  
 YV =1  
 ZV =1  
 DIST=6888  
 YF =229.431  
 CENTROID HIDDEN



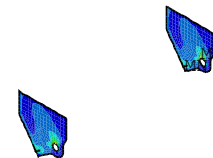
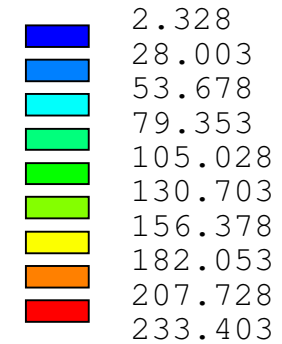
1

POSITION 8, MASS=415kg      PLATE t=19mm 27mm 36mm 50mm  
MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



ANSYS 12.1  
NOV 9 2021  
09:30:40  
PLOT NO. 52  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXM (AVG)  
MIDDLE  
DMX =.378099  
SMN =2.328  
SMX =233.403

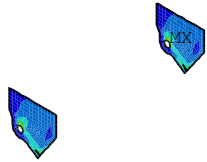
XV =1  
YV =1  
ZV =1  
DIST=6954  
YF =678.877  
CENTROID HIDDEN





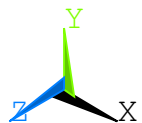
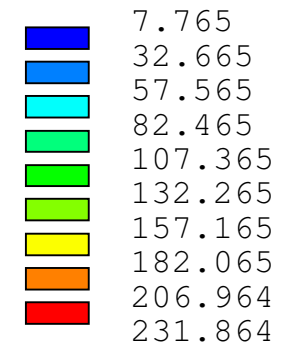
1

POSITION 8, MASS=415kg      PLATE t=19mm 27mm 36mm 50mm  
MAX EQUIVALENT STRESSES (top plane)      LC 1 - 18



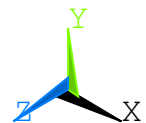
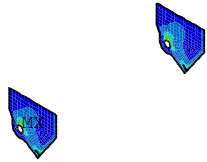
ANSYS 12.1  
NOV 9 2021  
09:30:40  
PLOT NO. 53  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXT (AVG)  
TOP  
DMX =.378099  
SMN =7.765  
SMX =231.864

XV =1  
YV =1  
ZV =1  
DIST=6954  
YF =678.877  
CENTROID HIDDEN



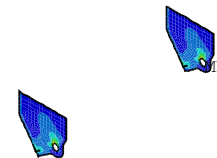
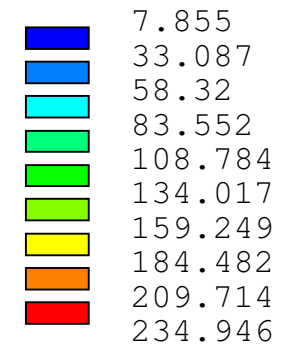
1

POSITION 8, MASS=415kg      PLATE t=19mm 27mm 36mm 50mm  
MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



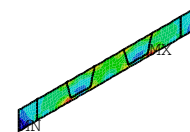
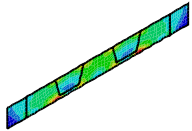
ANSYS 12.1  
NOV 9 2021  
09:30:40  
PLOT NO. 54  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXB (AVG)  
BOTTOM  
DMX =.378099  
SMN =7.855  
SMX =234.946

XV =1  
YV =1  
ZV =1  
DIST=6954  
YF =678.877  
CENTROID HIDDEN



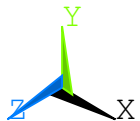
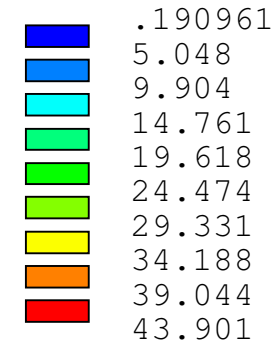
1

POSITION 9, MASS=181kg      PLATE t=20mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



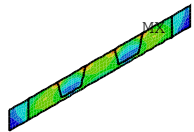
ANSYS 12.1  
NOV 9 2021  
09:30:41  
PLOT NO. 58  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXM (AVG)  
MIDDLE  
DMX =.234748  
SMN =.190961  
SMX =43.901

XV =1  
YV =1  
ZV =1  
DIST=7148  
YF =860  
CENTROID HIDDEN



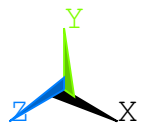
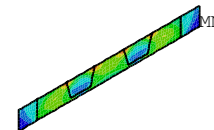
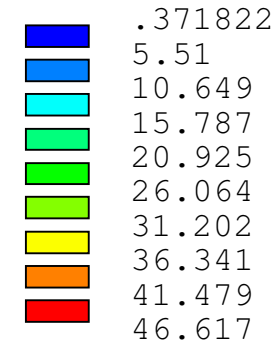
1

POSITION 9, MASS=181kg      PLATE t=20mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (top plane)      LC 1 - 18



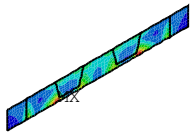
ANSYS 12.1  
NOV 9 2021  
09:30:41  
PLOT NO. 59  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXT (AVG)  
TOP  
DMX =.234748  
SMN =.371822  
SMX =46.617

XV =1  
YV =1  
ZV =1  
DIST=7148  
YF =860  
CENTROID HIDDEN



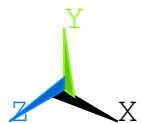
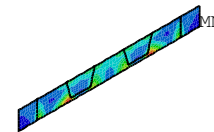
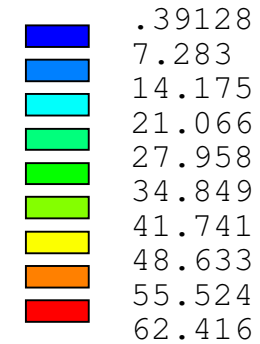
1

POSITION 9, MASS=181kg      PLATE t=20mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



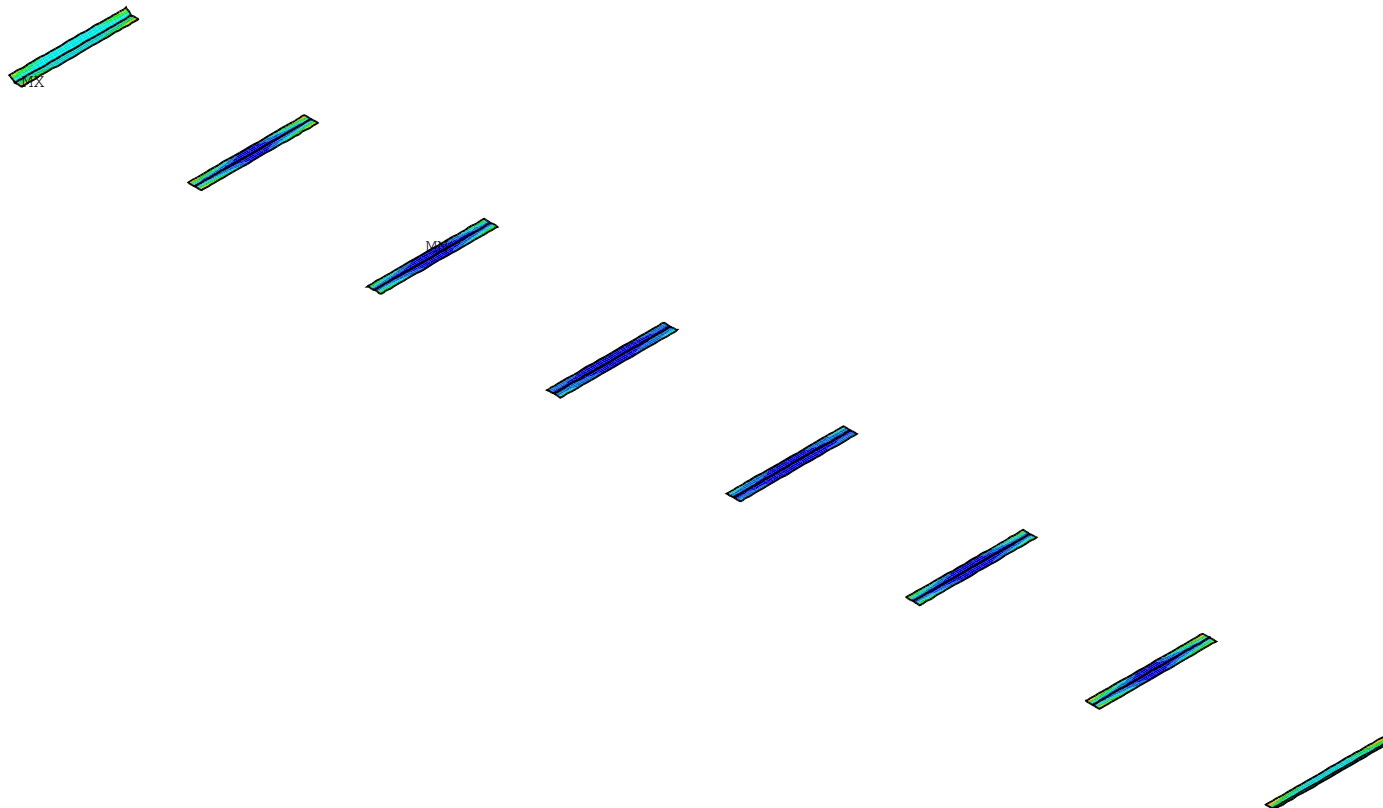
ANSYS 12.1  
NOV 9 2021  
09:30:41  
PLOT NO. 60  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXB (AVG)  
BOTTOM  
DMX =.234748  
SMN =.39128  
SMX =62.416

XV =1  
YV =1  
ZV =1  
DIST=7148  
YF =860  
CENTROID HIDDEN



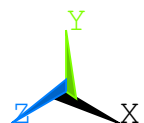
1

POSITION 10, MASS=184kg PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



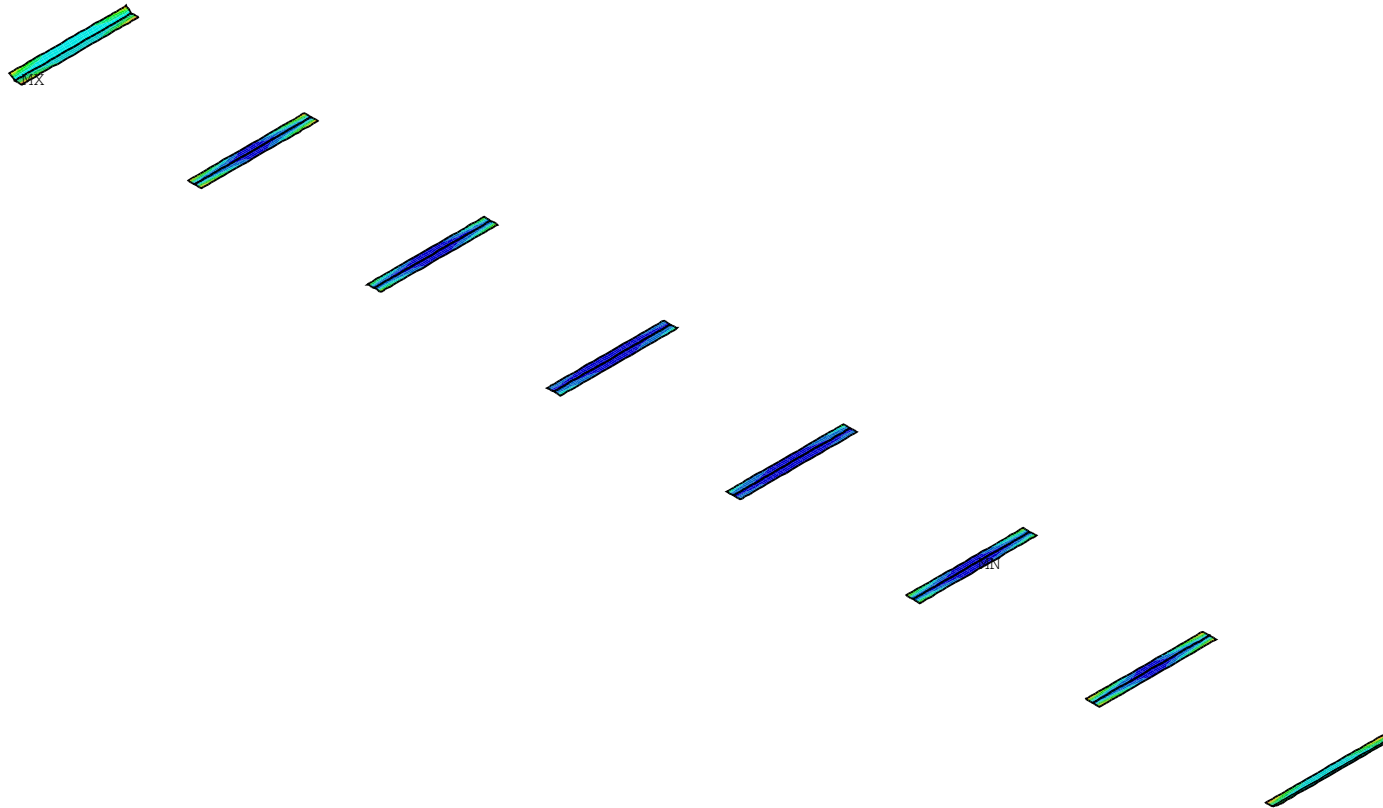
ANSYS 12.1  
 NOV 9 2021  
 09:30:42  
 PLOT NO. 64  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXM (AVG)  
 MIDDLE  
 DMX =3.033  
 SMN =10.049  
 SMX =220.926

XV =1  
 YV =1  
 ZV =1  
 DIST=5998  
 YF =21.509  
 CENTROID HIDDEN  
 10.049  
 33.48  
 56.911  
 80.341  
 103.772  
 127.203  
 150.634  
 174.065  
 197.495  
 220.926



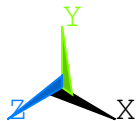
1

POSITION 10, MASS=184kg      PLATE t=15mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (top plane)      LC 1 - 18



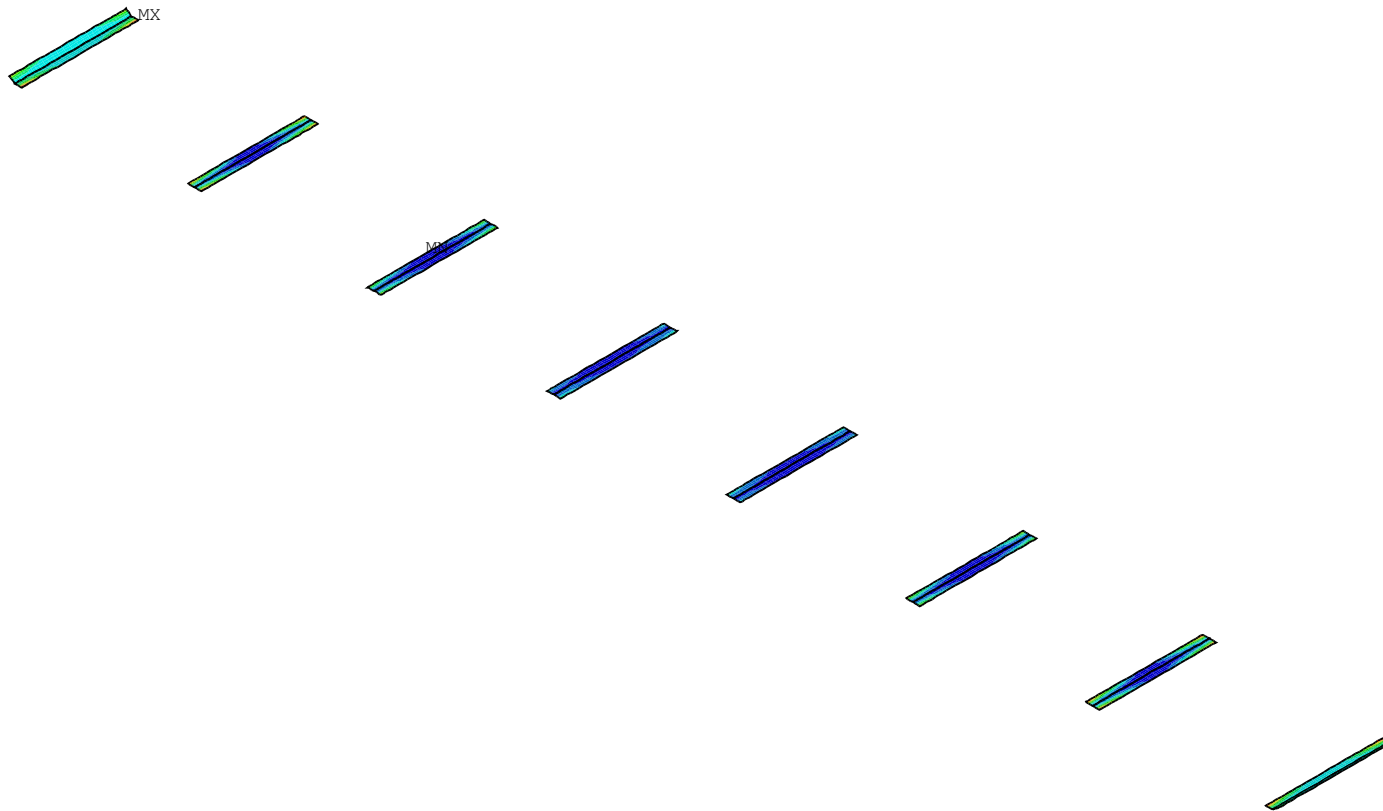
ANSYS 12.1  
NOV 9 2021  
09:30:42  
PLOT NO. 65  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXT (AVG)  
TOP  
DMX =3.033  
SMN =10.018  
SMX =223.627

XV =1  
YV =1  
ZV =1  
DIST=5998  
YF =21.509  
CENTROID HIDDEN  
10.018  
33.753  
57.487  
81.221  
104.956  
128.69  
152.424  
176.158  
199.893  
223.627



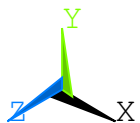
1

POSITION 10, MASS=184kg      PLATE t=15mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



ANSYS 12.1  
NOV 9 2021  
09:30:42  
PLOT NO. 66  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXB (AVG)  
BOTTOM  
DMX =3.033  
SMN =10.542  
SMX =218.227

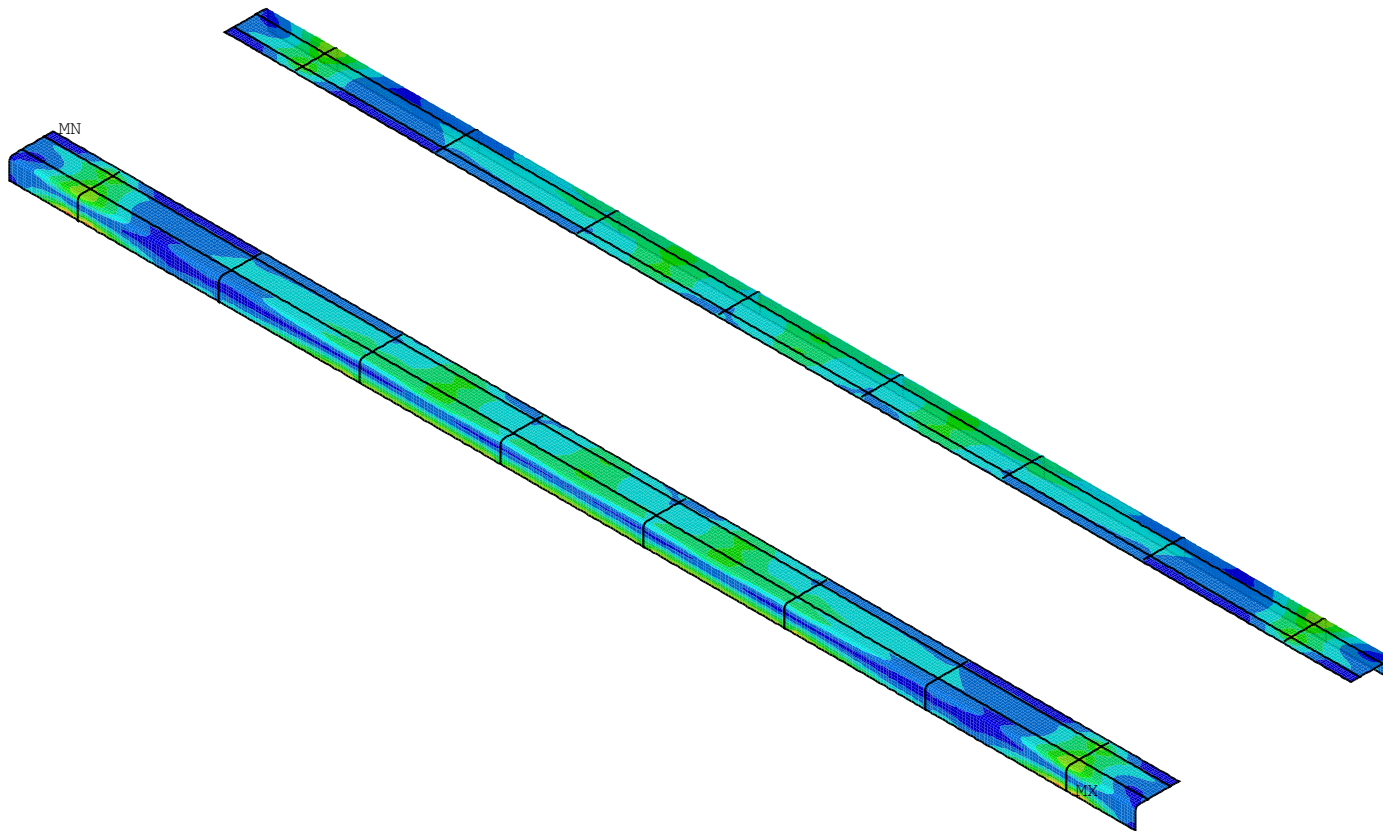
XV =1  
YV =1  
ZV =1  
DIST=5998  
YF =21.509  
CENTROID HIDDEN  
10.542  
33.618  
56.694  
79.77  
102.846  
125.922  
148.999  
172.075  
195.151  
218.227





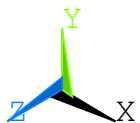
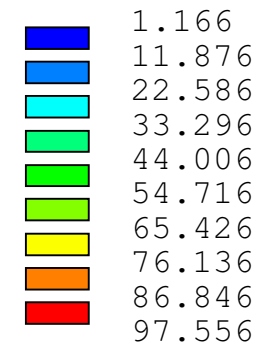
1

POSITION 11, MASS=4482kg PLATE t=20mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



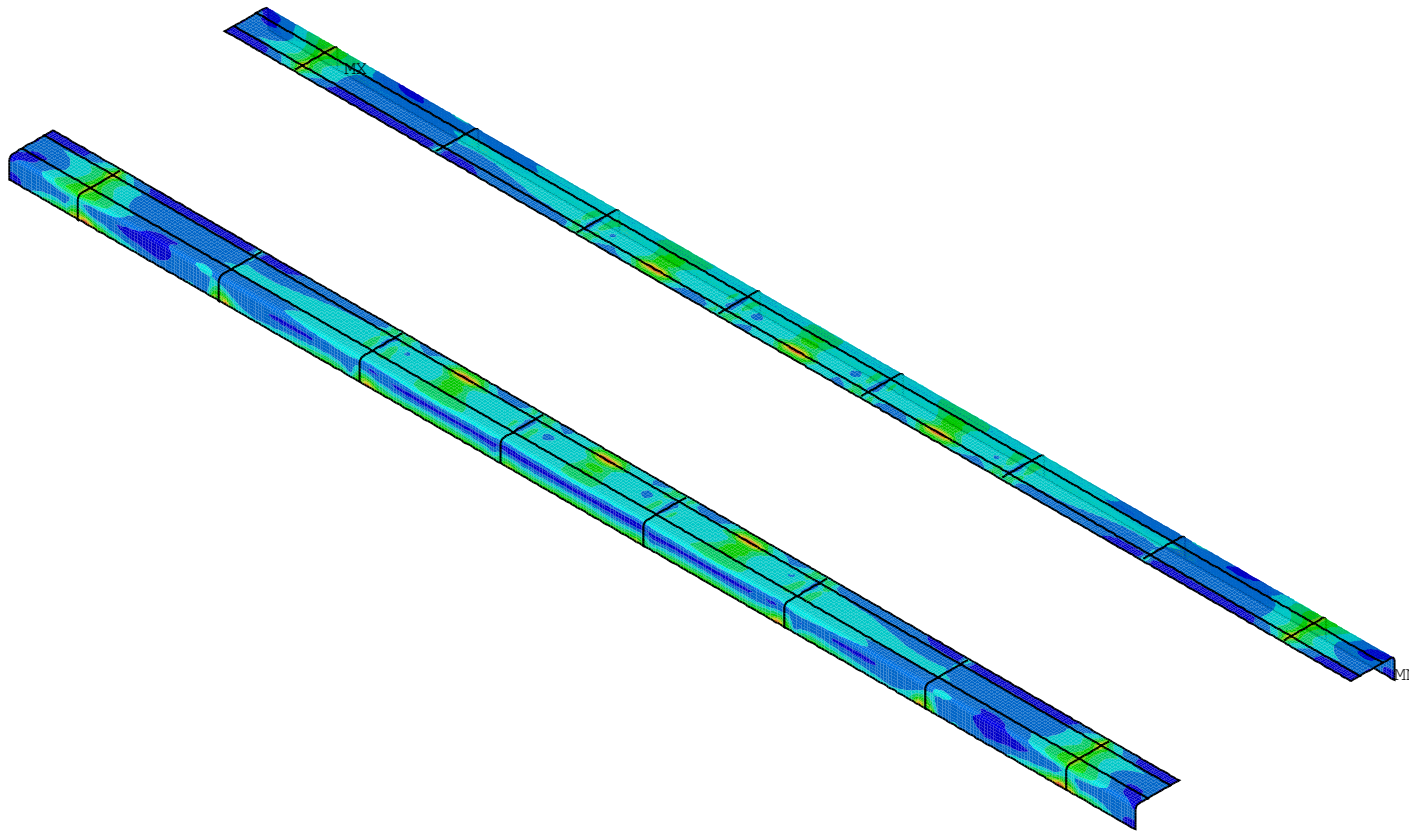
ANSYS 12.1  
NOV 9 2021  
09:30:47  
PLOT NO. 70  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXM (AVG)  
MIDDLE  
DMX =3.096  
SMN =1.166  
SMX =97.556

XV =1  
YV =1  
ZV =1  
DIST=7646  
YF =832.2  
CENTROID HIDDEN



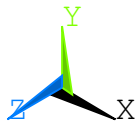
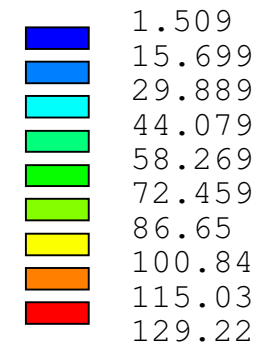
1

POSITION 11, MASS=4482kg PLATE t=20mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (top plane) LC 1 - 18



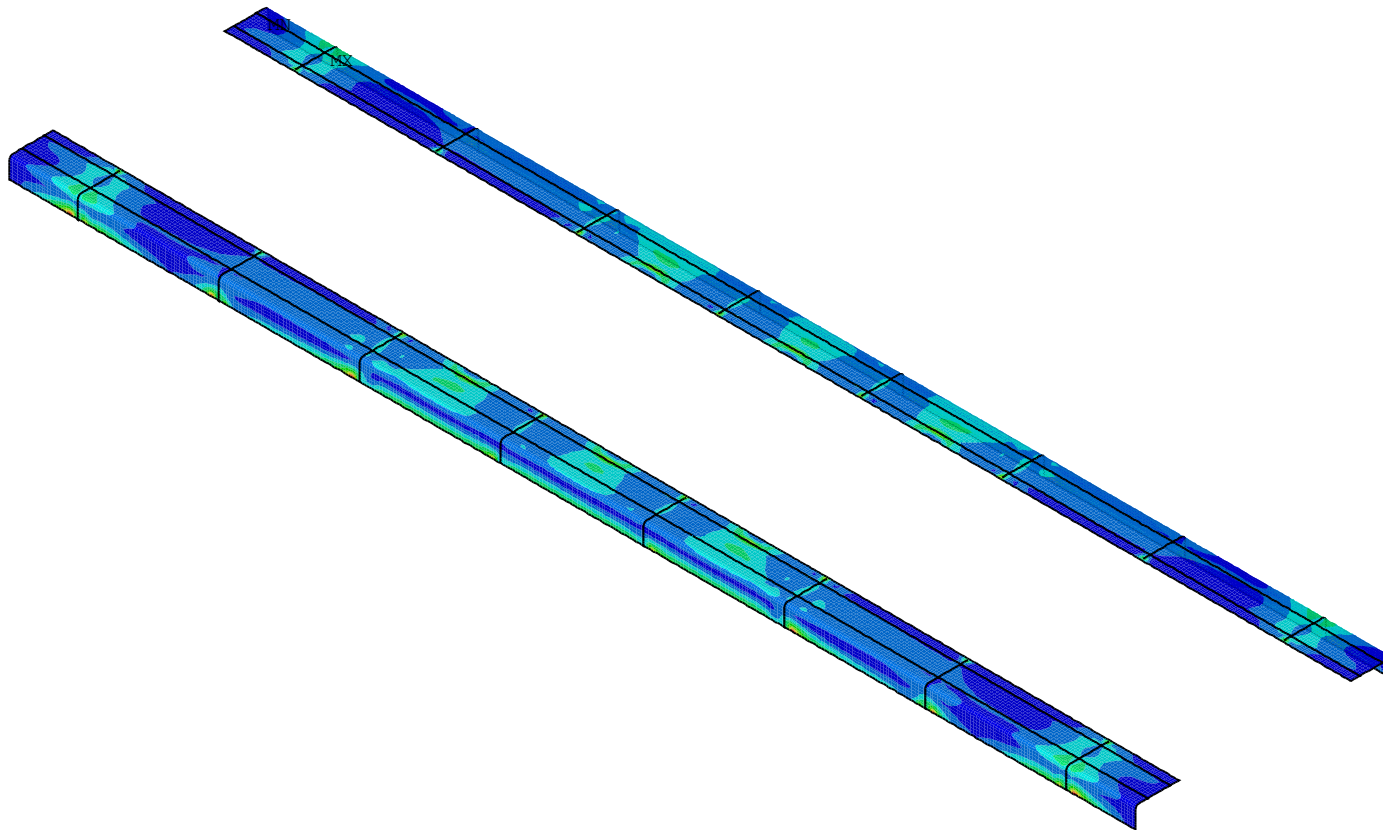
ANSYS 12.1  
NOV 9 2021  
09:30:47  
PLOT NO. 71  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXT (AVG)  
TOP  
DMX =3.096  
SMN =1.509  
SMX =129.22

XV =1  
YV =1  
ZV =1  
DIST=7646  
YF =832.2  
CENTROID HIDDEN



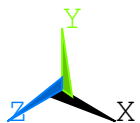
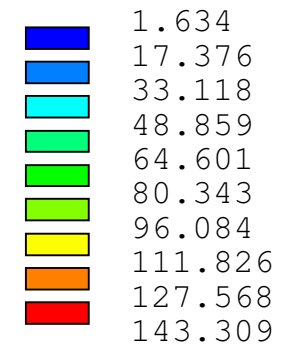
1

POSITION 11, MASS=4482kg PLATE t=20mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



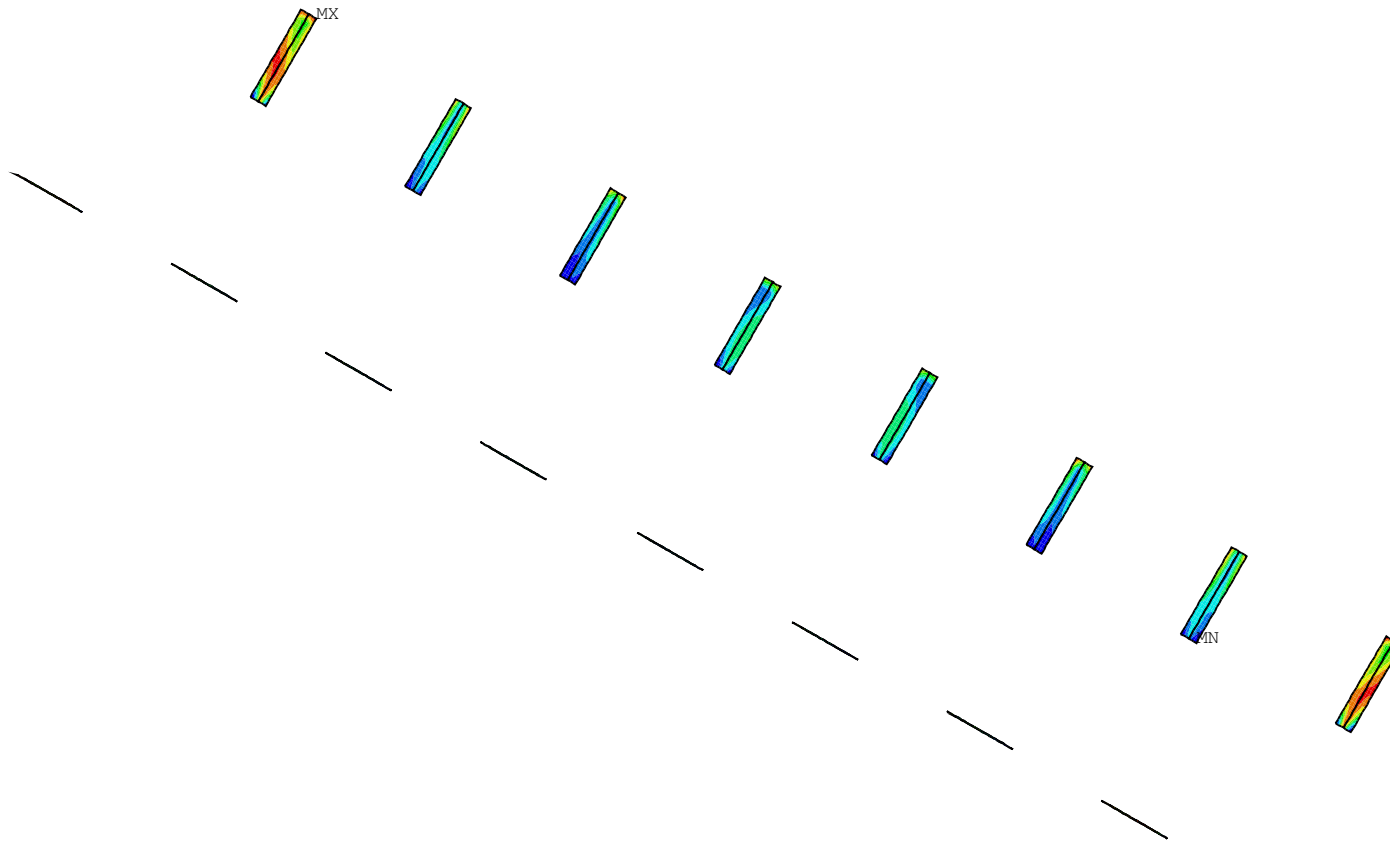
ANSYS 12.1  
NOV 9 2021  
09:30:48  
PLOT NO. 72  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXB (AVG)  
BOTTOM  
DMX =3.096  
SMN =1.634  
SMX =143.309

XV =1  
YV =1  
ZV =1  
DIST=7646  
YF =832.2  
CENTROID HIDDEN



1

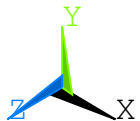
POSITION 12, MASS=347kg      PLATE t=15mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



ANSYS 12.1  
NOV 9 2021  
09:30:49  
PLOT NO. 76  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXM (AVG)  
MIDDLE  
DMX =3.047  
SMN =.167027  
SMX =50.674

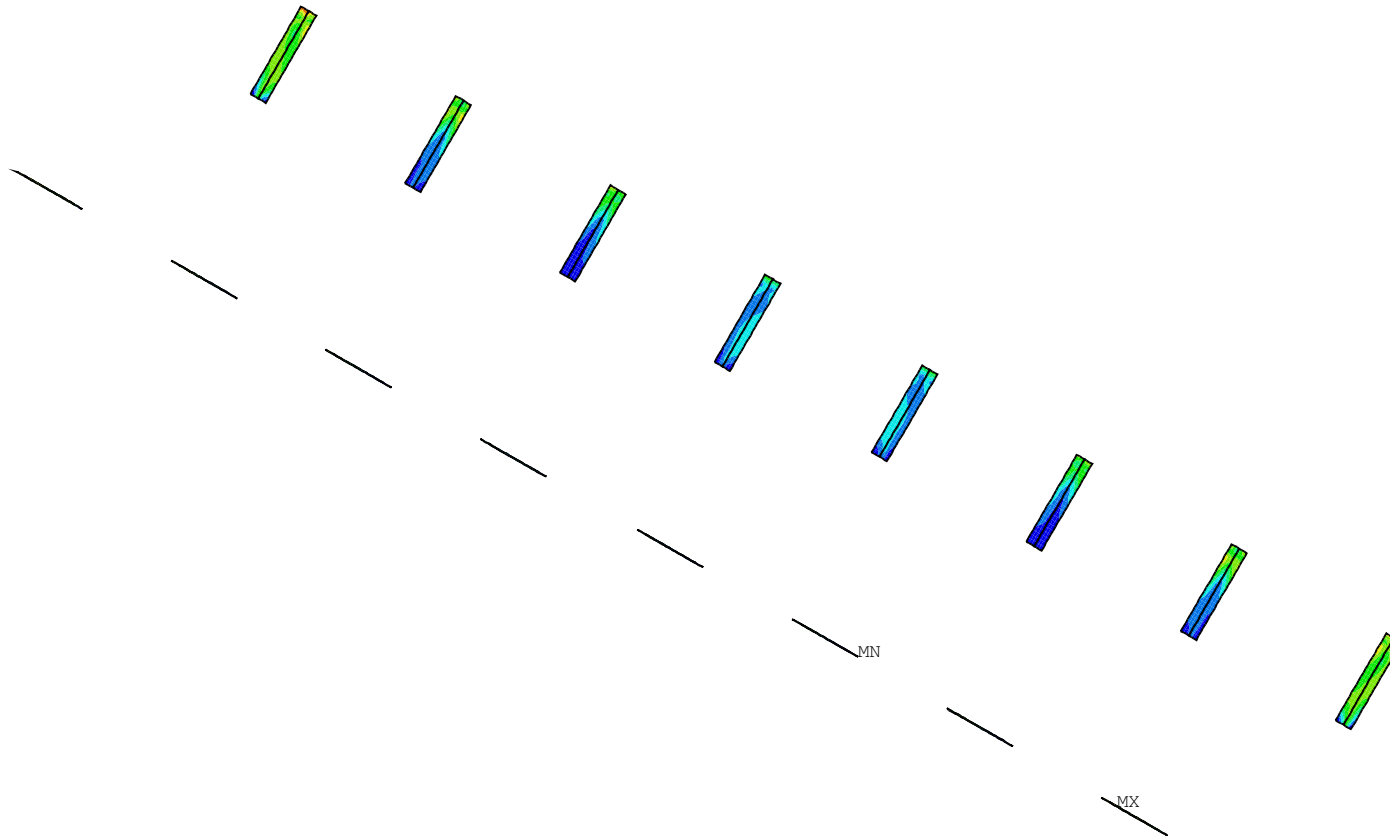
XV =1  
YV =1  
ZV =1  
DIST=6965  
YF =359.7  
CENTROID HIDDEN

Blue	.167027
Light Blue	5.779
Cyan	11.391
Green	17.003
Light Green	22.615
Yellow-Green	28.227
Yellow	33.838
Orange	39.45
Red-Orange	45.062
Red	50.674



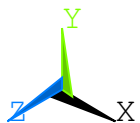
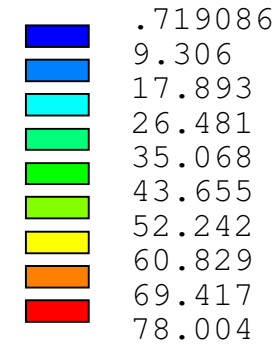
1

POSITION 12, MASS=347kg      PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (top plane)      LC 1 - 18



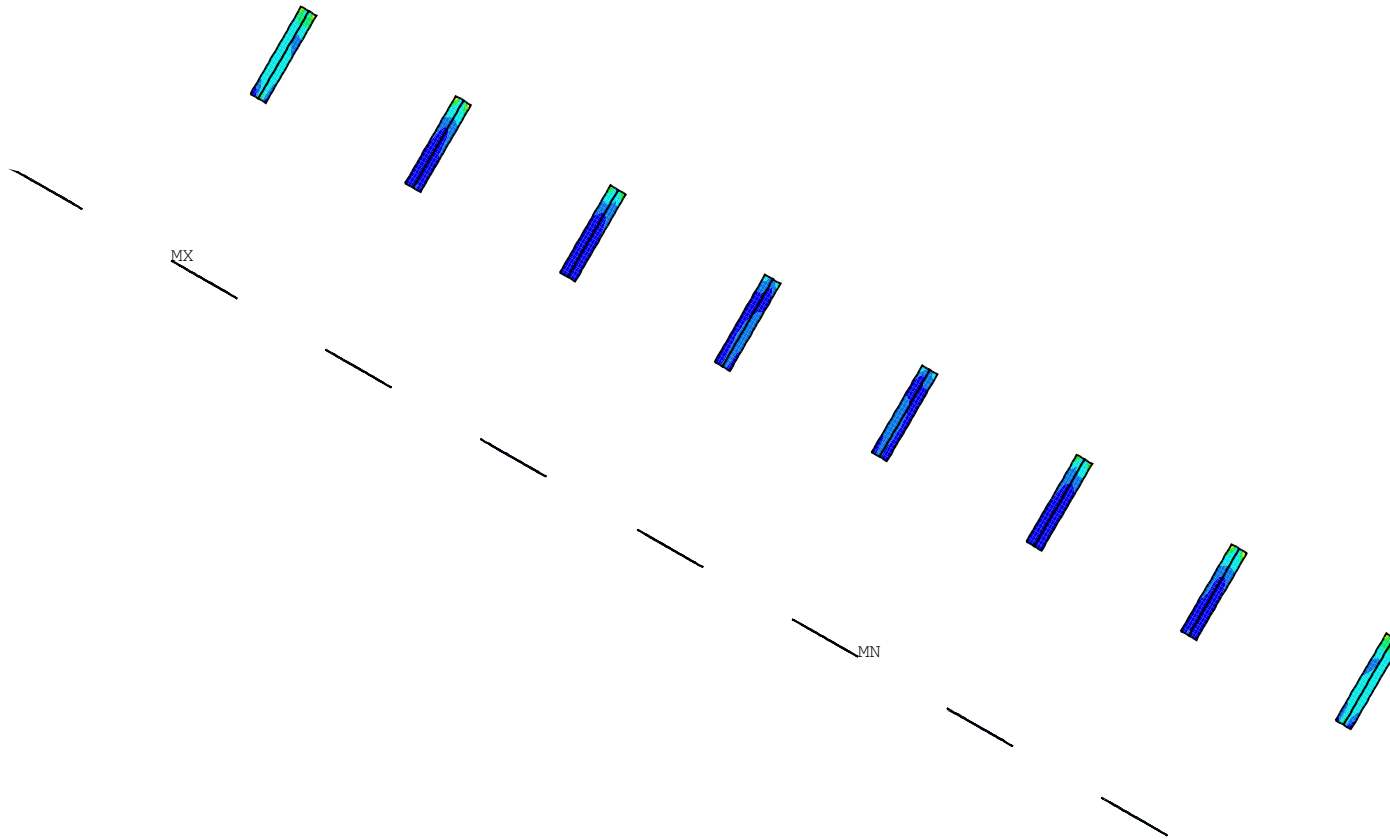
ANSYS 12.1  
 NOV 9 2021  
 09:30:50  
 PLOT NO. 77  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXT (AVG)  
 TOP  
 DMX =3.047  
 SMN =.719086  
 SMX =78.004

XV =1  
 YV =1  
 ZV =1  
 DIST=6965  
 YF =359.7  
 CENTROID HIDDEN



1

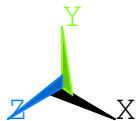
POSITION 12, MASS=347kg PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



ANSYS 12.1  
 NOV 9 2021  
 09:30:50  
 PLOT NO. 78  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXB (AVG)  
 BOTTOM  
 DMX =3.047  
 SMN =.715704  
 SMX =148.278

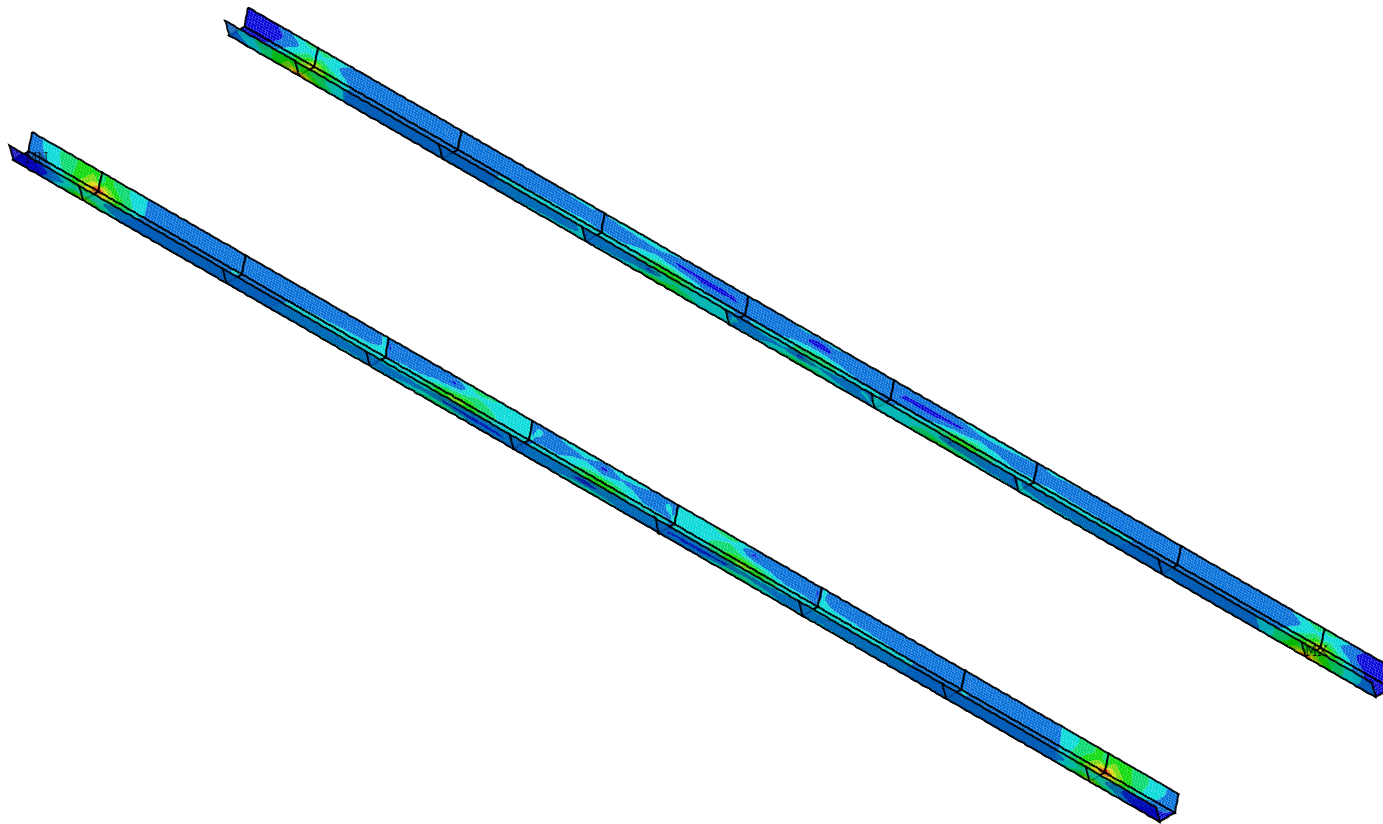
XV =1  
 YV =1  
 ZV =1  
 DIST=6965  
 YF =359.7  
 CENTROID HIDDEN

Blue	.715704
Light Blue	17.112
Cyan	33.507
Green	49.903
Light Green	66.299
Yellow-Green	82.695
Yellow	99.091
Orange	115.486
Red-Orange	131.882
Red	148.278



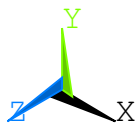
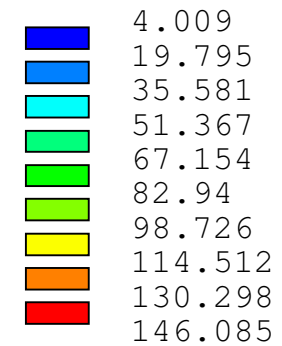
1

POSITION 14, MASS=2375kg    PLATE t=15mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



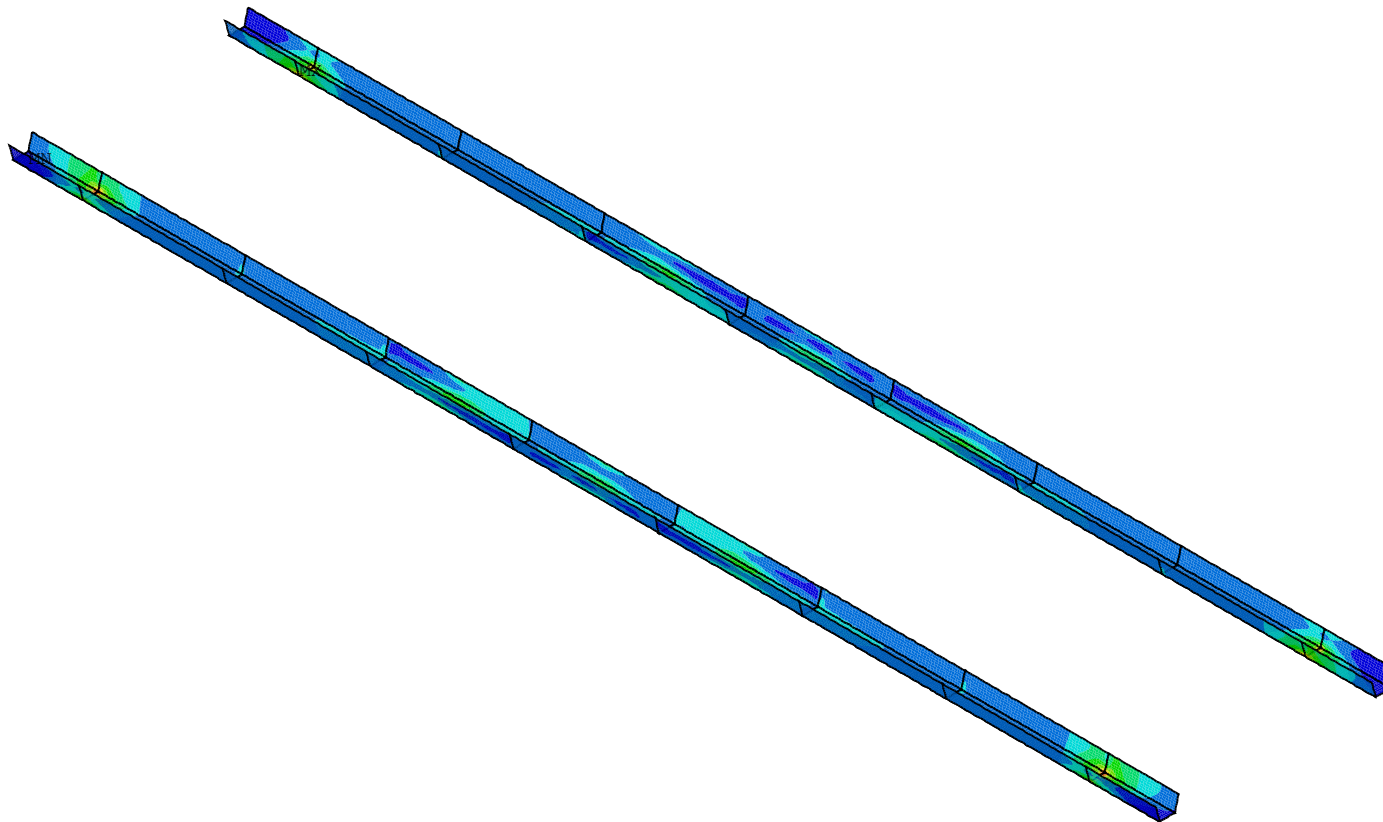
ANSYS 12.1  
NOV 9 2021  
09:30:54  
PLOT NO. 82  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXM (AVG)  
MIDDLE  
DMX =3.093  
SMN =4.009  
SMX =146.085

XV =1  
YV =1  
ZV =1  
DIST=7510  
YF =878.75  
CENTROID HIDDEN



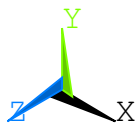
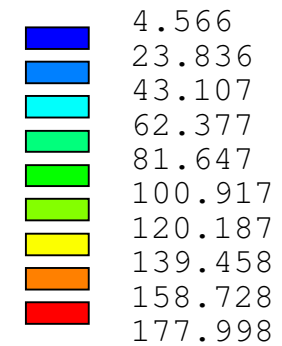
1

POSITION 14, MASS=2375kg    PLATE t=15mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (top plane)    LC 1 - 18



ANSYS 12.1  
NOV 9 2021  
09:30:55  
PLOT NO. 83  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXT (AVG)  
TOP  
DMX =3.093  
SMN =4.566  
SMX =177.998

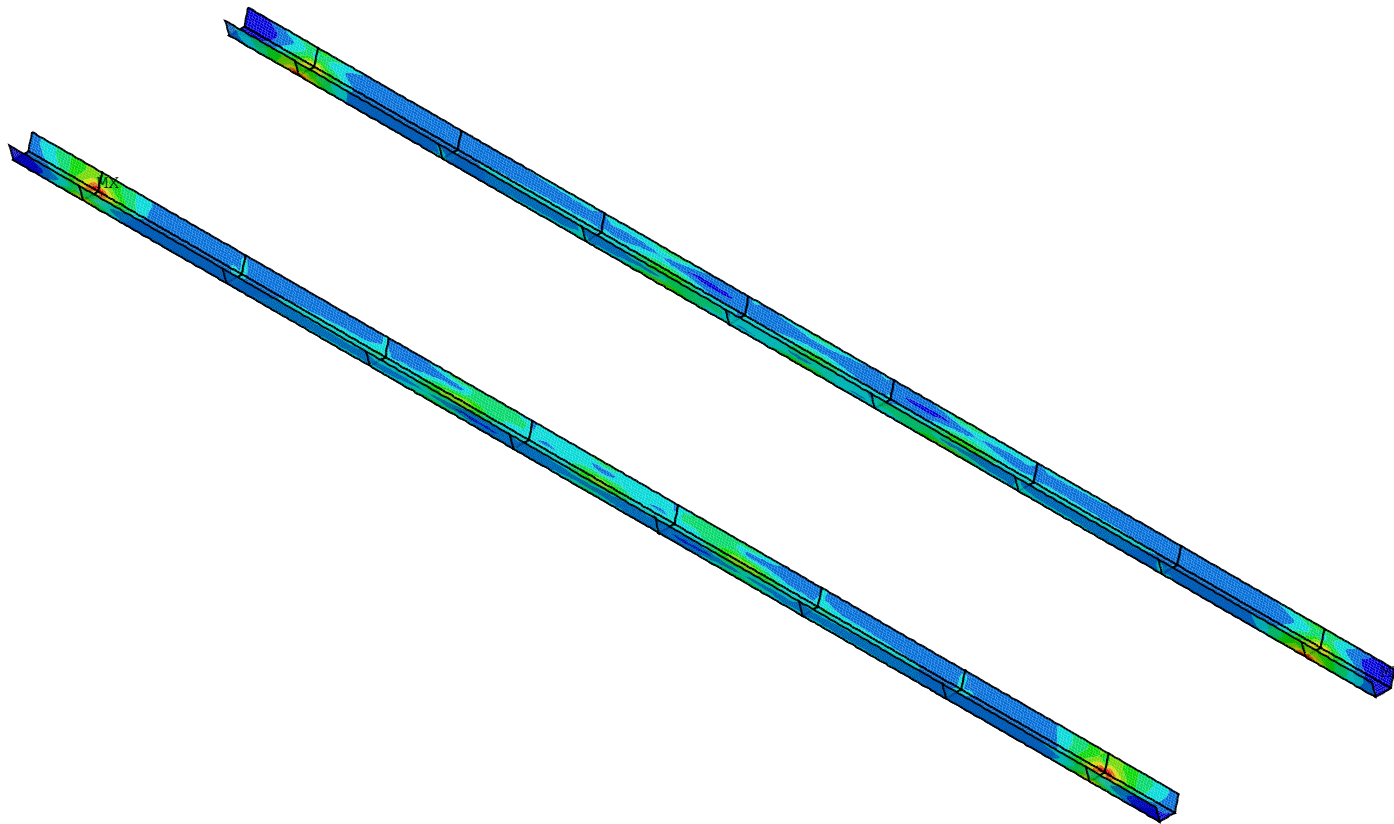
XV =1  
YV =1  
ZV =1  
DIST=7510  
YF =878.75  
CENTROID HIDDEN





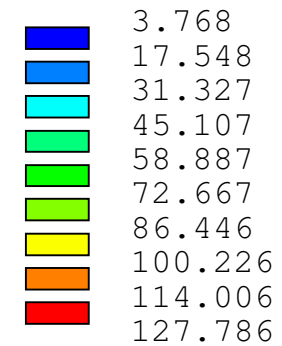
1

POSITION 14, MASS=2375kg PLATE t=15mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



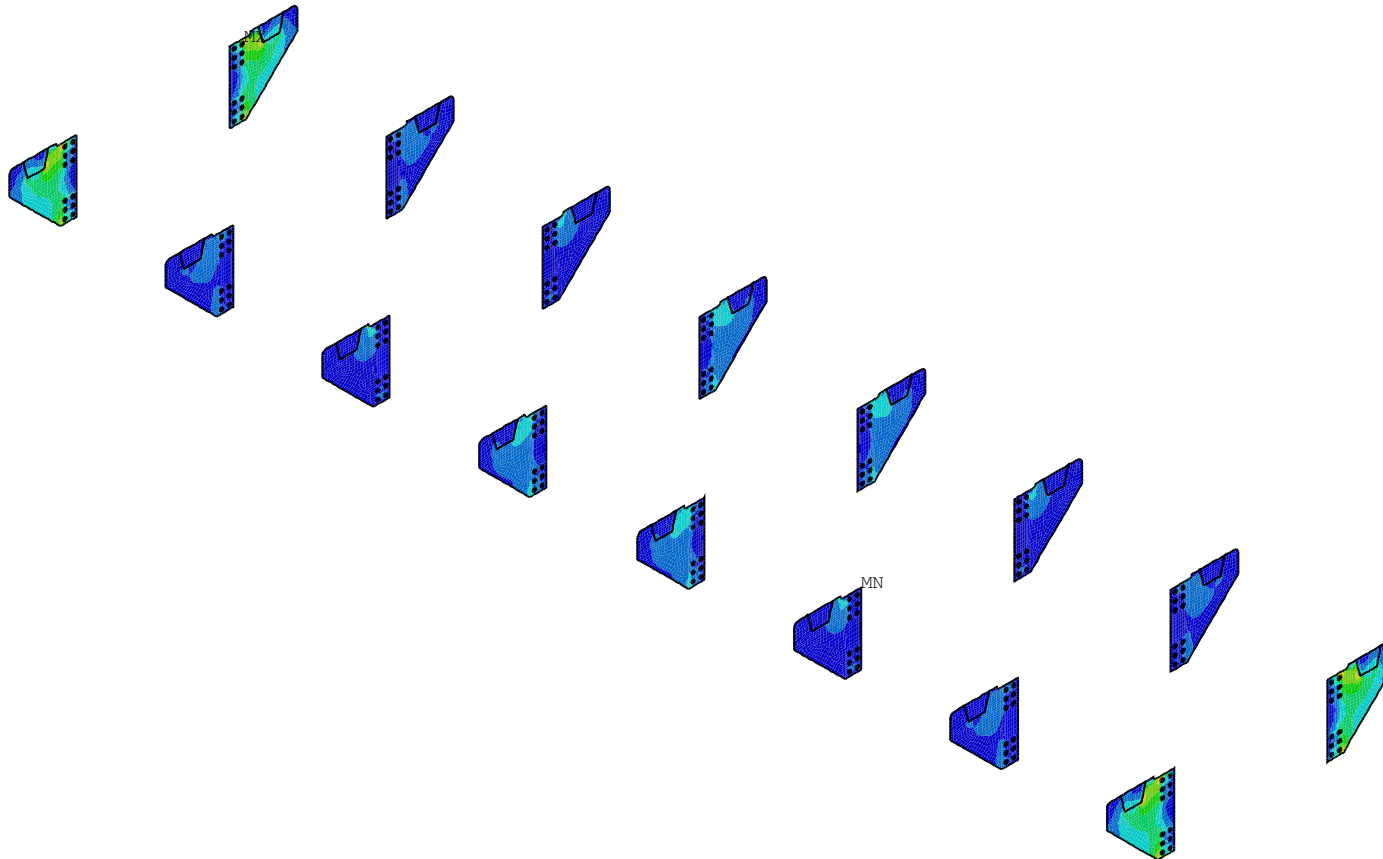
ANSYS 12.1  
NOV 9 2021  
09:30:55  
PLOT NO. 84  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXB (AVG)  
BOTTOM  
DMX =3.093  
SMN =3.768  
SMX =127.786

XV =1  
YV =1  
ZV =1  
DIST=7510  
YF =878.75  
CENTROID HIDDEN



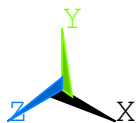
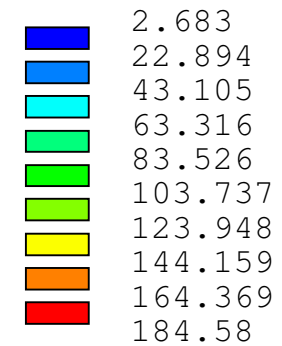
1

POSITION 15, MASS=1105kg PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



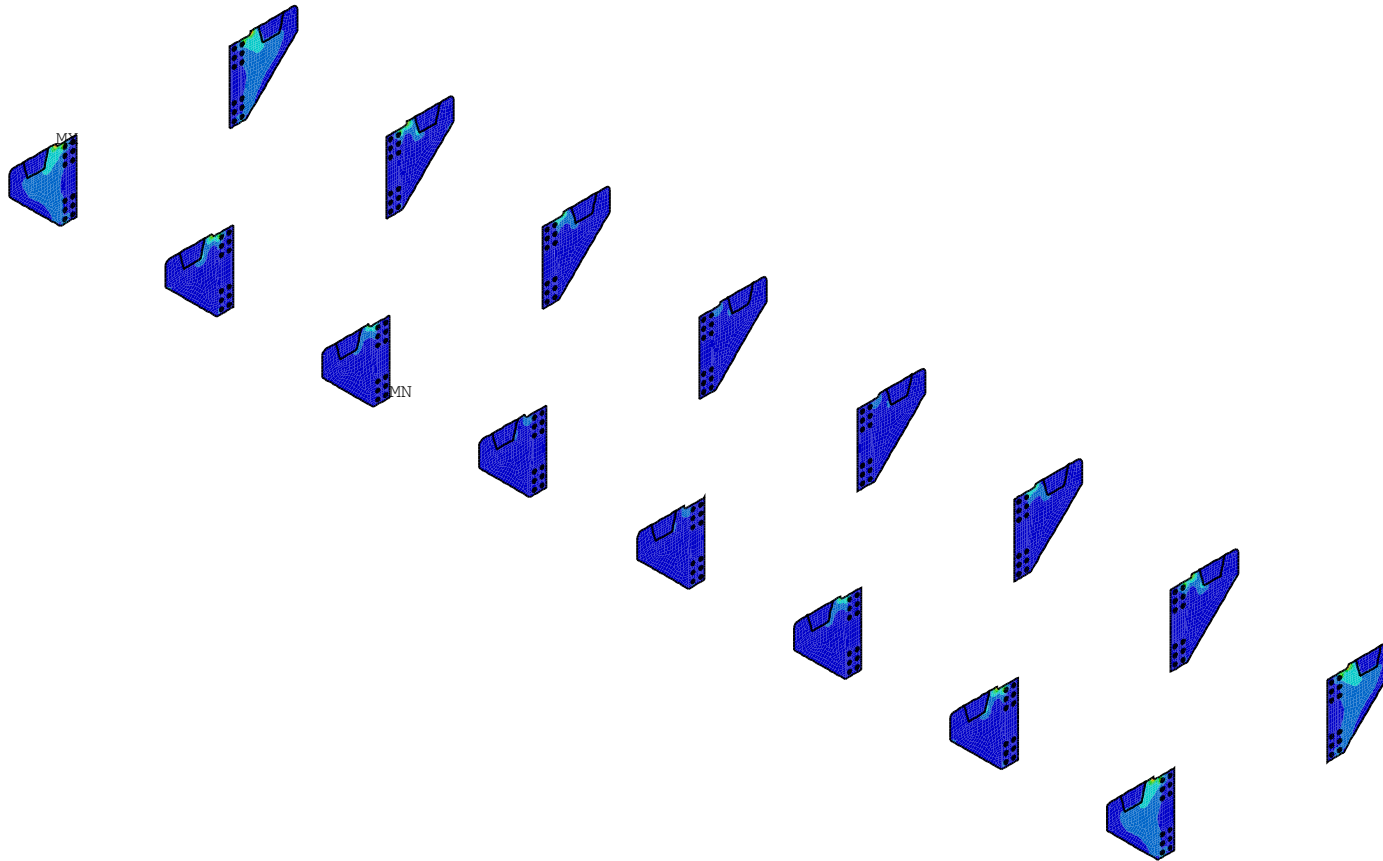
ANSYS 12.1  
 NOV 9 2021  
 09:31:01  
 PLOT NO. 88  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXM (AVG)  
 MIDDLE  
 DMX =3.037  
 SMN =2.683  
 SMX =184.58

XV =1  
 YV =1  
 ZV =1  
 DIST=6888  
 YF =507.5  
 CENTROID HIDDEN



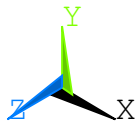
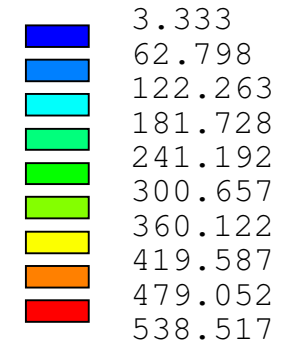
1

POSITION 15, MASS=1105kg PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (top plane) LC 1 - 18



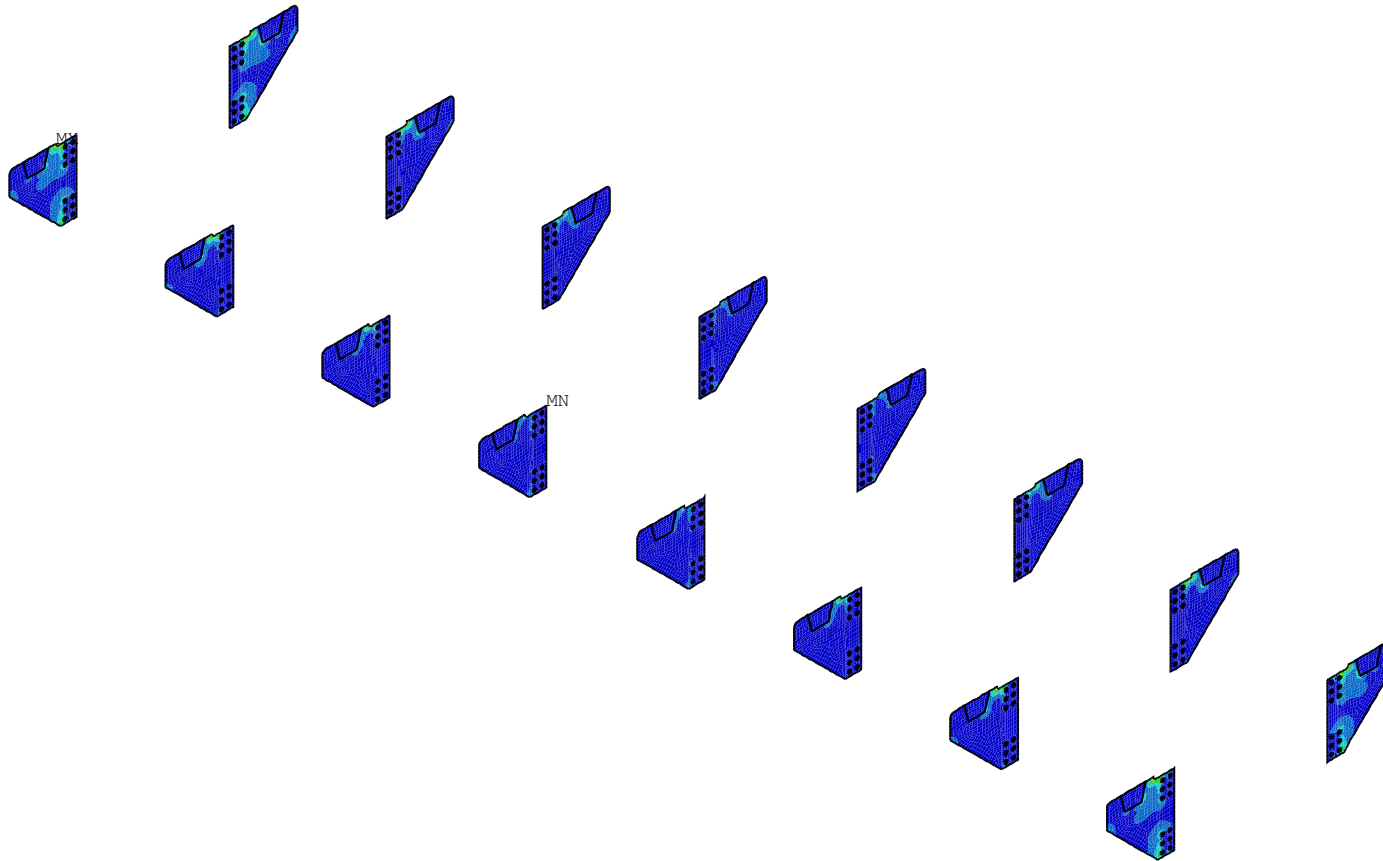
ANSYS 12.1  
 NOV 9 2021  
 09:31:01  
 PLOT NO. 89  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXT (AVG)  
 TOP  
 DMX =3.037  
 SMN =3.333  
 SMX =538.517

XV =1  
 YV =1  
 ZV =1  
 DIST=6888  
 YF =507.5  
 CENTROID HIDDEN



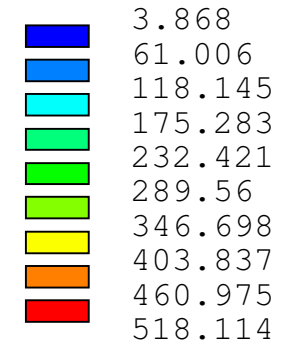
1

POSITION 15, MASS=1105kg PLATE t=15mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



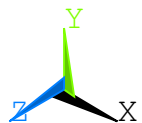
ANSYS 12.1  
 NOV 9 2021  
 09:31:02  
 PLOT NO. 90  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXB (AVG)  
 BOTTOM  
 DMX =3.037  
 SMN =3.868  
 SMX =518.114

XV =1  
 YV =1  
 ZV =1  
 DIST=6888  
 YF =507.5  
 CENTROID HIDDEN



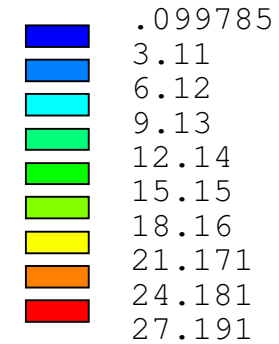
1

POSITION 19, MASS=93kg PLATE t=20mm 0mm 0mm 0mm  
 MAX EQUIVALENT STRESSES (middle plane) LC 1 - 18



ANSYS 12.1  
 NOV 9 2021  
 09:31:03  
 PLOT NO. 94  
 AVG ELEMENT SOLUTION  
 STEP=18  
 SUB =1  
 TIME=18  
 EQVMAXM (AVG)  
 MIDDLE  
 DMX =.102636  
 SMN =.099785  
 SMX =27.191

XV =1  
 YV =1  
 ZV =1  
 DIST=7646  
 YF =860  
 CENTROID HIDDEN



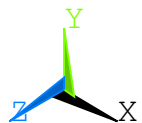
1

POSITION 19, MASS=93kg      PLATE t=20mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (top plane)      LC 1 - 18



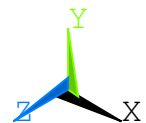
ANSYS 12.1  
NOV 9 2021  
09:31:03  
PLOT NO. 95  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXT (AVG)  
TOP  
DMX =.102636  
SMN =.353431  
SMX =23.093

XV =1  
YV =1  
ZV =1  
DIST=7646  
YF =860  
CENTROID HIDDEN



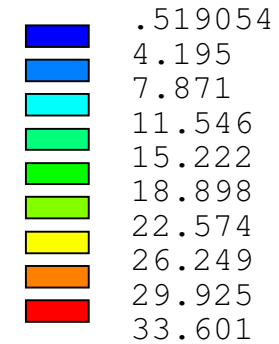
1

POSITION 19, MASS=93kg      PLATE t=20mm 0mm 0mm 0mm  
MAX EQUIVALENT STRESSES (bottom plane) LC 1 - 18



ANSYS 12.1  
NOV 9 2021  
09:31:03  
PLOT NO. 96  
AVG ELEMENT SOLUTION  
STEP=18  
SUB =1  
TIME=18  
EQVMAXB (AVG)  
BOTTOM  
DMX =.102636  
SMN =.519054  
SMX =33.601

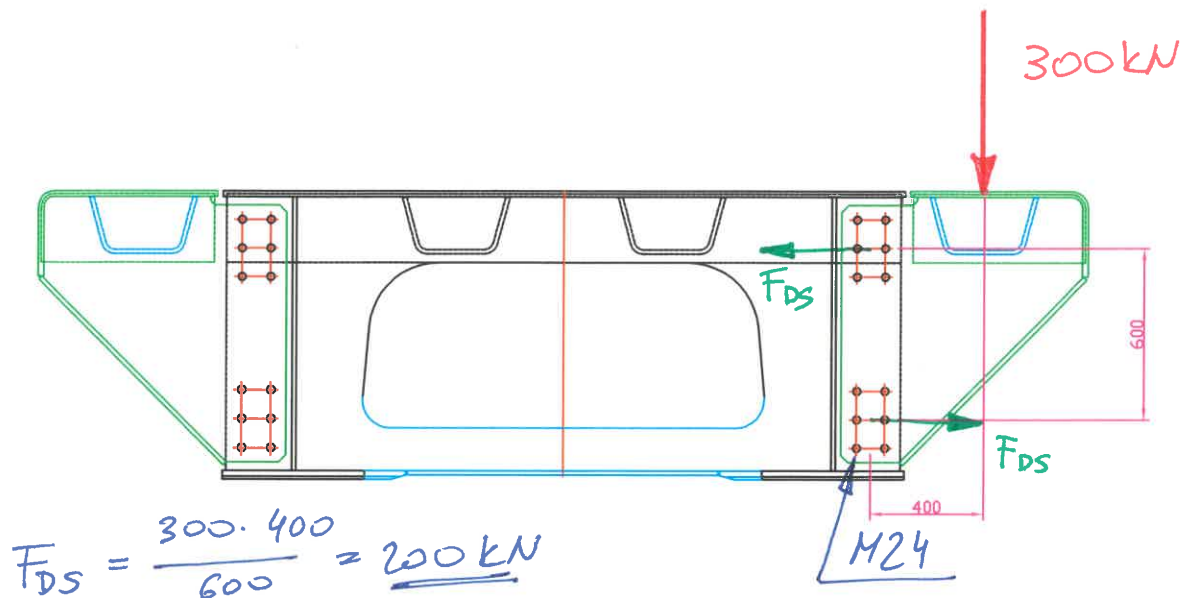
XV =1  
YV =1  
ZV =1  
DIST=7646  
YF =860  
CENTROID HIDDEN



# KONTROLA SPOJEV



# KONTROLA VIJAČENEGA SPOJA



$$F_{DS} = \frac{300 \cdot 400}{600} = \underline{\underline{200 \text{ kN}}}$$

M24:

$$F_p = 0,7 \cdot f_{ub} \cdot A_s$$

$$F_p = 0,7 \cdot 1000 \cdot 353 = \underline{\underline{247,1 \text{ kN}}}$$

$$M = 800 \text{ Nm}; \mu \approx 0,14$$

Odpornost proti zdrsni:

$$F_{sed} = \frac{k_s \cdot n \cdot \mu}{\gamma_{Ms}} \cdot F_p = \frac{1 \cdot 6 \cdot 0,4}{1,25} \cdot 247,1 = \underline{\underline{474,4 \text{ kN}}}$$

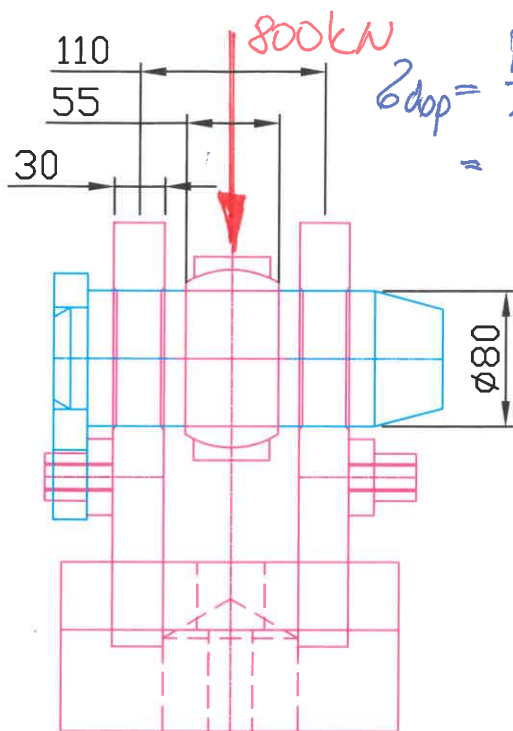
$$V = \frac{F_{sed}}{F_{DS}} = \frac{474,4}{200} = \underline{\underline{2,37}} \rightarrow \text{OK!}$$

$\mu = 0,4$  (med površinama glavega nosilca in pravičnega nosilca)

Pomrine pravilno pripraviti!

# KONTROLA SORNIKA

# KONTROLA SORNIKA



material sornika:  $42CrMo4+2T$   
 $R_{pl} = 650 \text{ N/mm}^2$   
 $\sigma_{dop} = \frac{R_{pl}}{1,2} = \frac{650}{1,2} = 541 \text{ N/mm}^2$   
Površinski pritisk:

$$p = \frac{F}{A} = \frac{800\,000}{80 \cdot 55} = 181 \text{ N/mm}^2$$

↓  
OK!

Strig:

$$\tau = \frac{4}{3} \cdot \frac{4 \cdot 400\,000}{\pi \cdot 80^2} = 106 \text{ N/mm}^2 \leq \sigma_{dop}$$

$$\tau_{dop} = \frac{\sigma_{dop}}{\sqrt{3}} = 250 \text{ N/mm}^2$$

↓  
OK!

Upogib:

$$M = \frac{F \cdot L}{4} = \frac{800 \cdot 0,11}{4} = 22 \text{ kNm} \rightarrow \text{na vamo stran}$$

izračun momenta globoko

$$W = \frac{\pi \cdot d^3}{32} = \frac{\pi \cdot 80^3}{32} = 50\,265 \text{ mm}^3$$

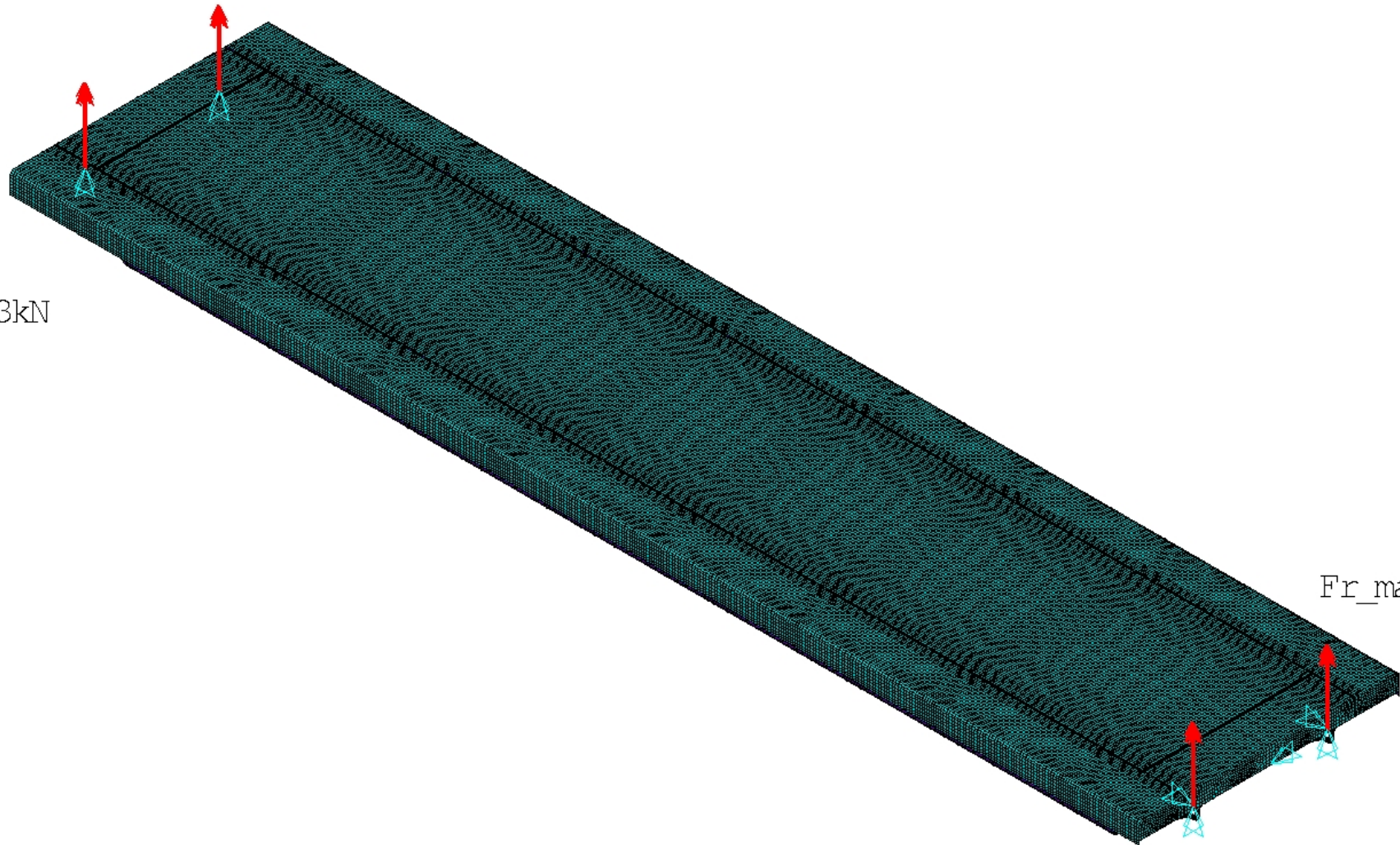
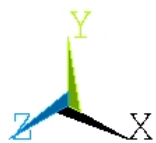
$$\sigma = \frac{M}{W} = \frac{22 \cdot 10^6}{50\,265} = 438 \text{ N/mm}^2 \leq 541 \text{ N/mm}^2$$

↓  
OK!

# REAKCIJE

## Največje reakcije v posamezni podpori

1 ELEMENTS

U  
F $Fr_{max}=673\text{kN}$  $Fr_{max}=673\text{kN}$  $Fr_{max}=673\text{kN}$  $Fr_{max}=673\text{kN}$ 

# ZAKLJUČEK

Konstrukcija je bila preverjena za 18 obremenilnih primerov (OP), ki so opisani zgoraj. Podlaga za izdelavo OP-jev je informacija naročnika o vozilih, ki se bodo pretovarjala na rampi. Podrobneje je določitev obremenitev opisana v tehničnem poročilu.

Slike napetosti prikazujejo največje primerjalne napetosti izmed nabora obremenitvenih primerov, za vsak konstrukcijski element. Slike torej prikazujejo ovojnico rezultatov analize 18 OP-jev. Dokaz nosilnosti konstrukcije je izveden po metodi dopustnih napetosti.

V primeru, da želi naročnik po rampi transportirati težja vozila (težja kot 120t), naj kontaktira projektanta, da se izvede kontrolni izračun, za točno določen tip vozila.

Zapisal: Klemen Ambrož, 18.11.2021