MODUL ZA PROIZVODNO MAŠINSTVO

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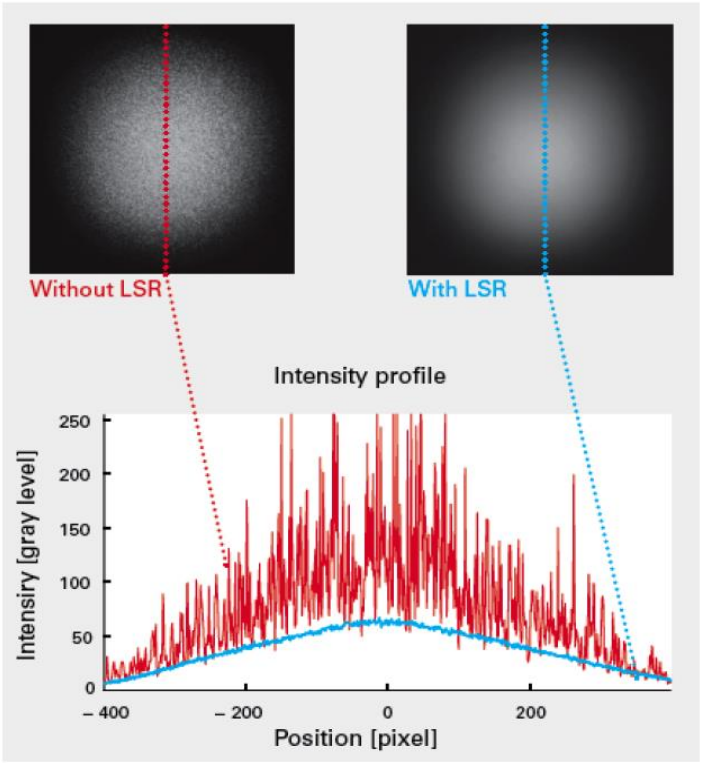
Prof. dr Božica Bojović

Kabinet 251
Prijem studenata tokom semestra
utorkom od 12 do 14h

bbojovic@mas.bg.ac.rs

PRIMERI MASTER RADOVA

Saradnja sa inostranom firmom gde je obavljena šestomesečna praksa
PROJEKTOVANJE I ANALIZA MEHANIZMA ZA LSR
MSc na engleskom jeziku



optotune
shaping the future of optics

Vereinbarung

zwischen

Optotune AG, Bernstrasse 388, CH-8953 Dietikon, Schweiz („Optotune")

und

Prof. B. Bojovic, Belgrade University, living at Milana Tankosića 11/8, 11000 Belgrade, Serbia („nachfolgend Projektmitarbeiter/in ")

bezüglich Masterarbeit von Aleksandar Popovic im Gebiet Mikroactuation und Speckle Reduction während dem 1. Oktober 2013 bis 31. März 2014

PROJEKTOVANJE I ANALIZA MEHANIZMA ZA LSR

Aim of master thesis

- Introduction to actuation mechanism for a laser speckle reducer (LSR). Operational principle of reluctance actuator and damping. Actuation technology selection.
- Resonance and actuating structures design, and coil design. Prototype fabrication. Prototype testing. Comparison of measured values to the FEM analysis results.
- SWOT and Utility analysis for actuation technology selection. Material selection and force calculation for structure design. Actuator performance testing, structure optimization and magnetic flux simulation by FEM simulations.

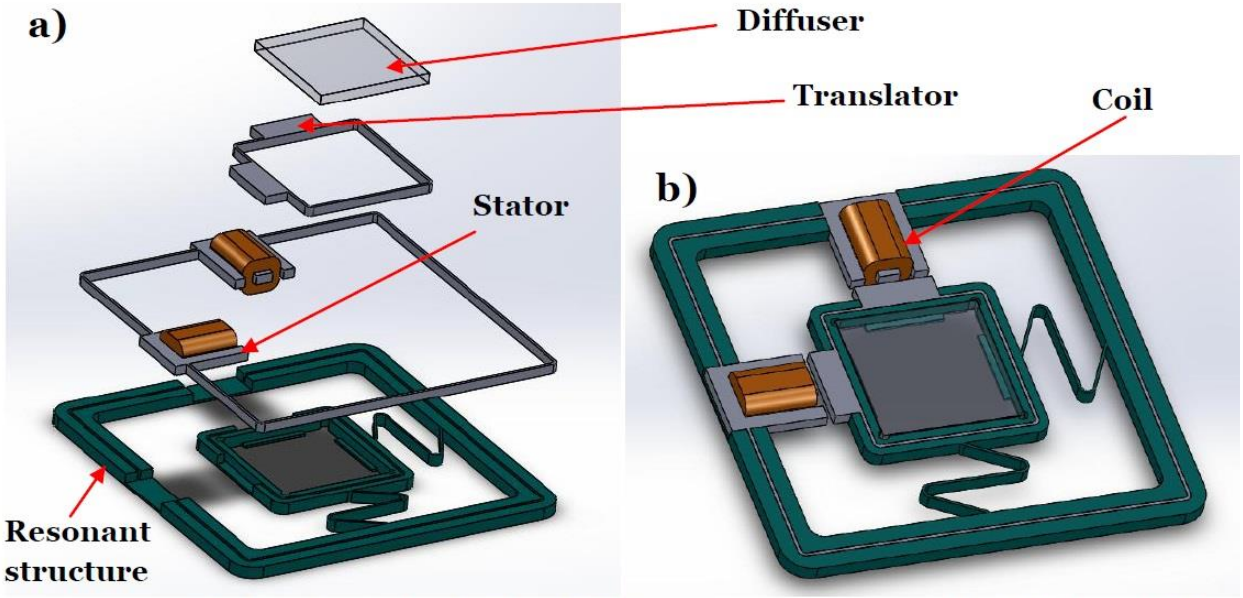


Figure 7.3: Combined metal – plastic 2D LSR structure. a) Disassembled; b) Assembled.

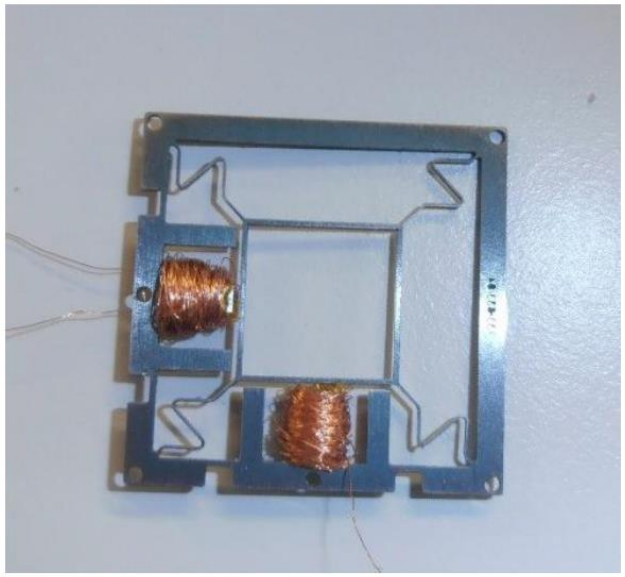


Figure 5.2: Manufactured 2D LSR.

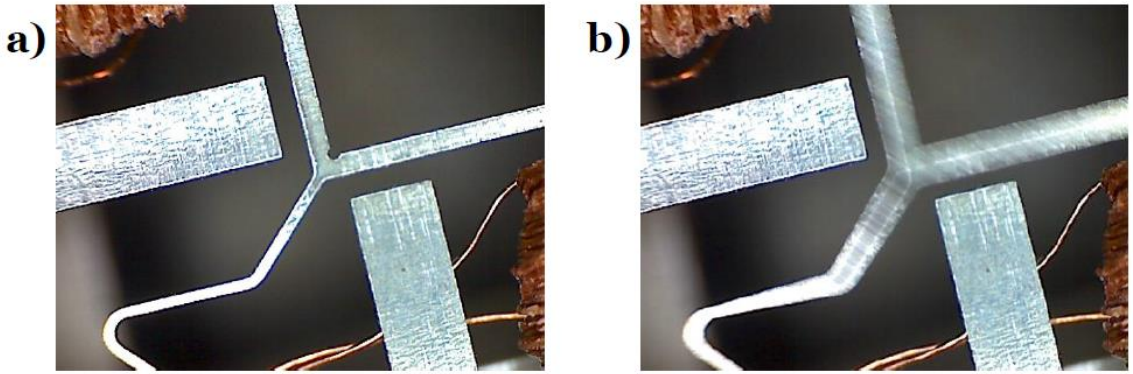


Figure 5.6: 2D Structure in movement. a) not actuated; b) actuated.

Laserska obrada čeličnog lima debljine 10 mikrometra

COMSOL Multiphysics® software

Određivanje širine opruga je rezultat analize magnetnog fluksa. Optimalna širina je 300 mikrometra

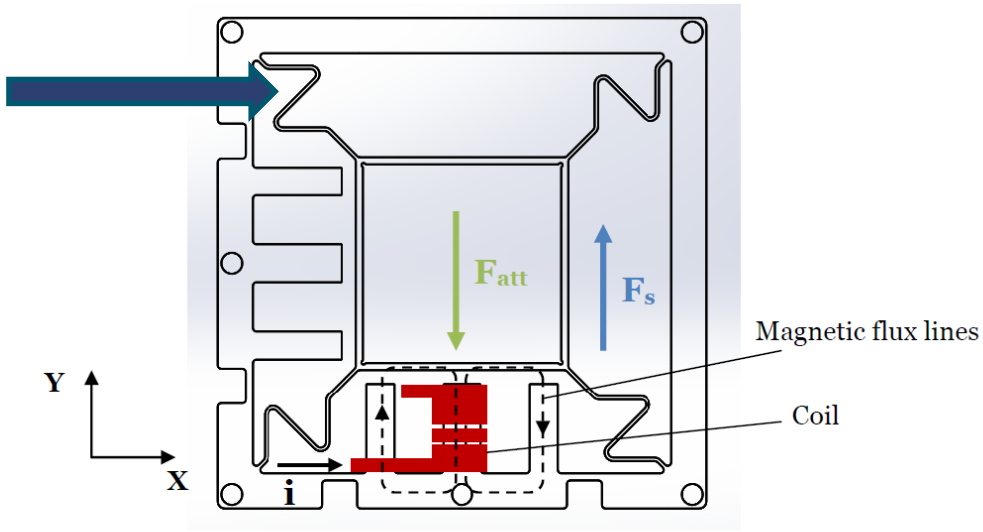
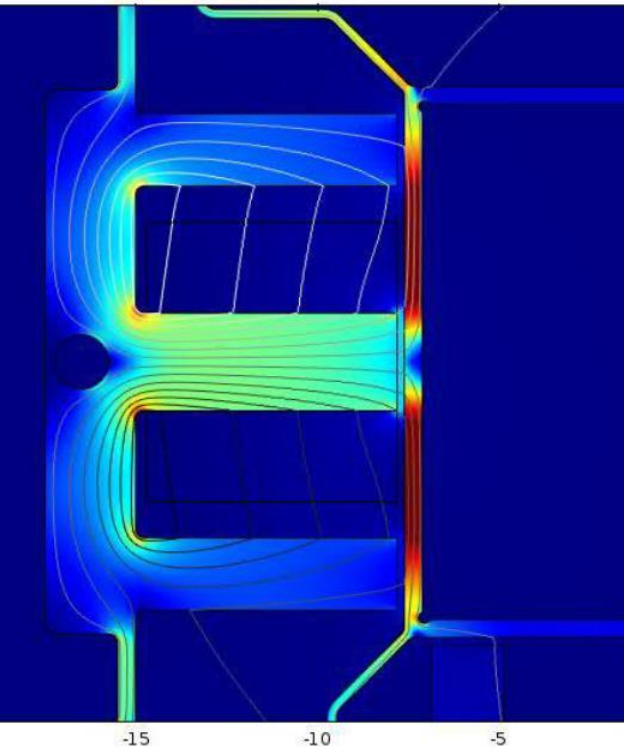


Figure 4.18: 2D Resonance structure actuation. F_s - spring force; F_{att} – attracting force



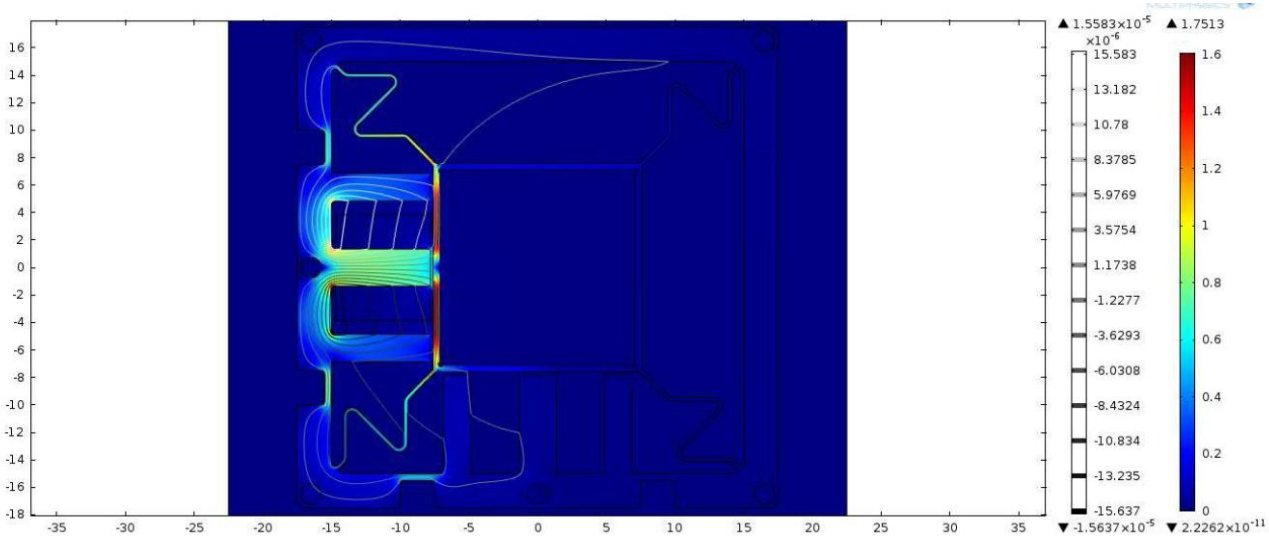
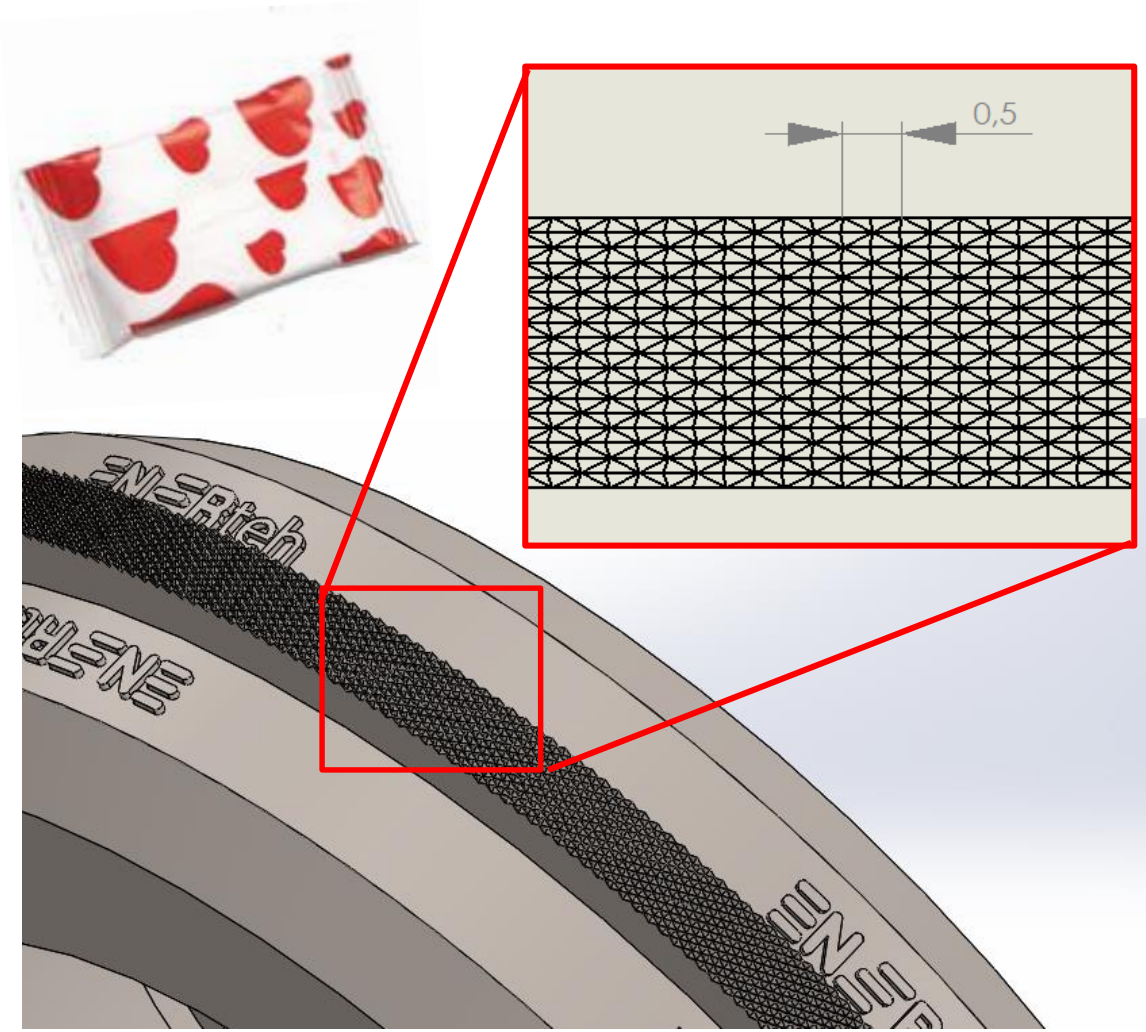


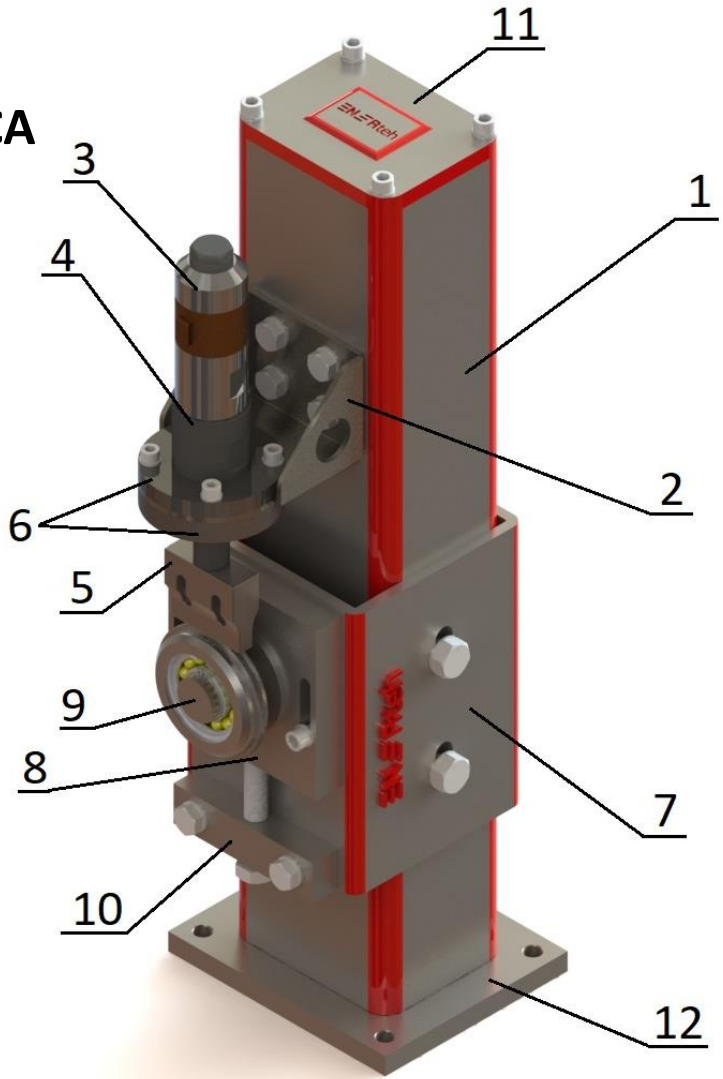
Figure 4.32: Magnetic flux density and magnetic flux lines within the structure, 2D LSR.

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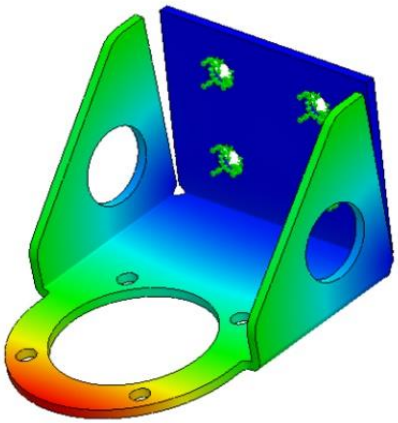
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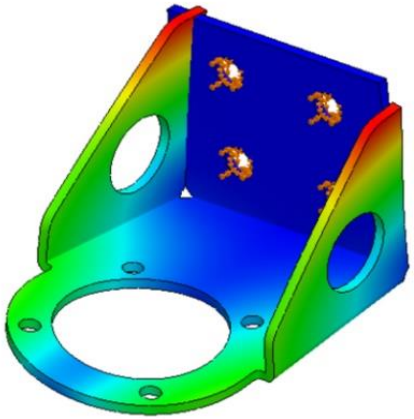
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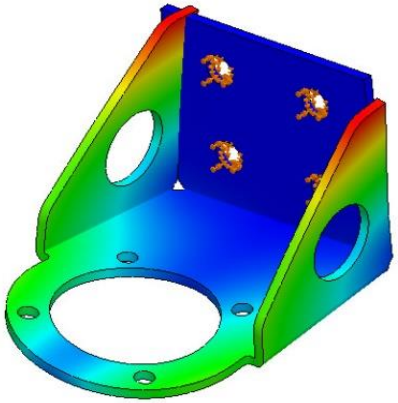


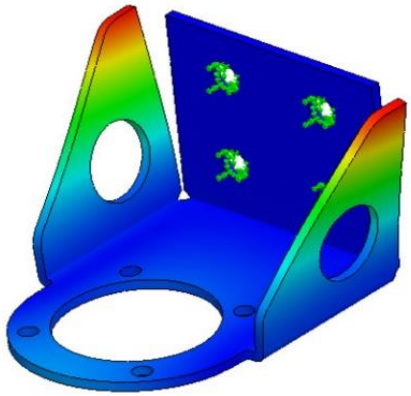


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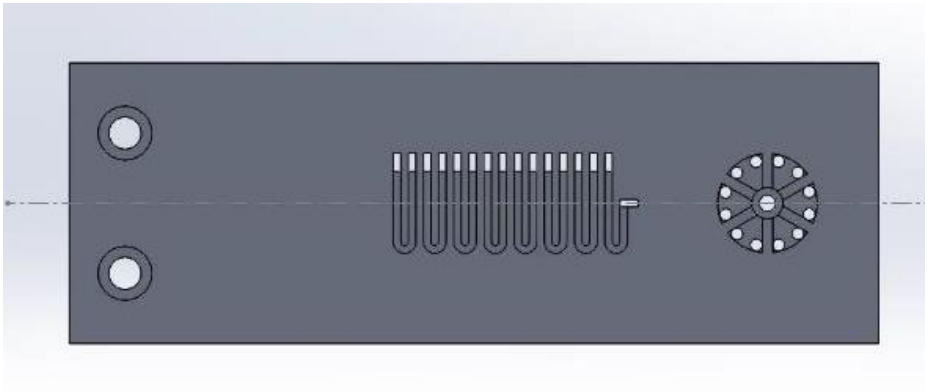


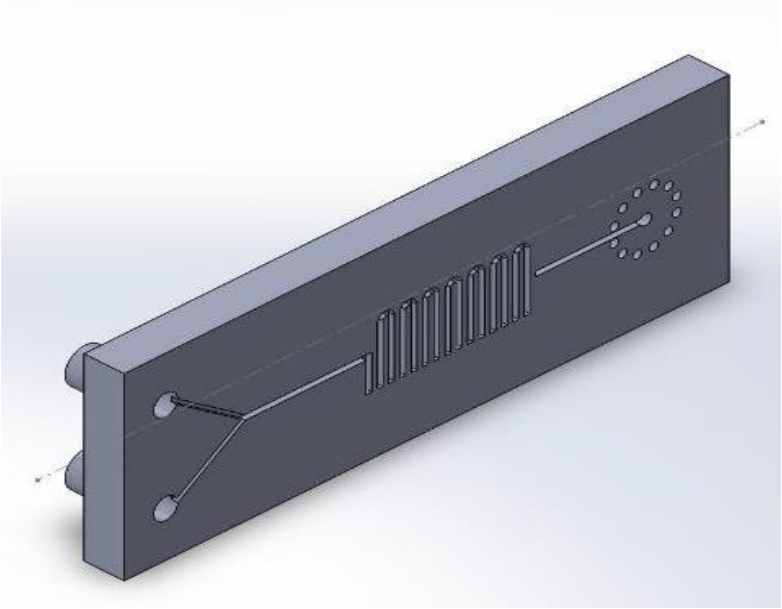


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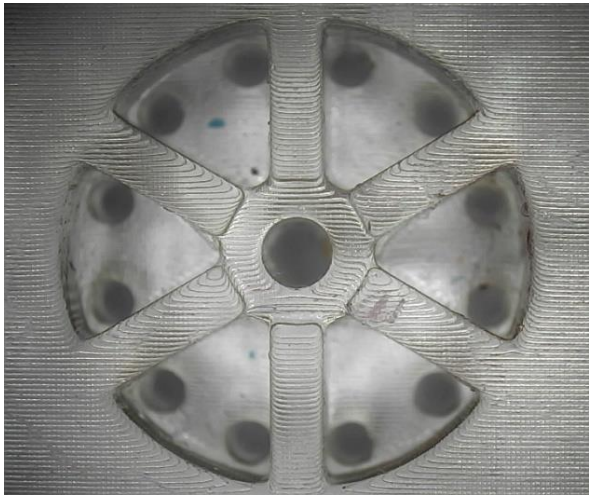
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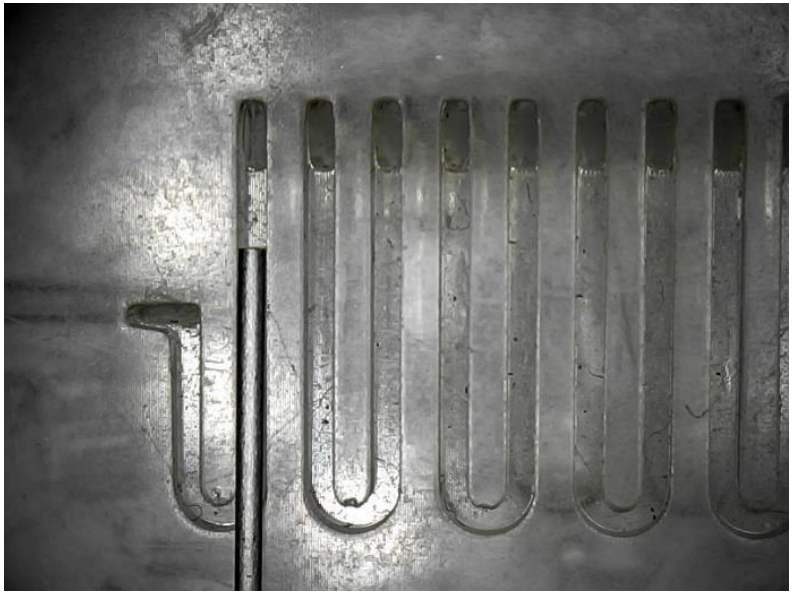


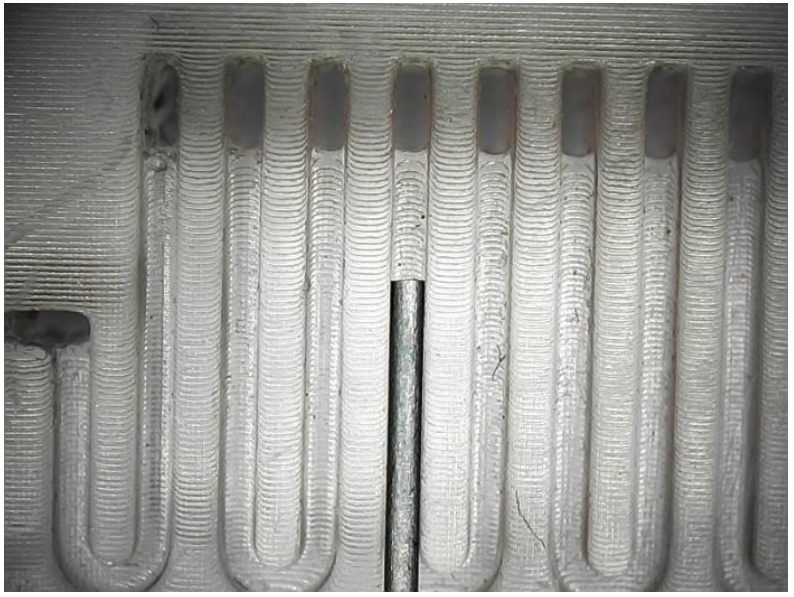










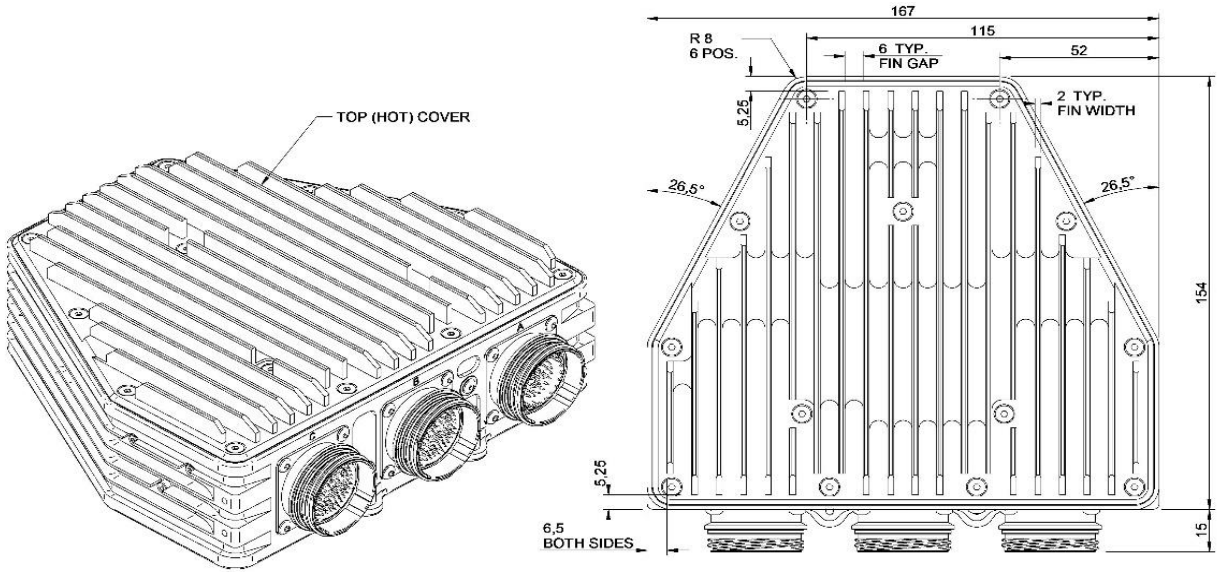


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PROJEKTOVANJE I IZRADA STRUKTUIRANE POVRŠINE SA FUNKCIONALNIM OREBRENJIMA PRIMENOM ADITIVNE TEHNOLOGIJE

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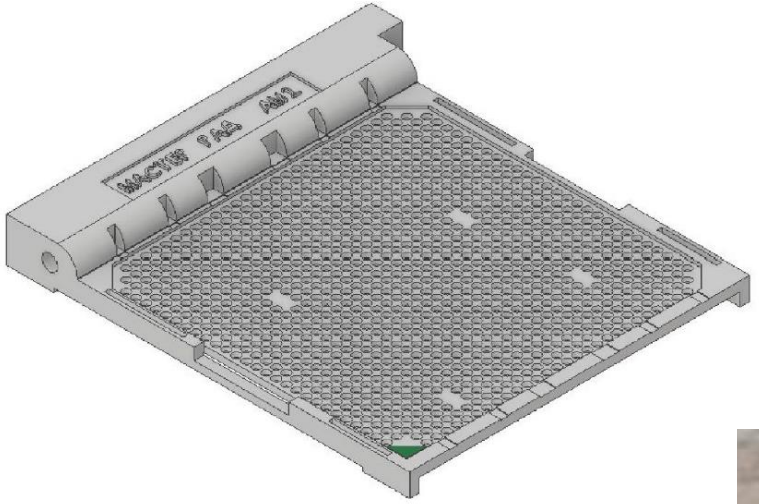


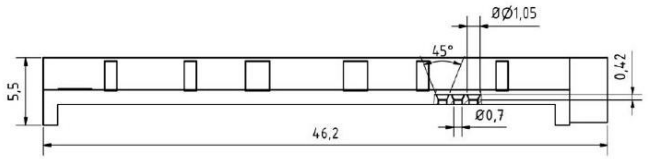


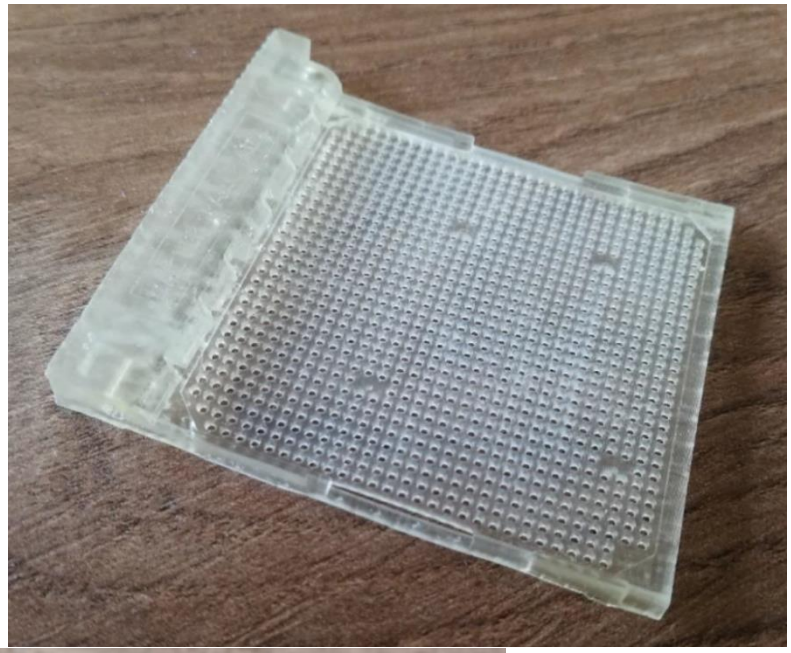
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BRZA IZRADA ZAMENSKOG DELA SA MATRICOM OTVORA

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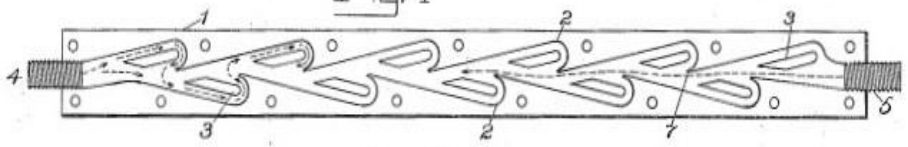
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PROTOTIP MODULARNOG TESLINOG VENTILA





Fig. 1



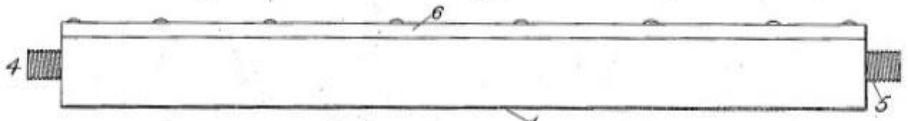
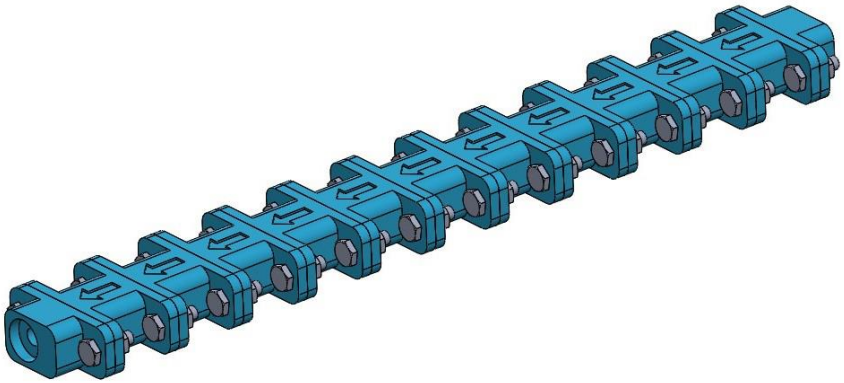
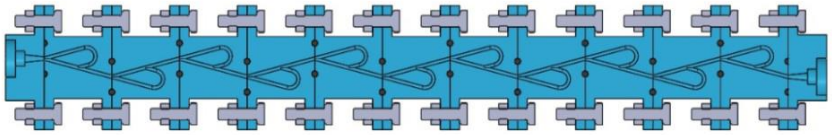
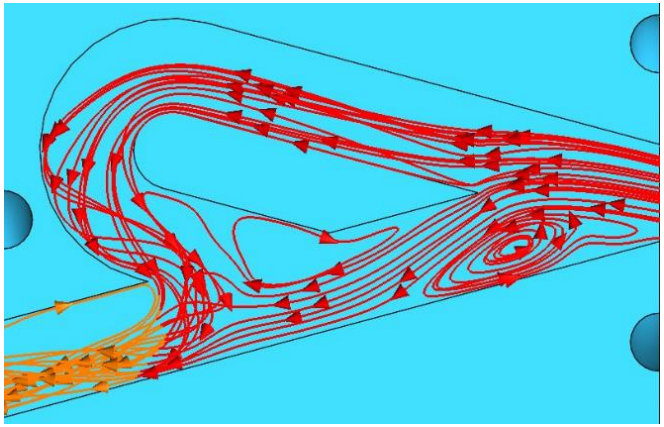


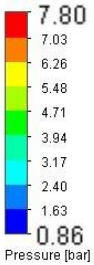
Fig. 2









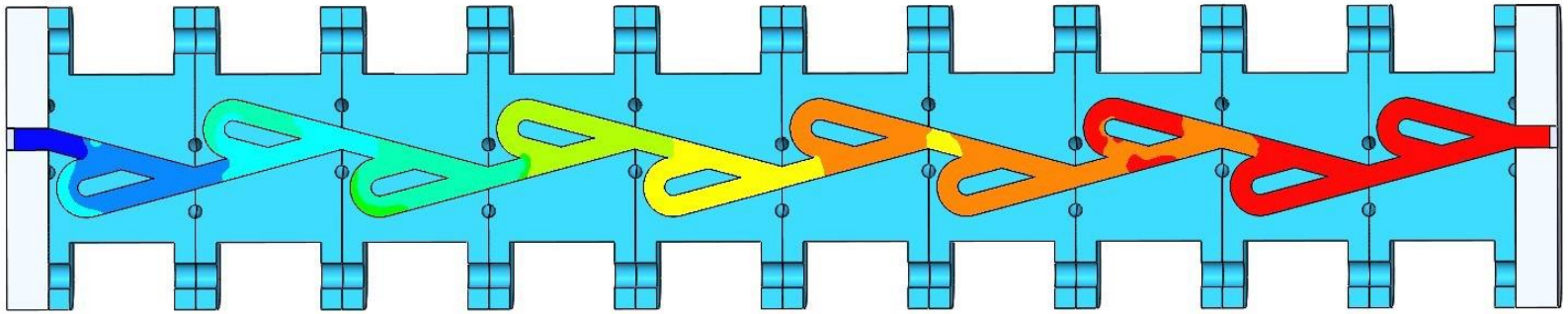


Iteration = 641



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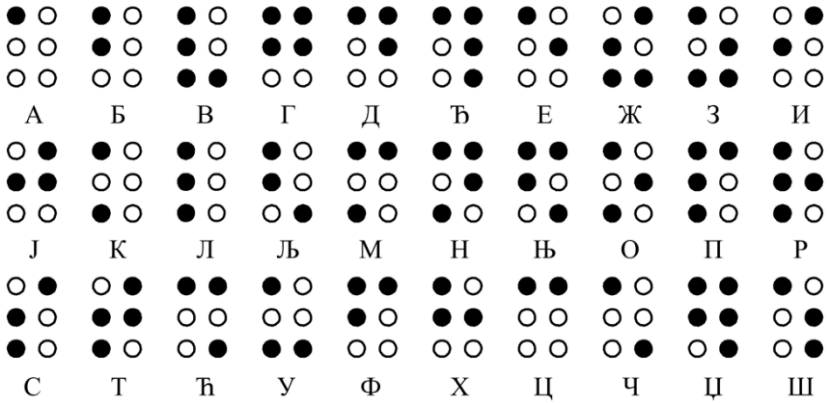
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Flow Trajectories 1



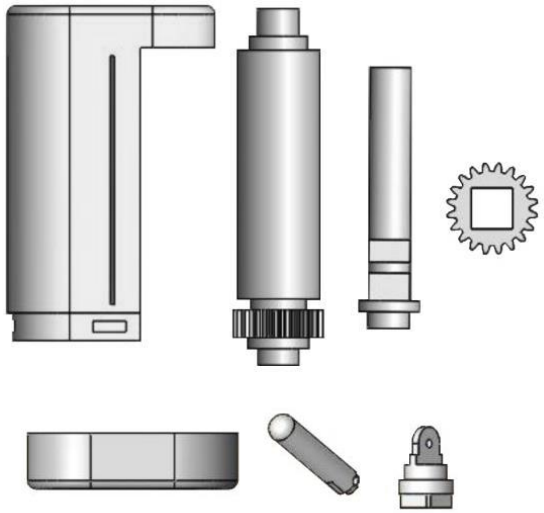
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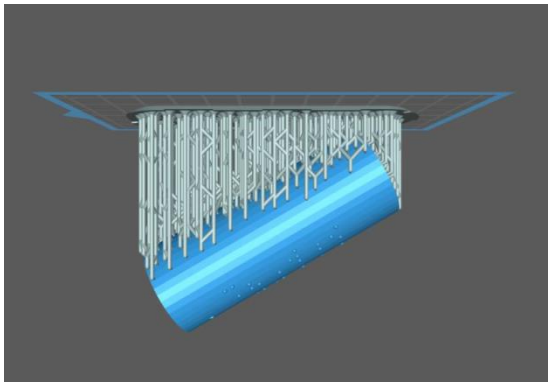
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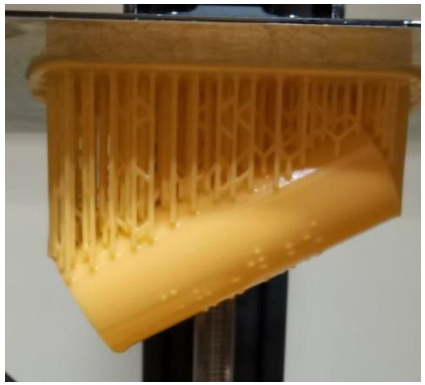
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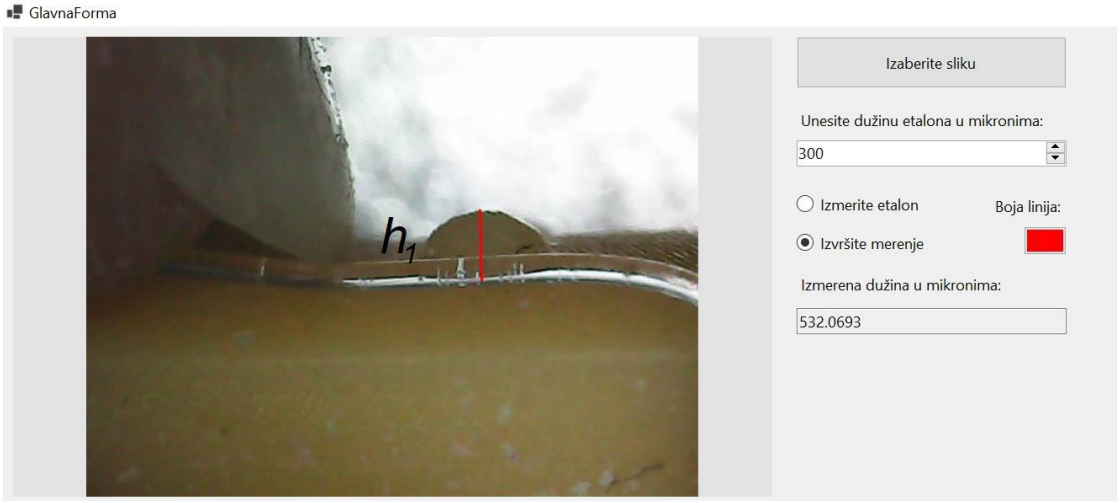


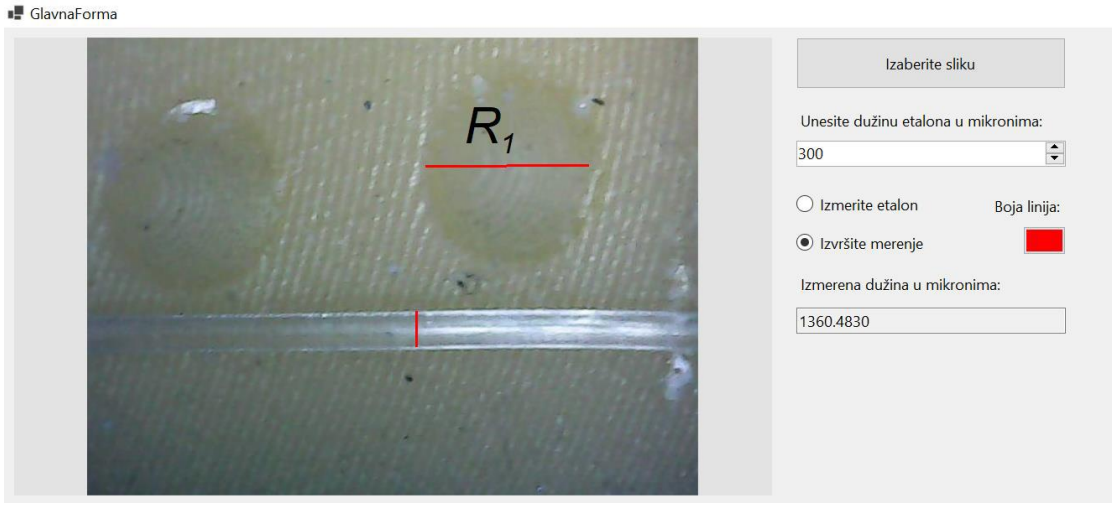












Nominalne dimenzije kalote

R1 = 1300 µm

h = 500 µm

Relativna greška dimenzija kalote

δR1 = 4.65%

δh = 6.4%

Dozvoljena relativna greška dimenzija kalote

δR1 = 1.5%

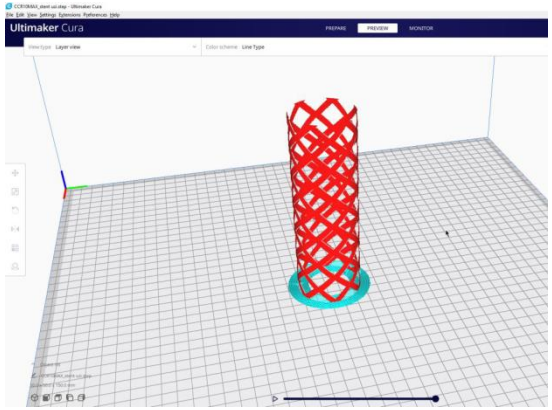
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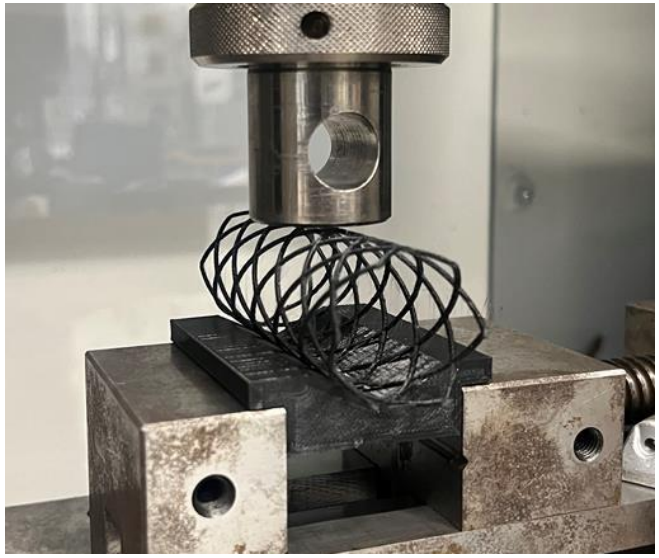


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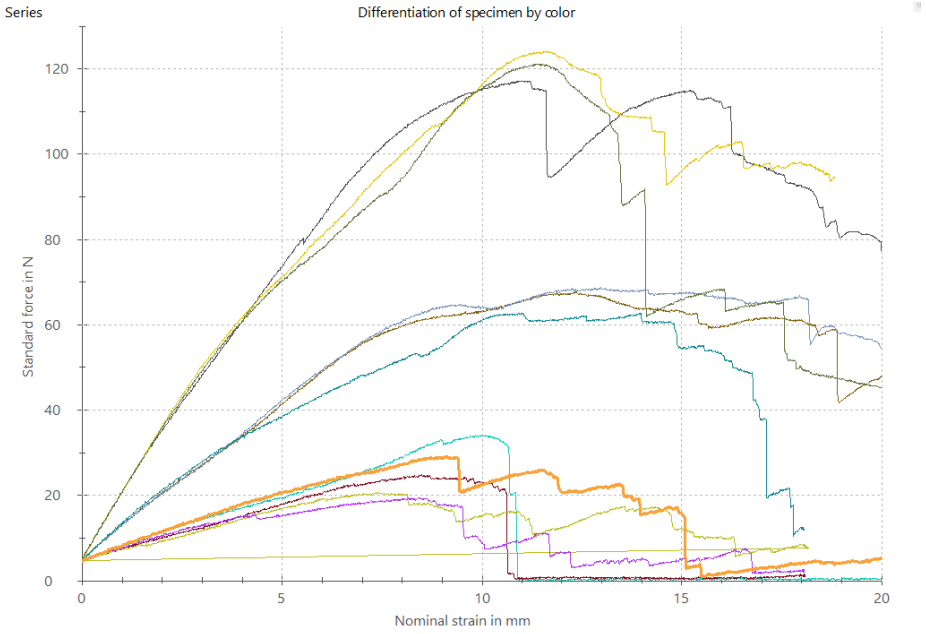
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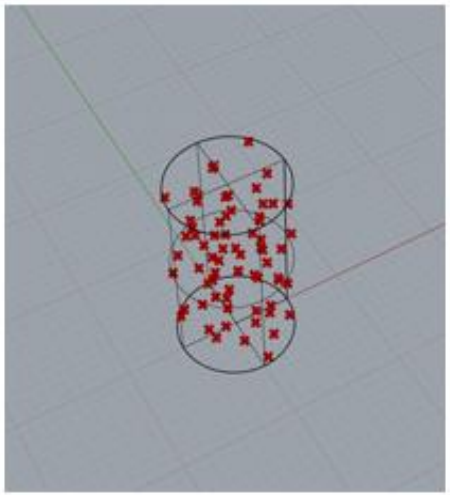


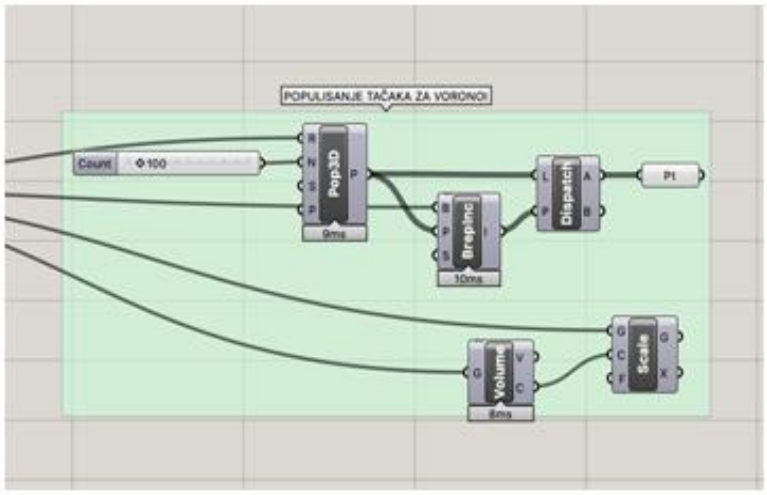




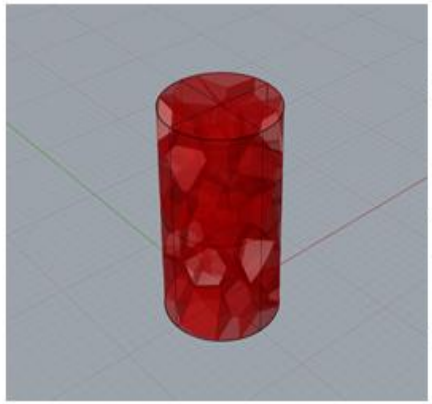
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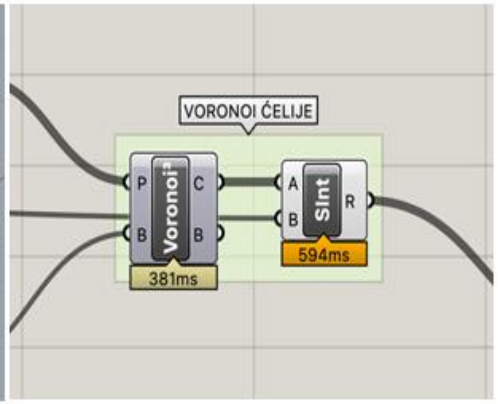
Modeliranje u novom Sw
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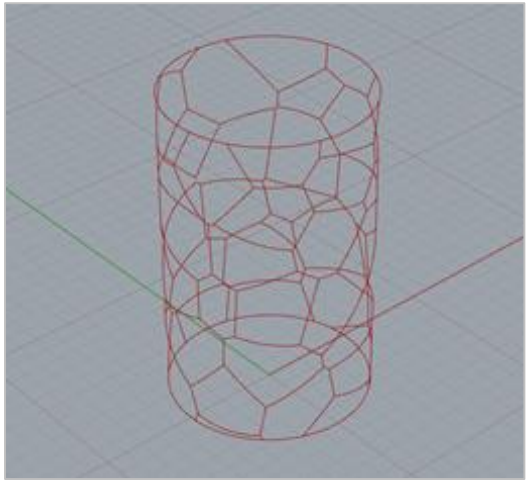


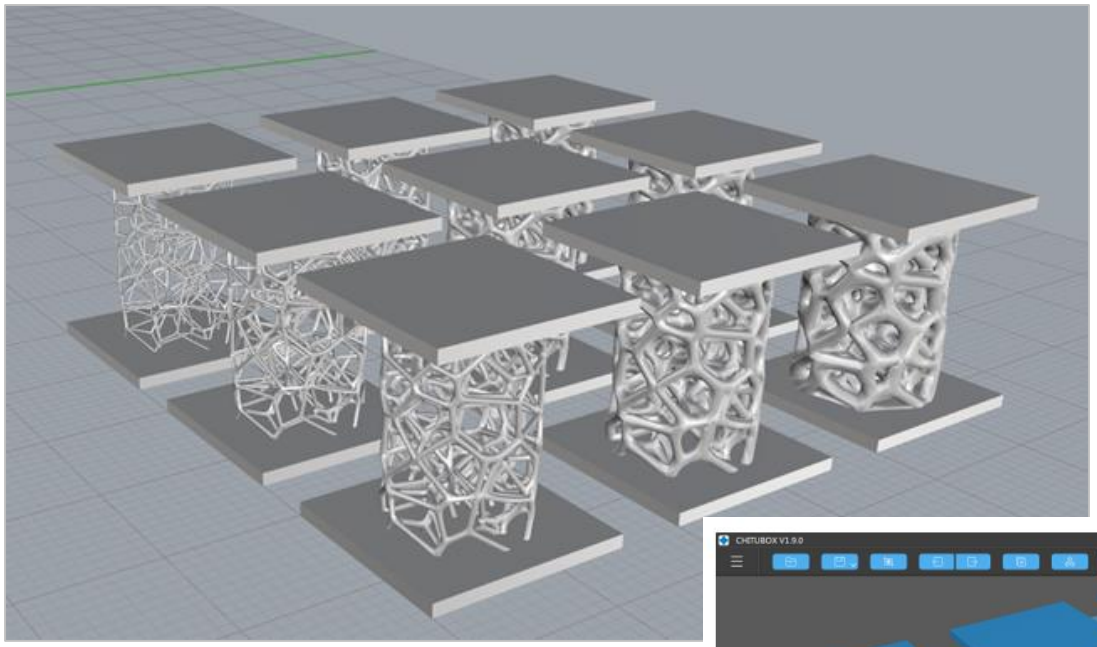
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Vizuelni programski jezik

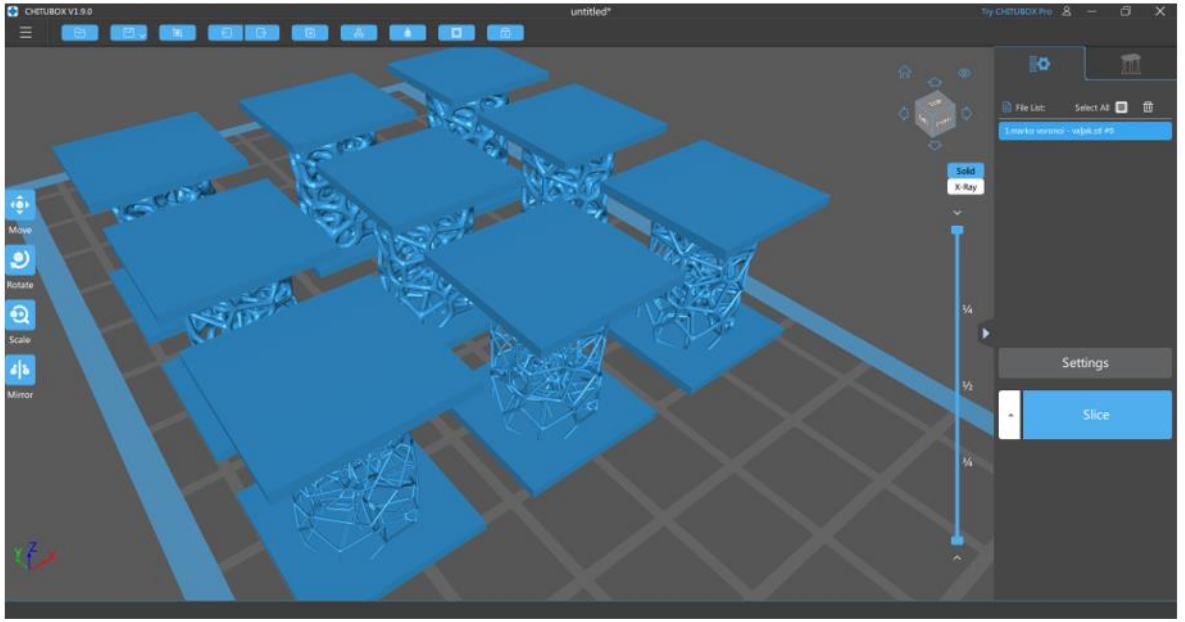




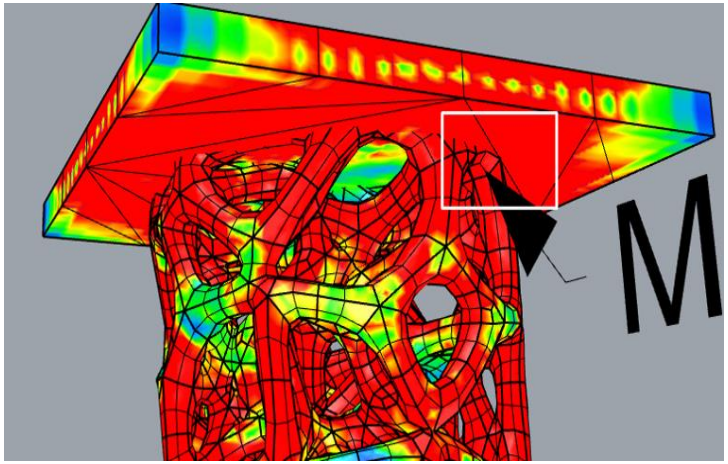
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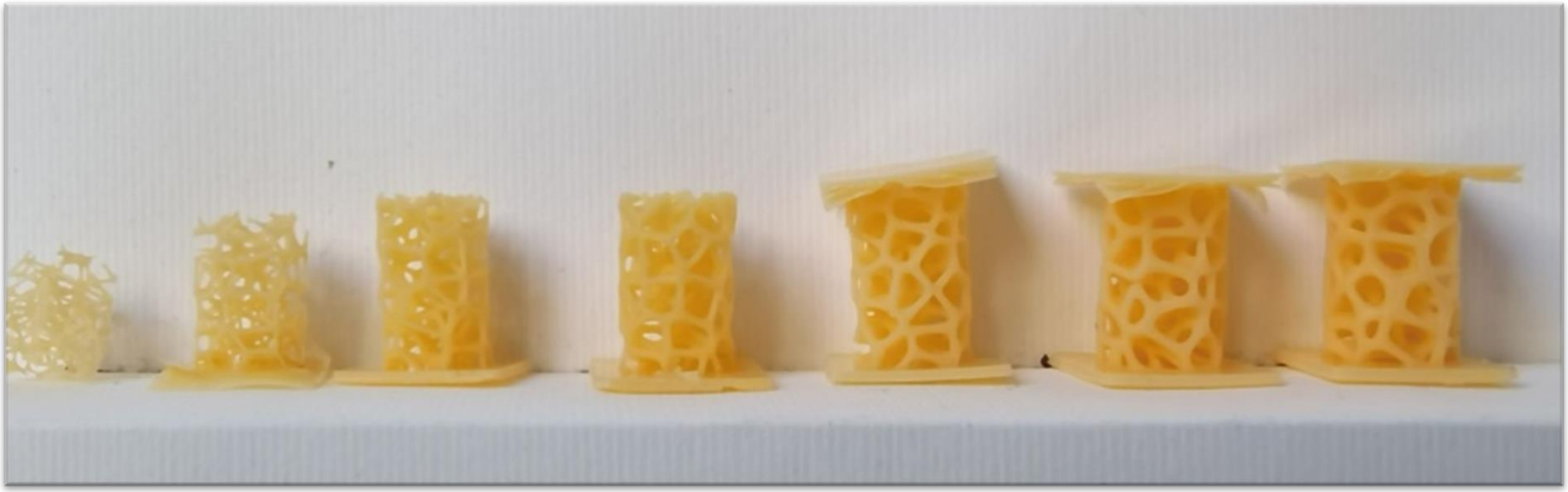





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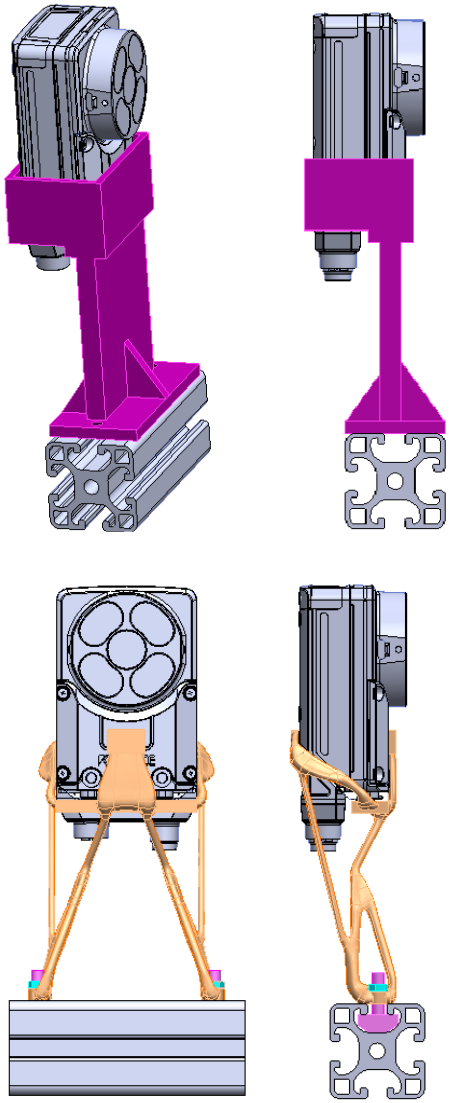

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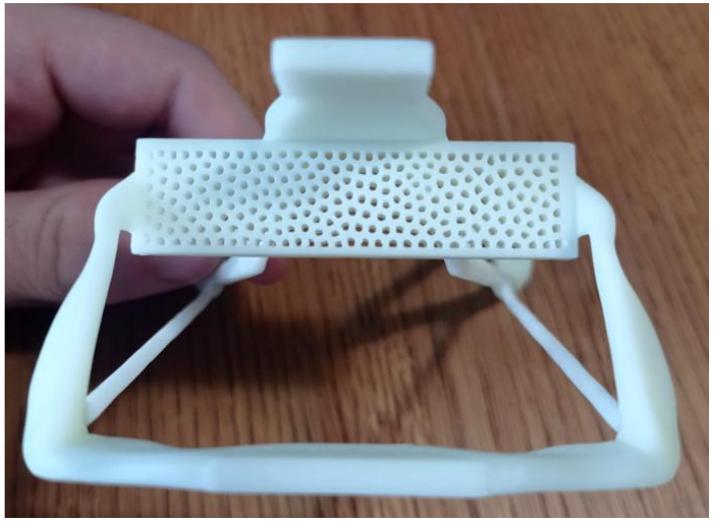
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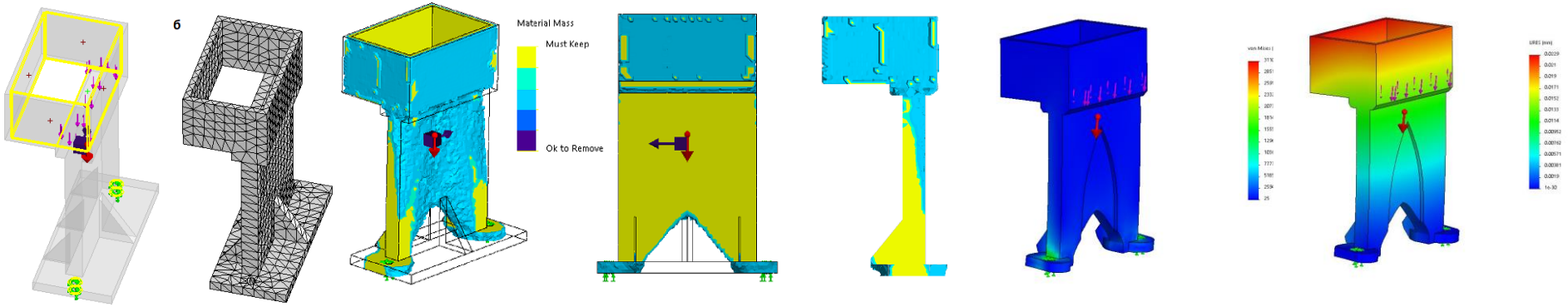
Simulacije u novom Sw

PRIMENA TOPOLOŠKE OPTIMIZACIJE I GENERATIVNOG DIZAJNA PRILIKOM IZRADE DRŽAČA ZA VIZUELNI SENZOR U INDUSTRIJSKOM OKRUŽENJU

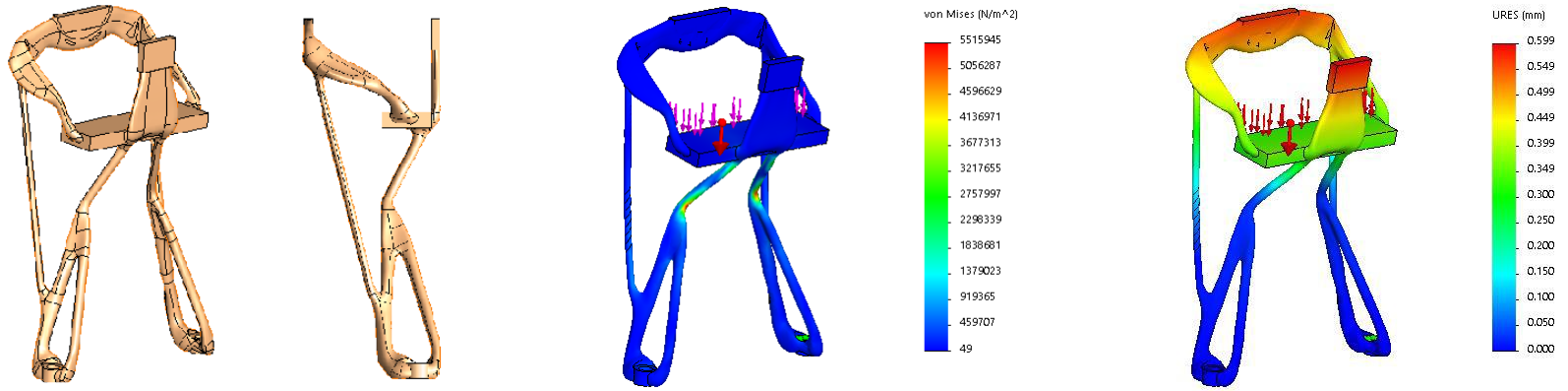






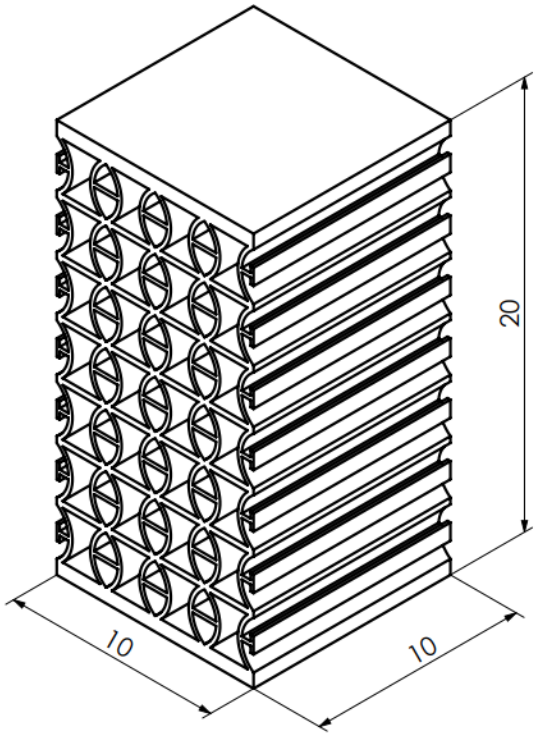


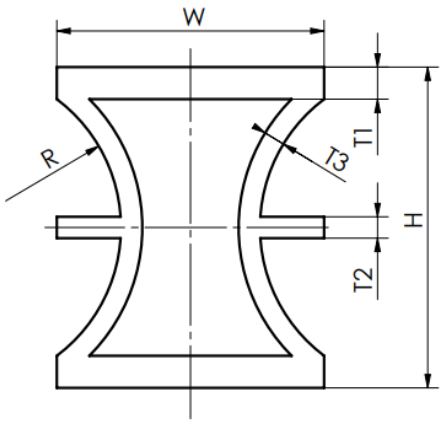
Topološka optimizacija -SolidWorks,
Generativni dizajn - Fusion 360.



PRIMERI MASTER RADOVA

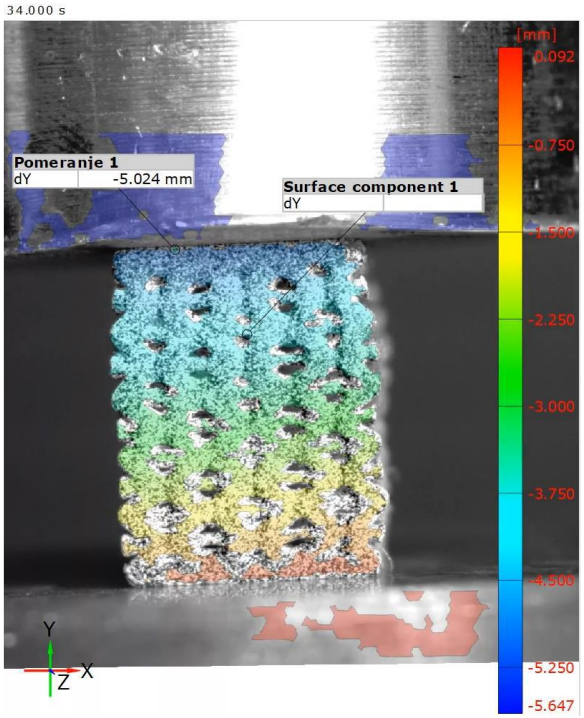
DIC Digital Image Correlation
MEHANIČKO TESTIRANJE NA PRITISAK EPRUVETE AUKSETIČKE MIKRO-STRUKTURE IZRAĐENE ADITIVNOM TEHNOLOGIJOM

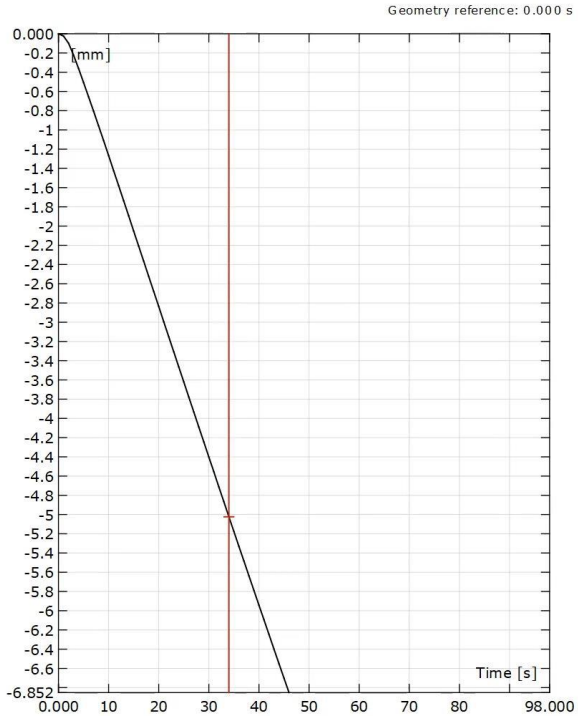


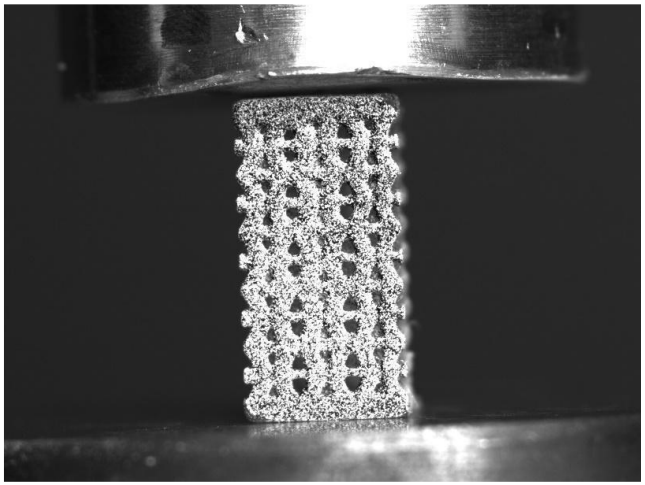


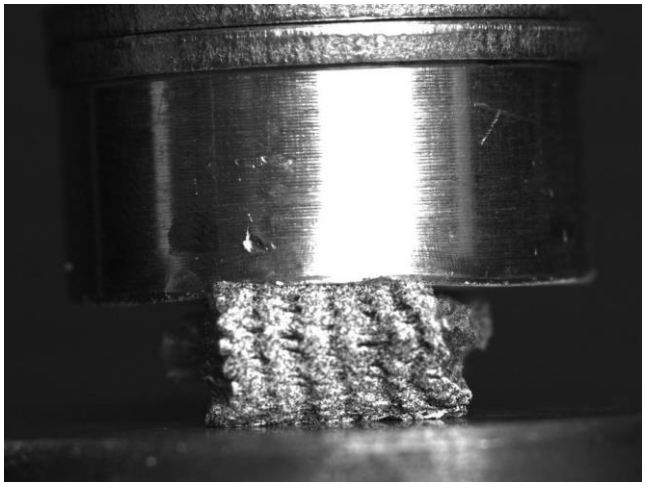


Auksetička struktura sa varijacijom debljine zida
FLEX smola
Kidalica i DIC







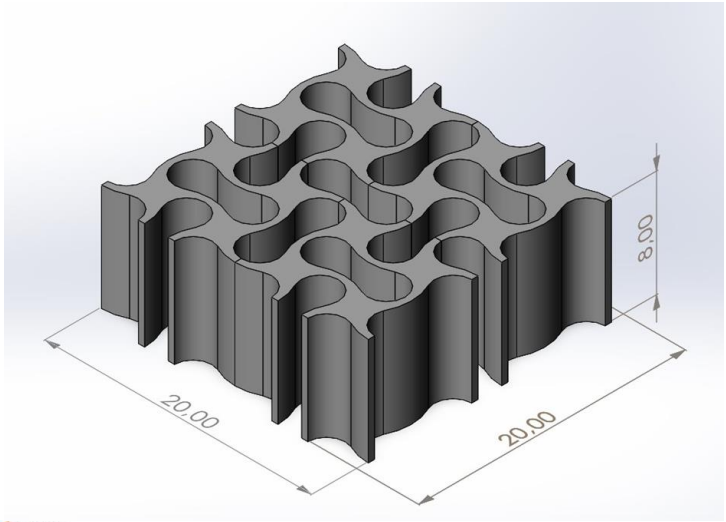


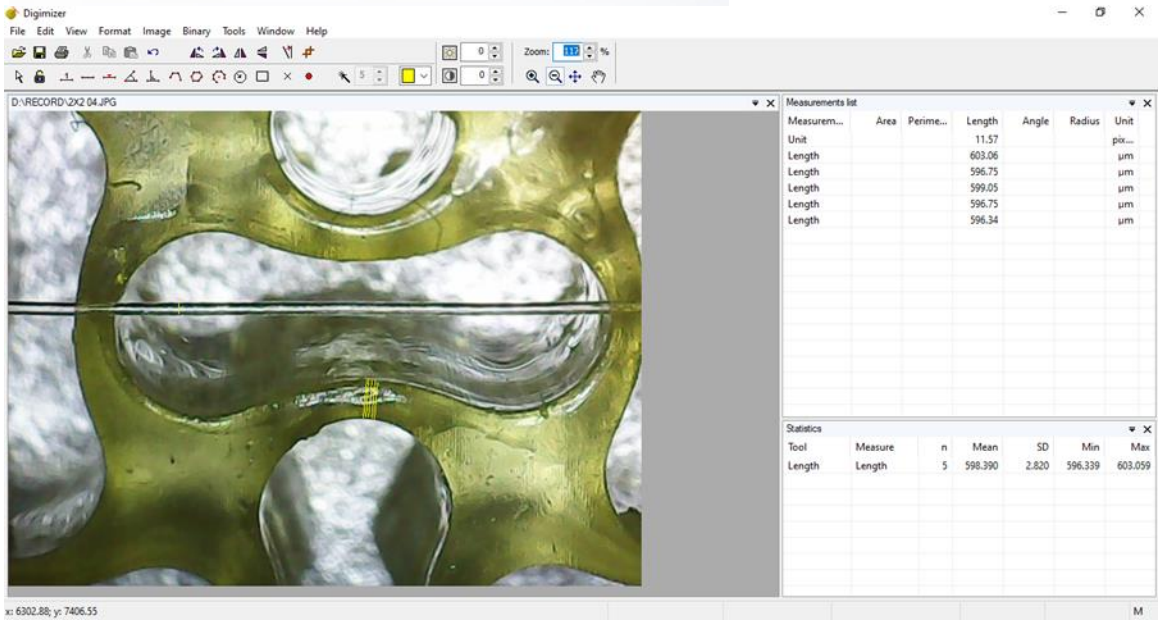
Sabijen uzorak debjine zida 0.7mm za 5.024 mm

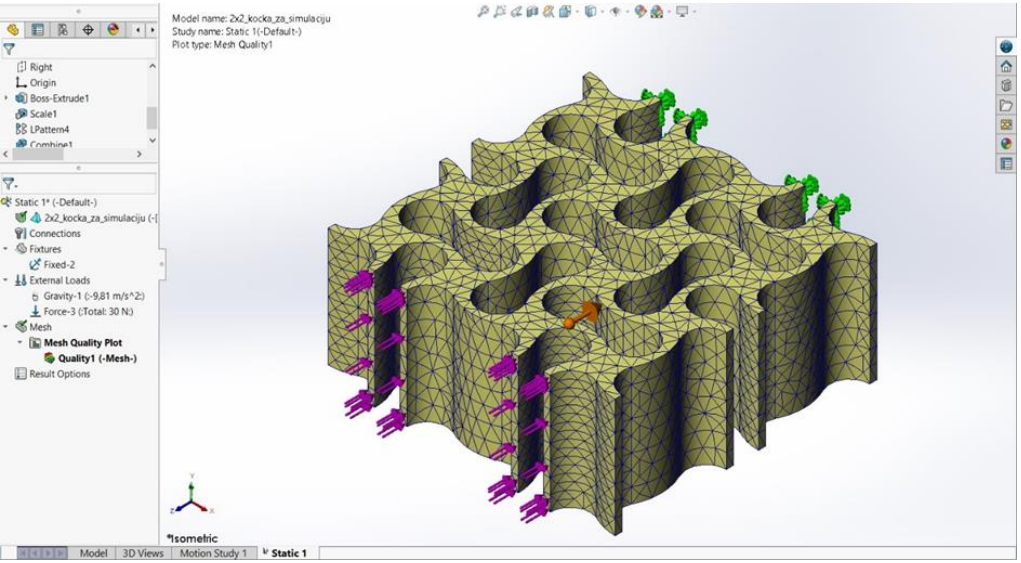
Sabijen uzorak za 13.23 mm

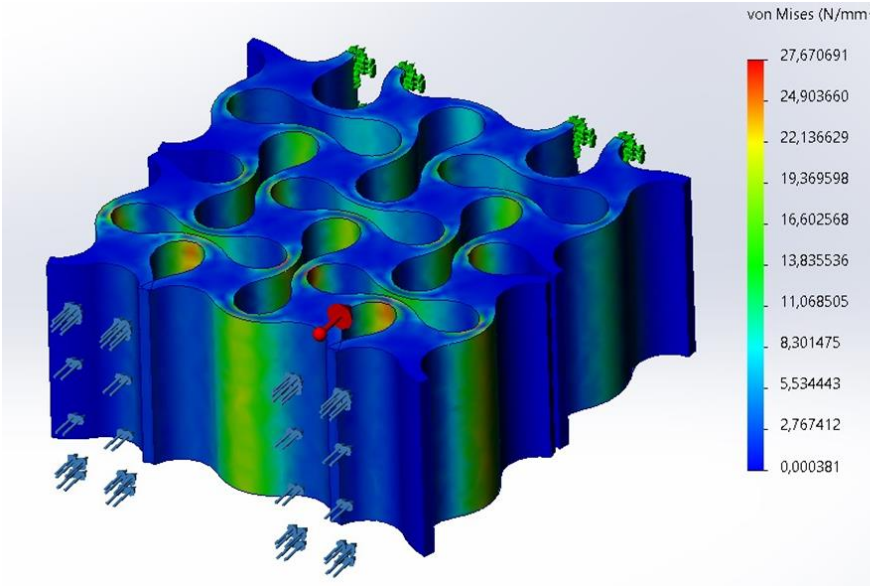
PRIMERI MASTER RADOVA

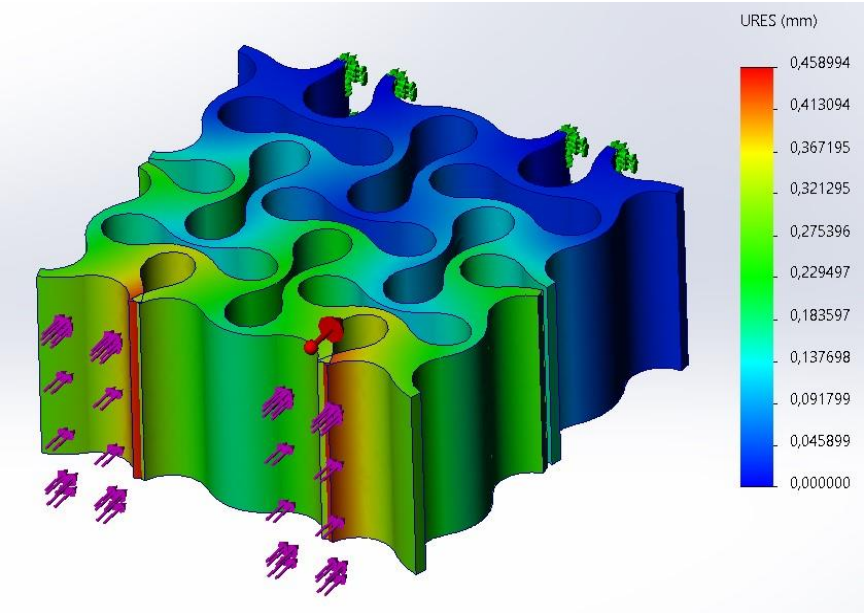
MKE analiza
STATIČKA ANALIZA MIKRO-PERFORIRANE AUKSETIČKE STRUKTURE

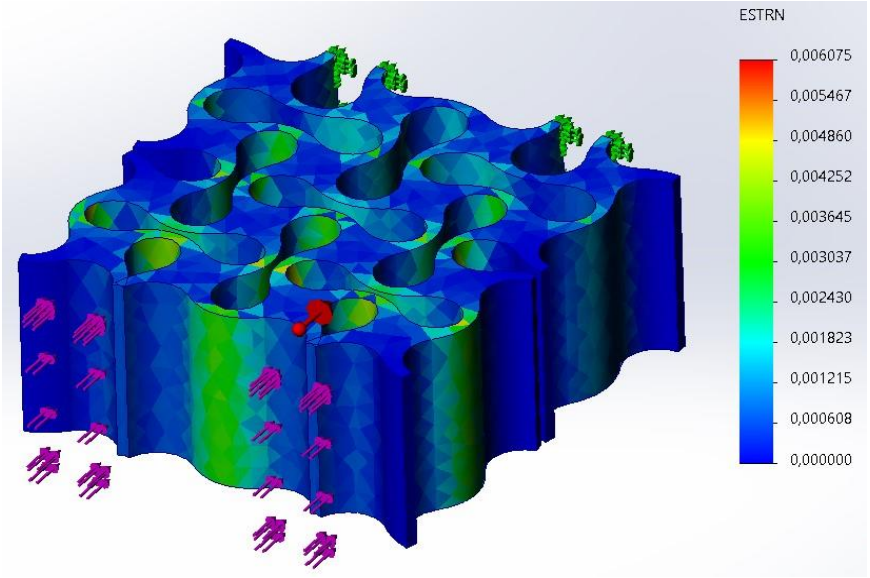

8,00
20,00
20,00


Digimizer
File Edit View Format Image Binary Tools Window Help
D:\RECORD\2x2 04.JPG
Measurements list
Measurem... Area Perime... Length Angle Radius Unit
Unit 11.57 pix...
Length 603.06 µm
Length 596.75 µm
Length 599.05 µm
Length 596.75 µm
Length 596.34 µm
Statistics
Tool Measure n Mean SD Min Max
Length Length 5 598.390 2.820 596.339 603.059
x: 6302.88; y: 7406.55


Model name: 2x2_kocka_za_simulaciju
Study name: Static 1(-Default-)
Plot type: Mesh Quality1
Right
Origin
Boss-Extrude1
Scale1
LPattern4
Static 1* (-Default-)
Connections
Fixtures
Fixed-2
External Loads
Gravity-1 (-9,81 m/s^2)
Force-3 (:Total: 30 N:)
Mesh
Mesh Quality Plot
Quality1 (-Mesh-)
Result Options
*Isometric
Model
3D Views
Motion Study 1
Static 1


von Mises (N/mm
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16,602568
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11,068505
8,301475
5,534443
2,767412
0,000381


URES (mm)
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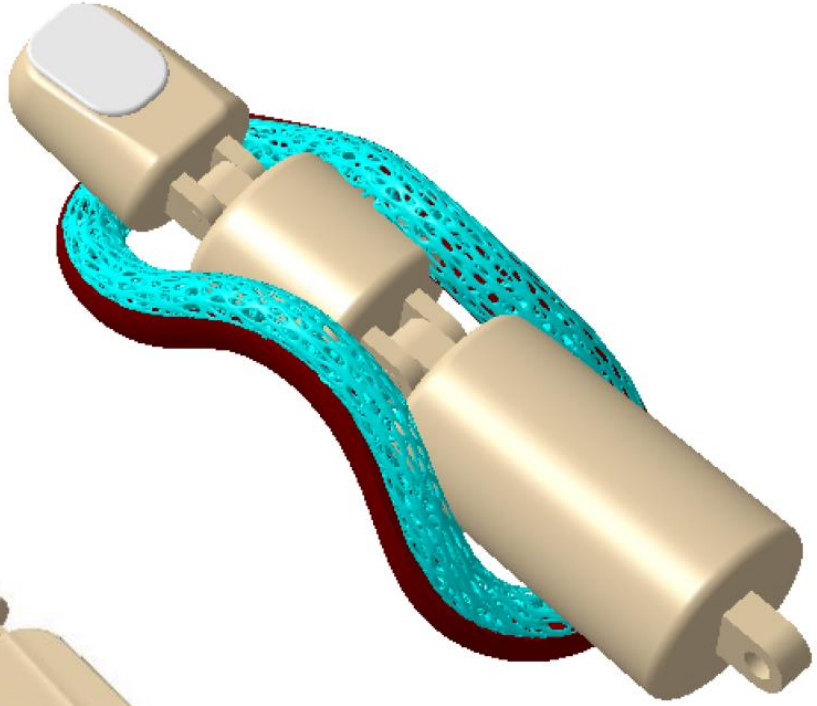

ESTRN
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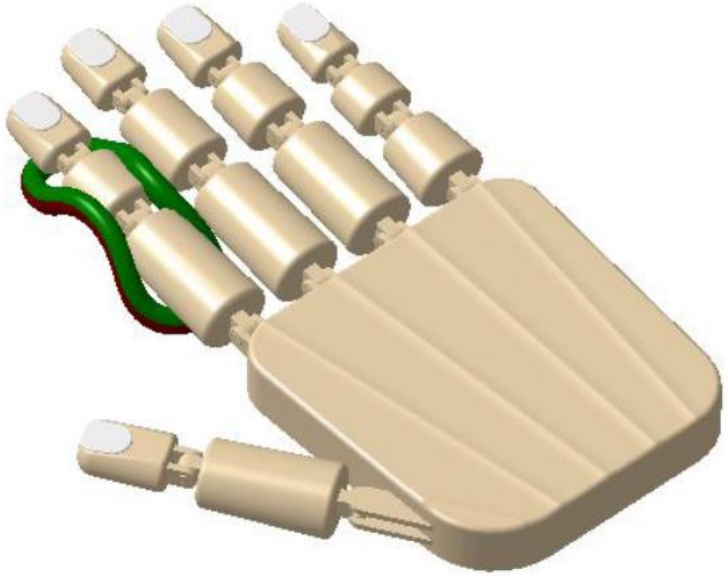
PRIMERI MASTER RADOVA

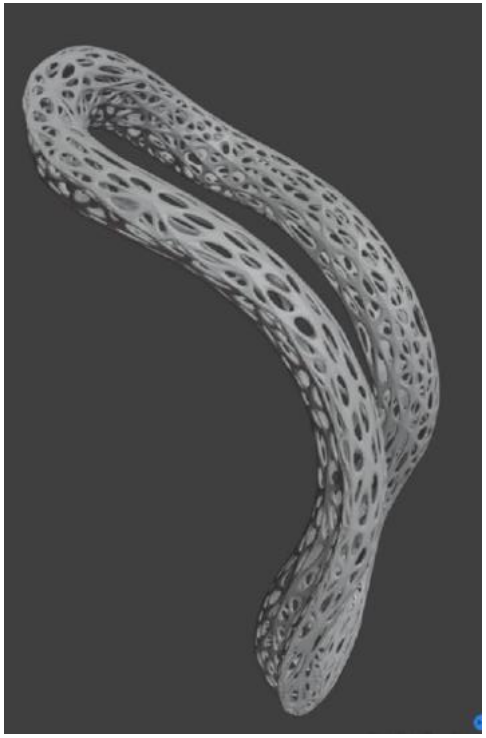
KONSTRUKCIJA I IZRADA PROTOTIPA ELASTIČNOG SPLINTA SA OPTIMIZOVANOM MIKRO STRUKTUROM

Catia V5

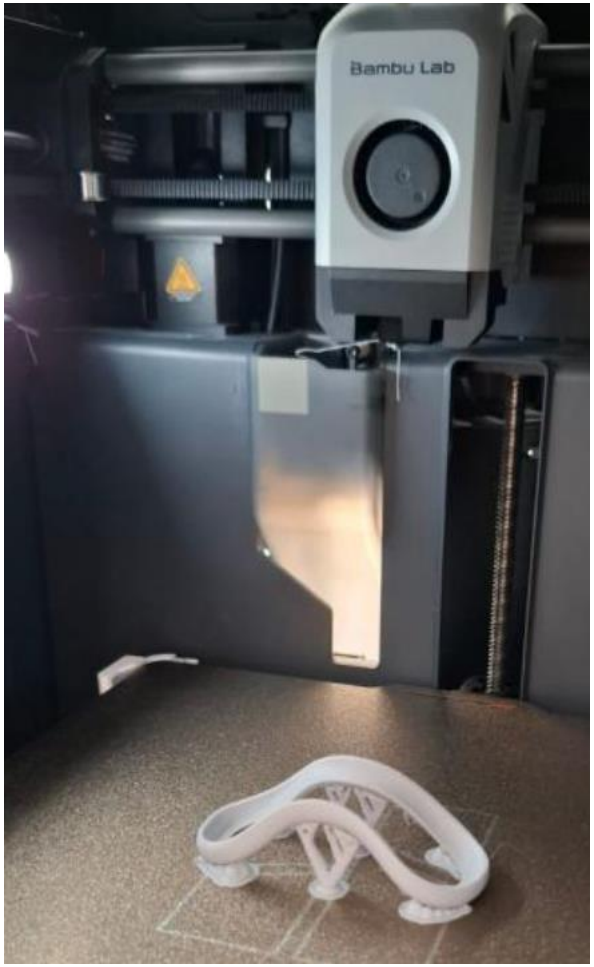
Blender









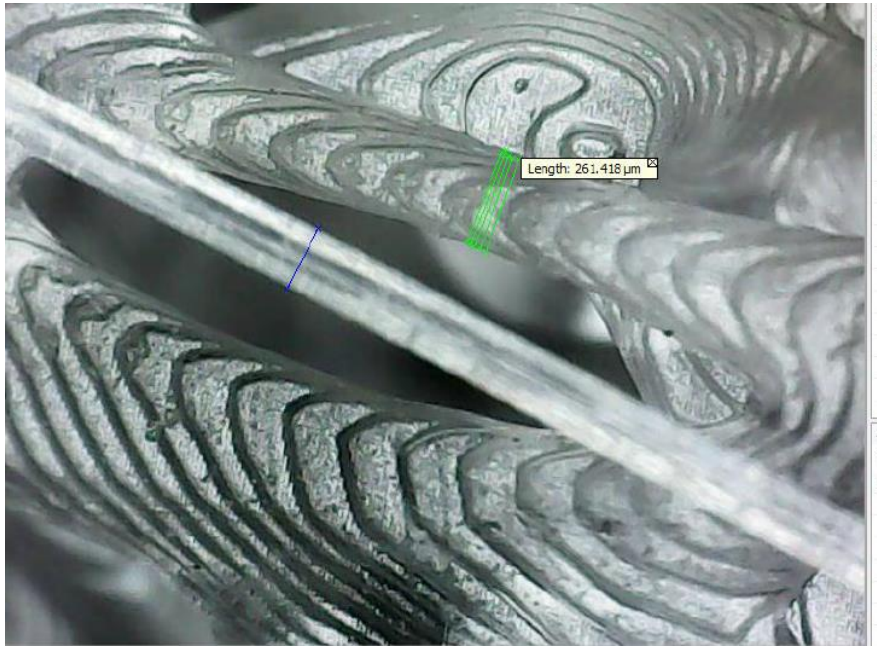




Elegoo Mars 5 Ultra

Bambu Lab P1S





Measurem...	Area	Perimeter	Length	Angle	Radius	Unit
Unit			50.334			pixels
Length			256.737			µm
Length			269.313			µm
Length			259.606			µm
Length			257.489			µm
Length			261.418			µm

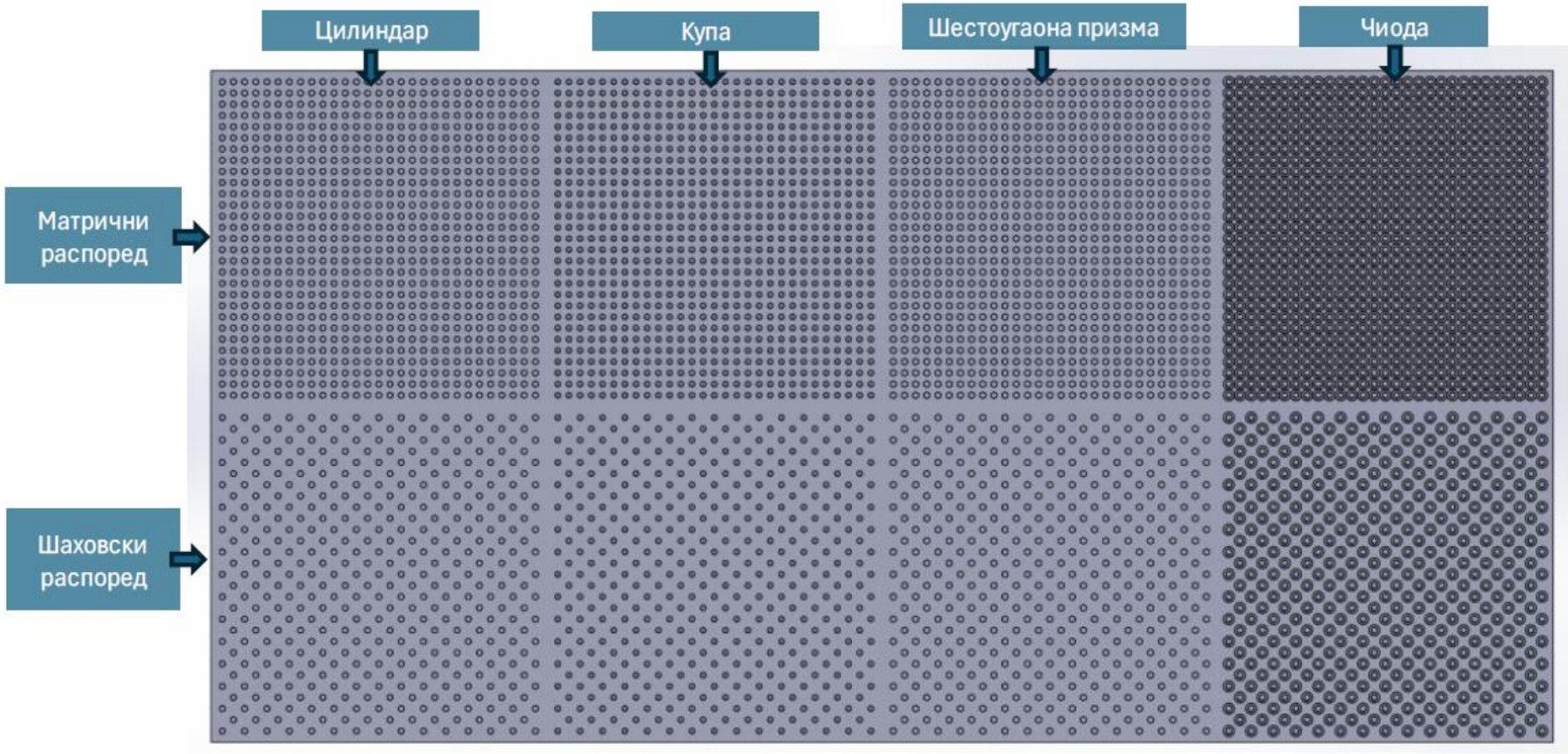
Statistics

Tool	Measure	n	Mean	SD	Min	Max
Length	Length	5	260.9125	5.0421	256.737	269.313



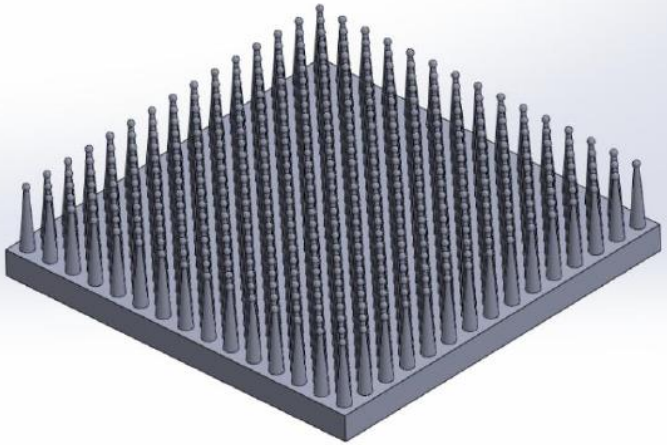
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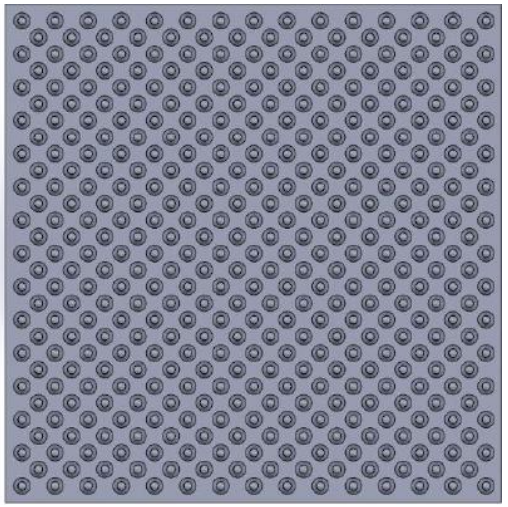
ISPITIVANJE MOGUĆNOSTI IZRADE MIKRO-STRUKTUIRANIH POVRŠINA OD FOTOPOLIMERNE SMOLE


Цилиндар
Купа
Шестоугаона призма
Чиода
Матрични распоред
Шаховски распоред



Formlabs Form 4

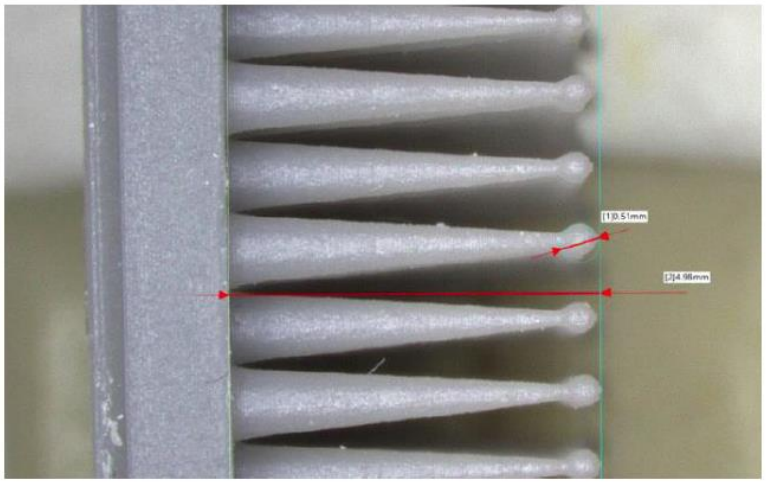


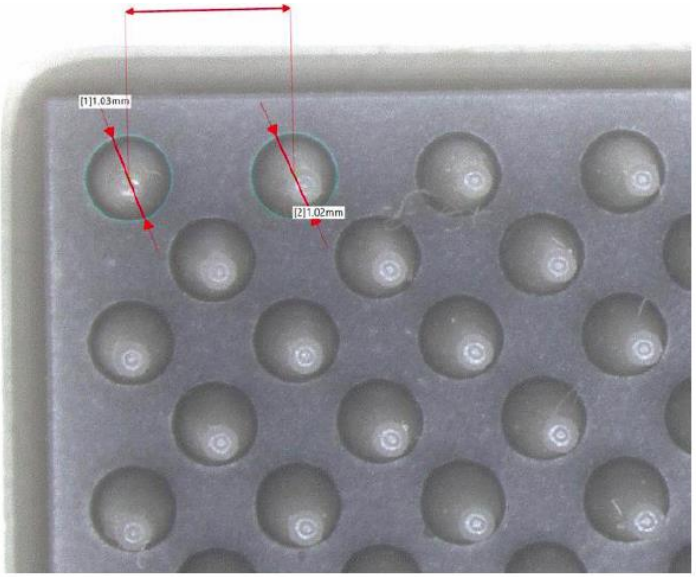






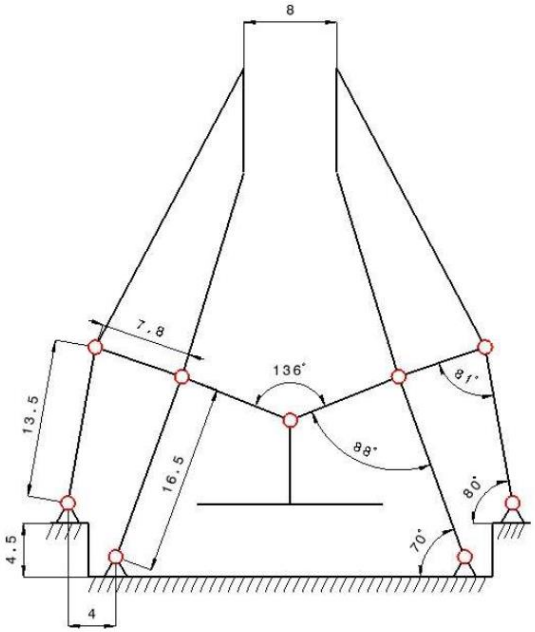
Микроскоп Keyence VHX-7000



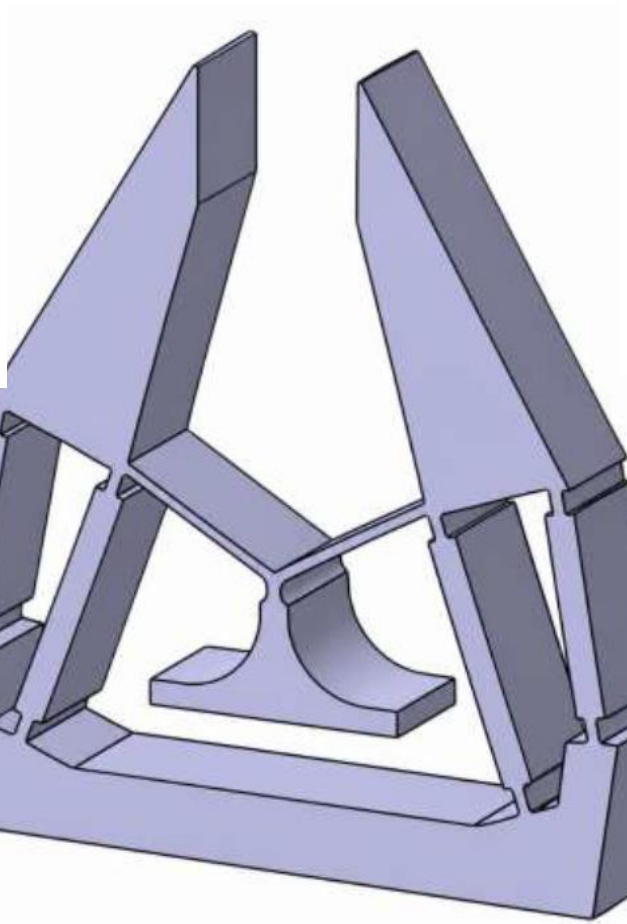


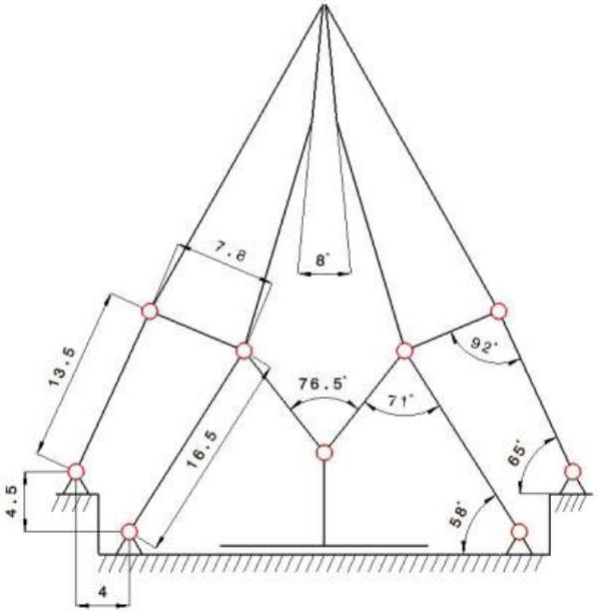
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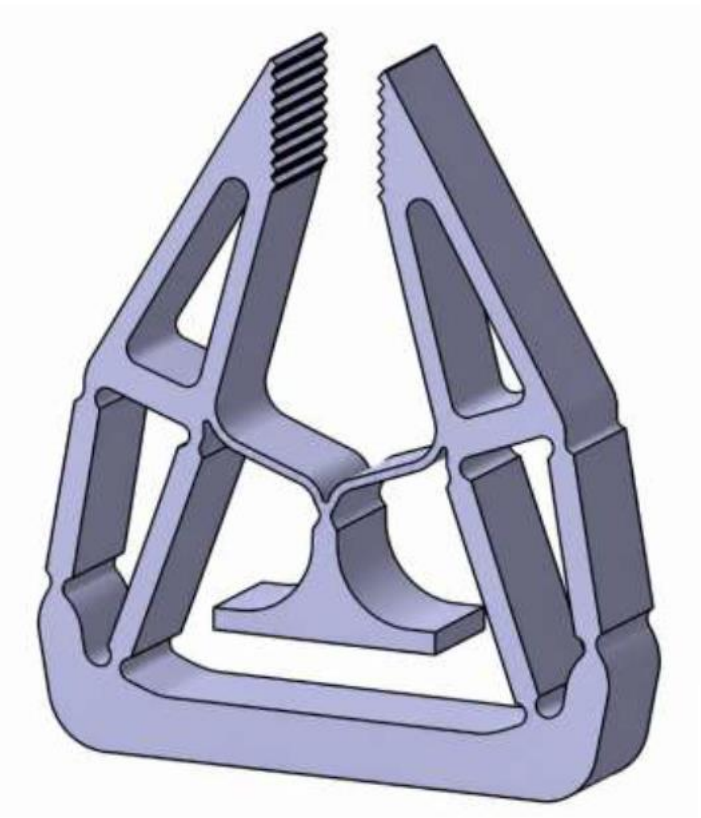
PROJEKTOVANJE ROBOTSKOG HVATAČA NA BAZI POPUSTLJIVOG MEHANIZMA I IZRADA FOTOPOLIMERIZACIJOM U KADI

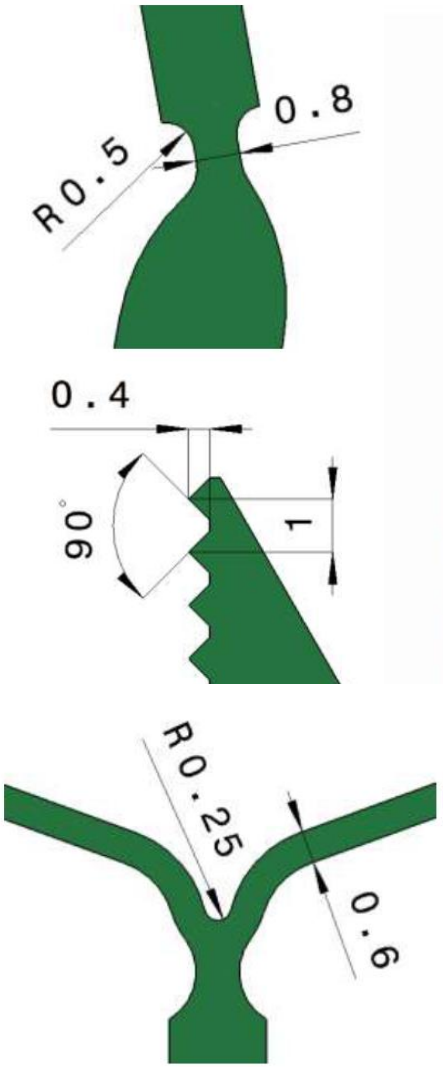


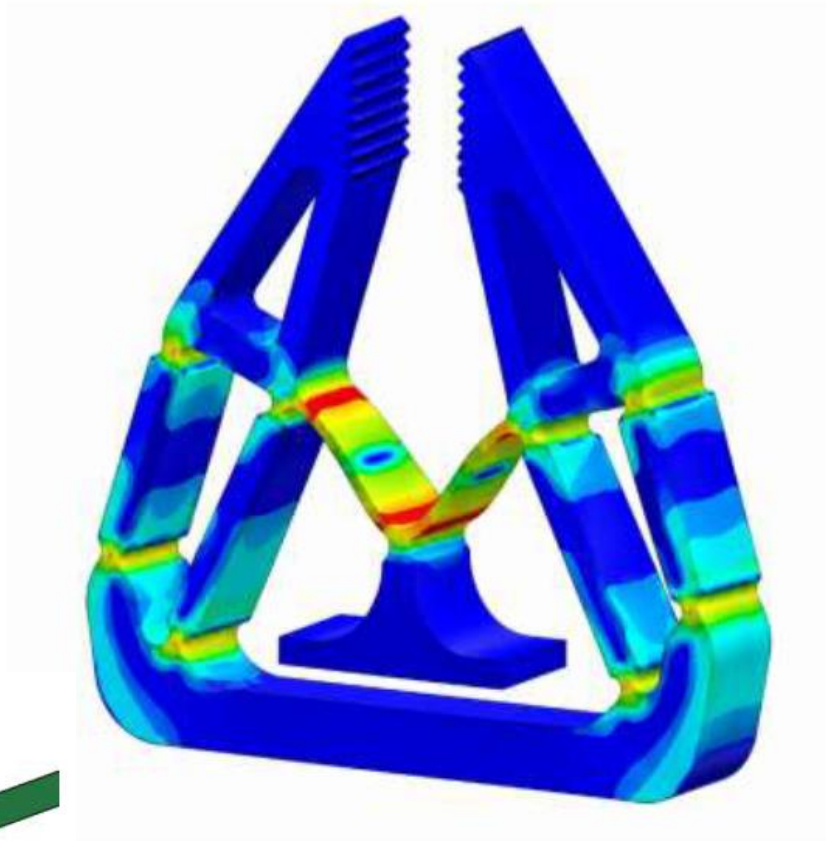
CATIA V5.



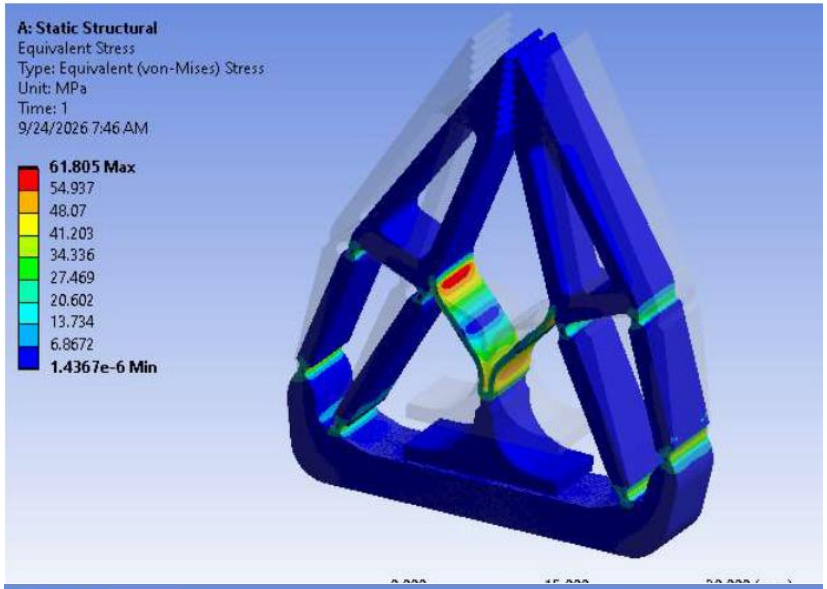


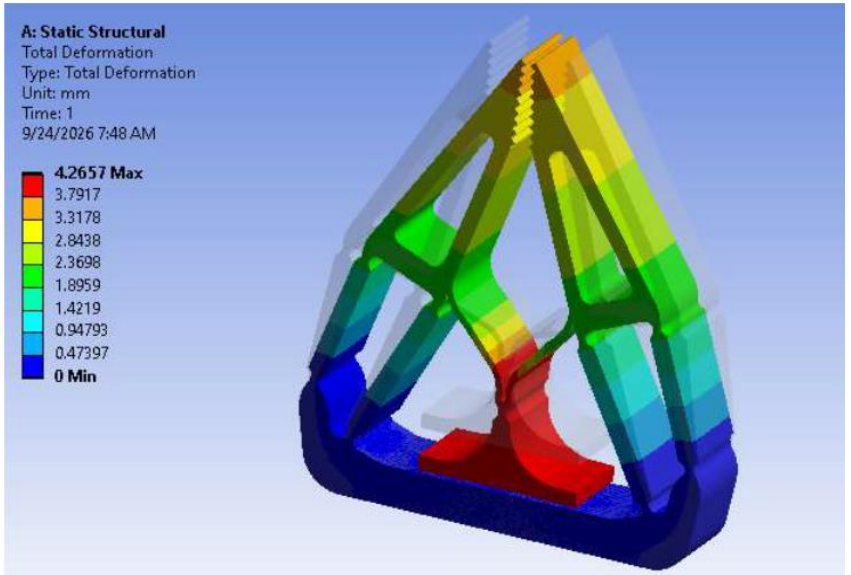


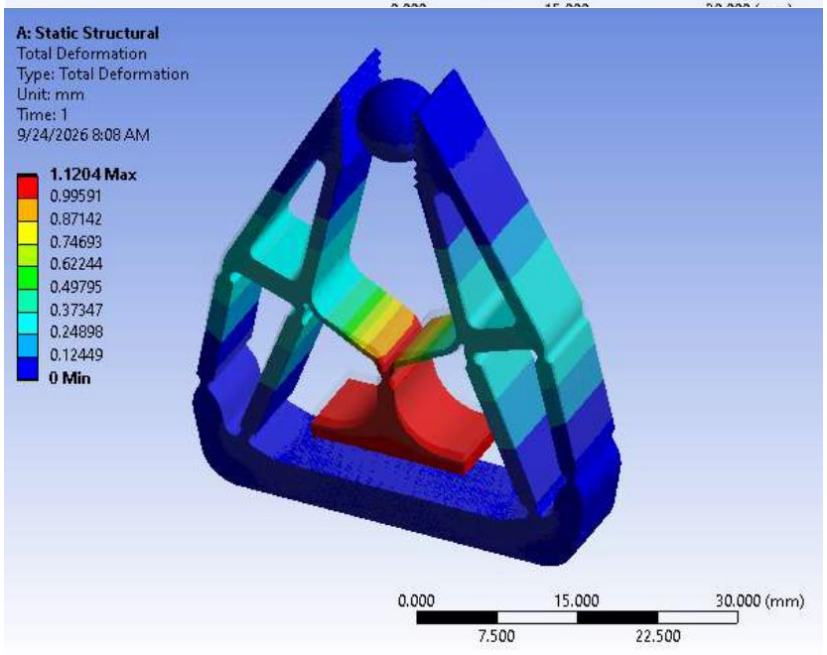


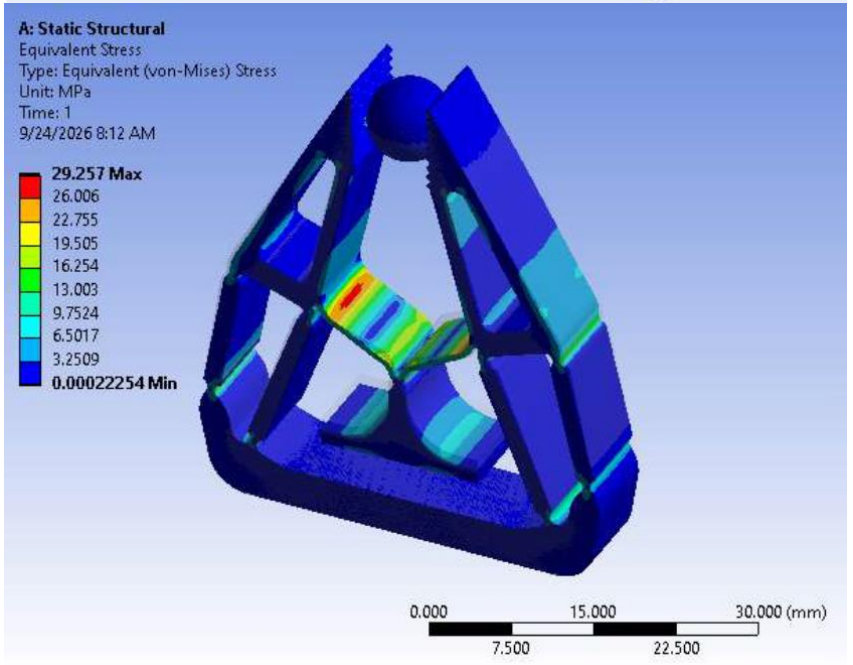


ANSYS

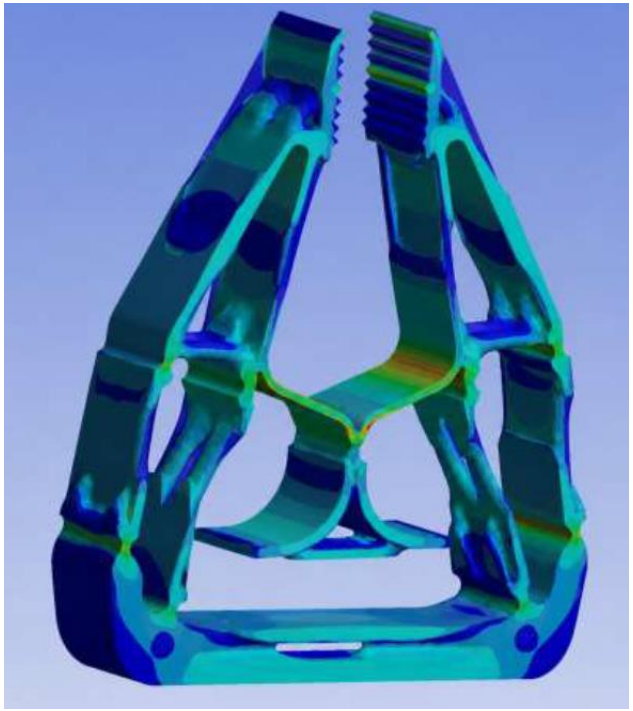

A: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1
9/24/2026 7:46 AM
61.805 Max
54.937
48.07
41.203
34.336
27.469
20.602
13.734
6.8672
1.4367e-6 Min


A: Static Structural
Total Deformation
Type: Total Deformation
Unit: mm
Time: 1
9/24/2026 7:48 AM
4.2657 Max
3.7917
3.3178
2.8438
2.3698
1.8959
1.4219
0.94793
0.47397
0 Min


A: Static Structural
Total Deformation
Type: Total Deformation
Unit: mm
Time: 1
9/24/2026 8:08 AM
1.1204 Max
0.99591
0.87142
0.74693
0.62244
0.49795
0.37347
0.24898
0.12449
0 Min
0.000
15.000
30.000 (mm)
7.500
22.500


A: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1
9/24/2026 8:12 AM
29.257 Max
26.006
22.755
19.505
16.254
13.003
9.7524
6.5017
3.2509
0.00022254 Min
0.000
15.000
30.000 (mm)
7.500
22.500

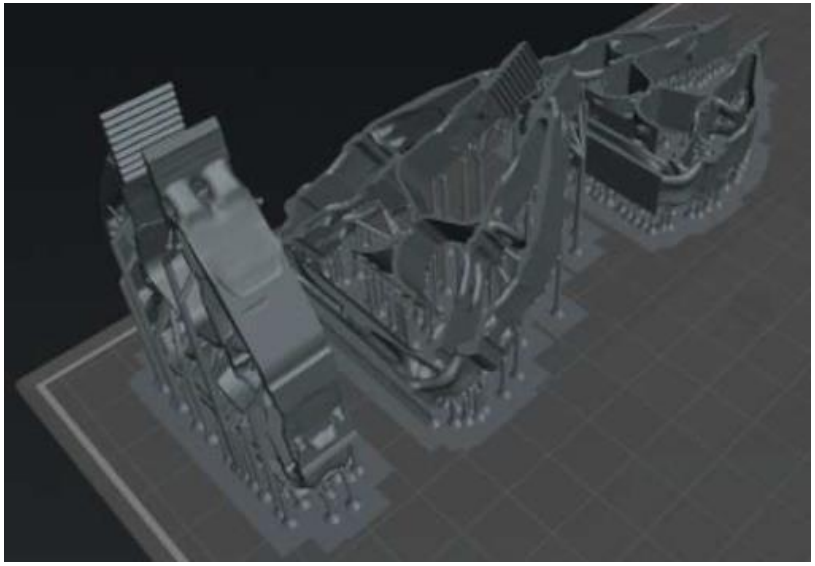

A
1 Static Structural
2 Engineering Data
3 Geometry
4 Model
5 Setup
6 Solution
7 Results
Static Structural
B
1 Topology Optimization
2 Engineering Data
3 Geometry
4 Model
5 Setup
6 Solution
7 Results
Topology Optimization
C
1 Static Structural
2 Engineering Data
3 Geometry
4 Model
5 Setup
6 Solution
7 Results
Static Structural



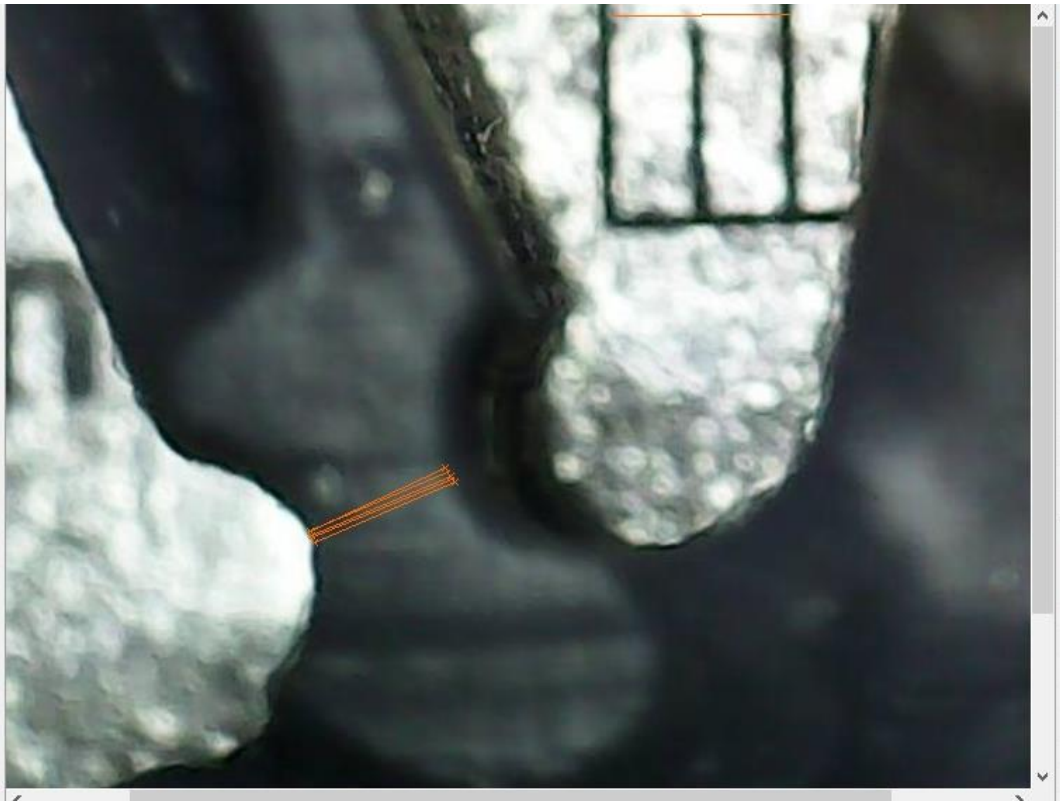




Elego saturn 4k







Measurem...	Area	Perimeter	Length	Angle	Radius	Unit
Unit			88.359			pixels
Length			850.924			µm
Length			865.210			µm
Length			843.797			µm
Length			833.624			µm
Length			821.864			µm

Statistics

Tool	Measure	n	Mean	SD	Min	Max
Length	Length	5	843.0836	16.5176	821.864	865.210