

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



وزارت علوم، تحقیقات و فناوری

دانشگاه پناپ

دانشکده فنی و مهندسی

طراحی اجزا ۲

استاد راهنما:

دکتر عبازاده

ارائه دهنده:

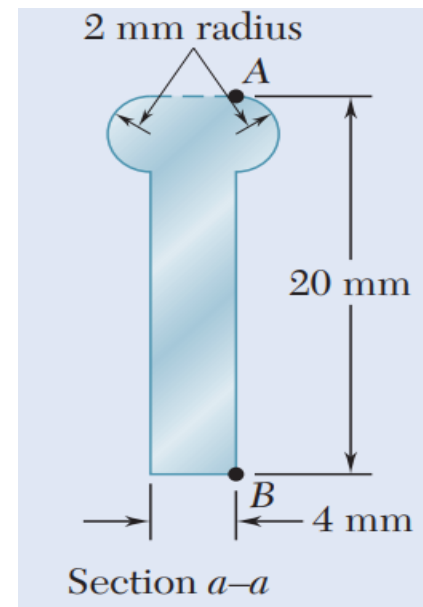
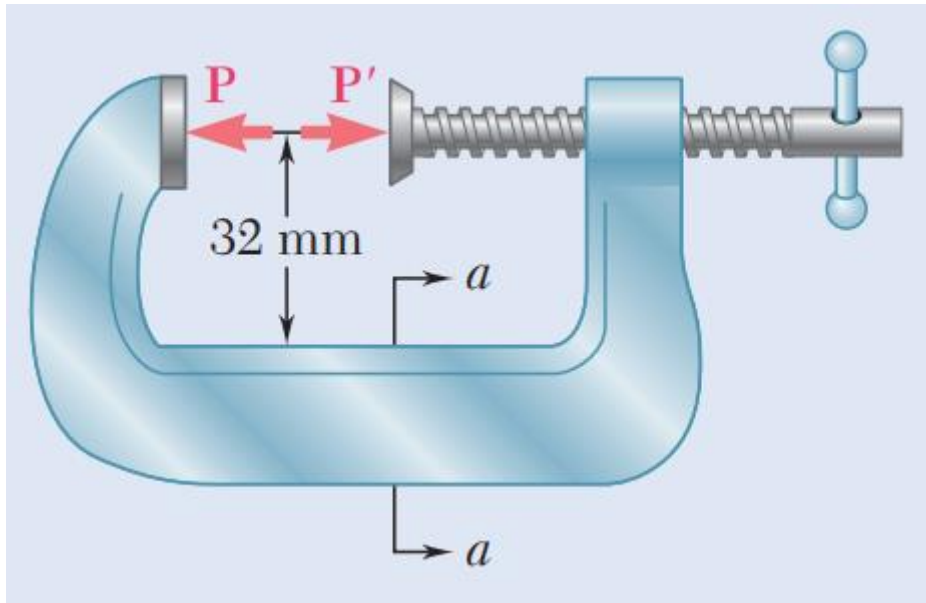
جعفر شیر علی زاده ۹۸۳۶۱۰۴۲

بهار ۱۴۰۱

تنش در نقطه A

تنش در نقطه B

محل محور خشی مقطع a-a



$$A_1 = (20mm)(4mm) = 80mm^2$$

$$\bar{y}_1 = \frac{1}{2}(20mm) = 10mm$$

$$A_2 = \pi(2mm)^2 = 4\pi mm^2$$

$$\bar{y}_2 = 20 - 2 = 18mm$$

$$c_B = \bar{y} = \frac{\sum A\bar{y}}{\sum A} = \frac{(80)(10) + (4\pi)(18)}{80 + 4\pi} = 11.086$$

$$c_A = 20 - \bar{y} = 8.914mm$$

$$d_1 = 11.086 - 10 = 1.086mm$$

$$d_2 = 18 - 11.086 = 6.914mm$$

$$I_1 = \bar{I}_1 + A_1 d_1^2 = \frac{1}{2} (4)(20)^3 + (80)(1.086)^2 = 2.761 \times 10^3 \text{ mm}^4$$

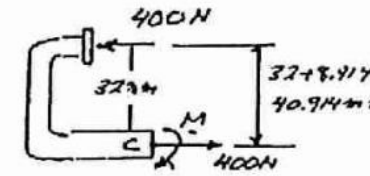
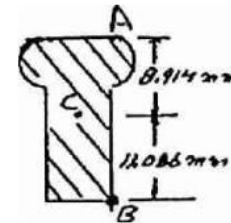
$$I_2 = \bar{I}_2 + A_2 d_2^2 = \frac{\pi}{4} (2)^4 + (4\pi)(6.914)^2 = 0.613 \times 10^3 \text{ mm}^4$$

$$I = I_1 + I_2 = 3.374 \times 10^3 \text{ mm}^4 = 3.374 \times 10^{-9} \text{ m}^4$$

$$A = A_1 + A_2 = 92.566 \text{ mm}^2 = 92.566 \times 10^{-6} \text{ m}^2$$

$$e = 32 + 8.914 = 40.914 \text{ m}$$

$$M = Pe = (400 \text{ n})(40.914 \text{ m}) = 16.3656 \text{ N.m}$$



تنش در نقطه A

$$\sigma_A = \frac{P}{A} + \frac{Mc}{I} = \frac{400}{92.321 \times 10^{-6}} + \frac{(16.3656)(8.914 \times 10^{-3})}{3.374 \times 10^{-9}} = 94.493 \times 10^4 \text{ m}^2$$

$$\sigma_A = \sigma_{Min} = 94.49 \text{ m}^2$$

تنش در نقطه B

$$\sigma_A = \frac{P}{A} + \frac{Mc}{I} = \frac{400}{92.566 \times 10^{-6}} - \frac{(16.3656)(11.086)}{3.374 \times 10^{-9}} = 188.51 \times 10^4 \text{ m}^2$$

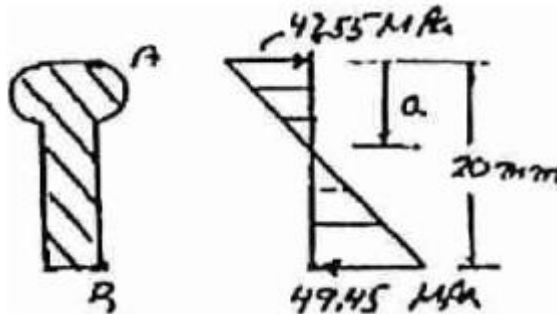
$$\sigma_B = \sigma_{\max} = 188.51 \text{ m}^2$$

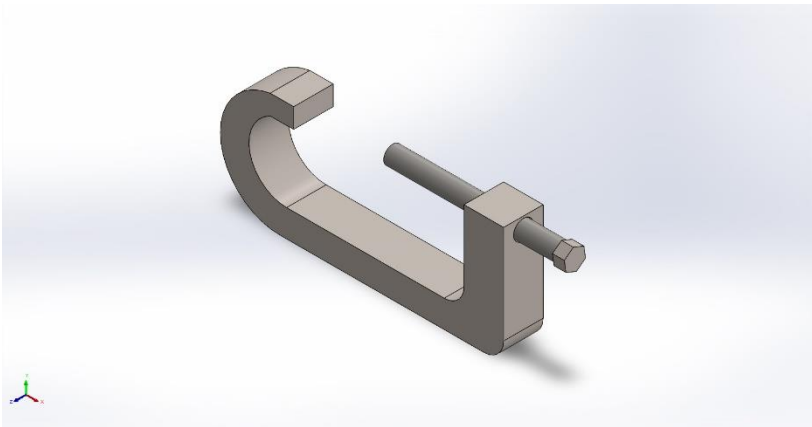
محور خنثی

$$\frac{a}{47.55} = \frac{20}{47.55 + 49.45}$$



$$a = 9.80 \text{ mm}$$





Description
No Data

Simulation of Assem3

Date: Monday, June 27, 2022
Designer: jafarshiralizadeh
Study name: Static 1
Analysis type: Static

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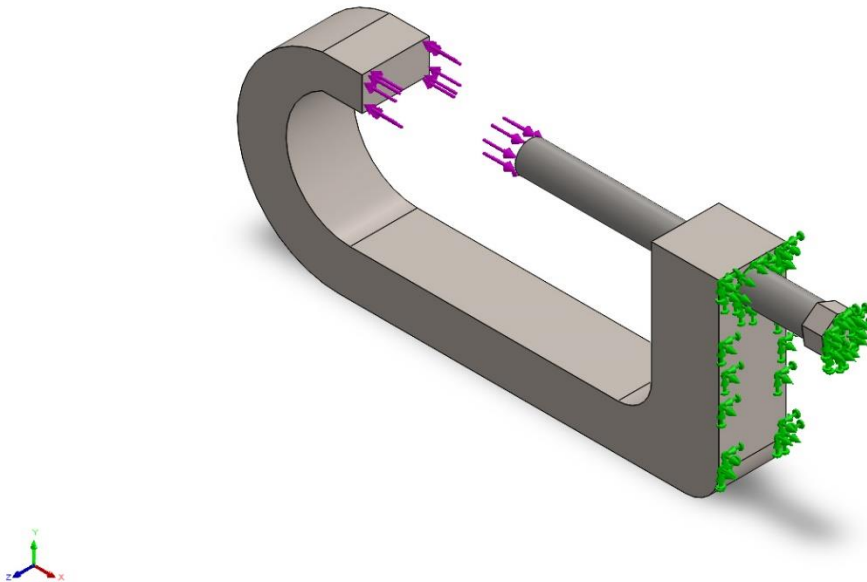
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Assumptions

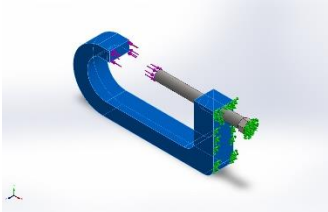
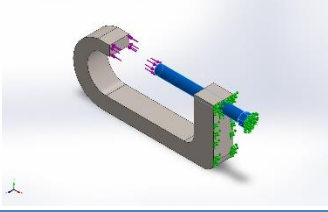


Model Information



Model name: Assem3
Current Configuration: Default

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Cut-Extrude1 	Solid Body	Mass:0.0665872 kg Volume:8.64768e-06 m ³ Density:7,700 kg/m ³ Weight:0.652554 N	F:\solid\New folder (16)\Part5.SLDPRT Jun 27 00:43:20 2022
Boss-Extrude3 	Solid Body	Mass:0.00600269 kg Volume:7.7957e-07 m ³ Density:7,700 kg/m ³ Weight:0.0588264 N	F:\solid\New folder (16)\Part6.SLDPRT Jun 27 00:43:33 2022



Study Properties

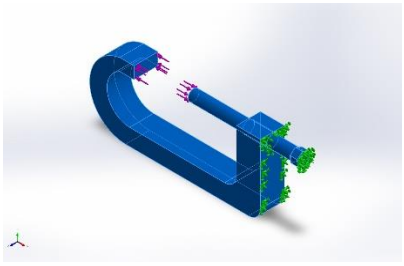
Study name	Static 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	Automatic
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (F:\solid\New folder (16))

Units

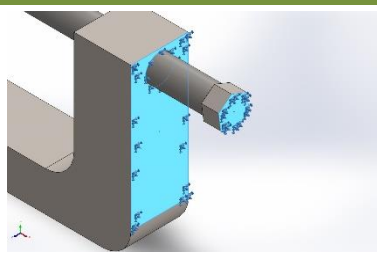
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m ²

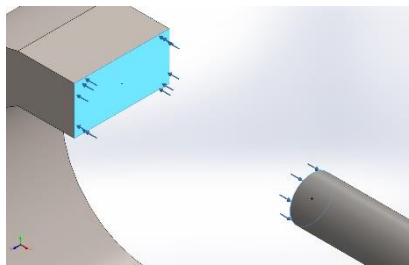


Material Properties

Model Reference	Properties	Components
	Name: Alloy Steel Model type: Linear Elastic Isotropic Default failure criterion: Max von Mises Stress Yield strength: 6.20422e+08 N/m ² Tensile strength: 7.23826e+08 N/m ² Elastic modulus: 2.1e+11 N/m ² Poisson's ratio: 0.28 Mass density: 7,700 kg/m ³ Shear modulus: 7.9e+10 N/m ² Thermal expansion coefficient: 1.3e-05 /Kelvin	SolidBody 1(Cut-Extrude1)(Part5-1), SolidBody 1(Boss-Extrude3)(Part6-1)
Curve Data:N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details		
Fixed-1		Entities: 2 face(s) Type: Fixed Geometry		
Resultant Forces				
Components	X	Y	Z	Resultant
Reaction force(N)	0.0260782	0.000964046	0.00253344	0.0262187
Reaction Moment(N.m)	0	0	0	0

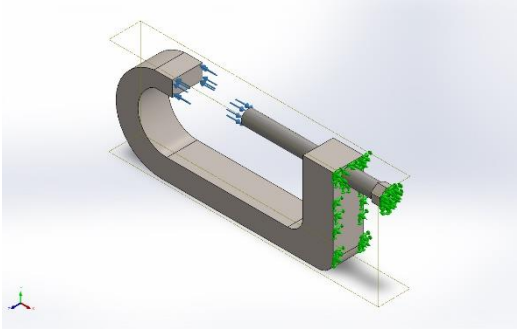
Load name	Load Image	Load Details
Force-1		Entities: 2 face(s) Type: Apply normal force Value: 400 N



Connector Definitions

No Data

Contact Information

Contact	Contact Image	Contact Properties
Global Interaction		Type: Bonded Components: 1 component(s) Options: Independent mesh



Mesh information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points for High quality mesh	16 Points
Element Size	2.11331 mm
Tolerance	0.105665 mm
Mesh Quality	High
Remesh failed parts independently	Off

Mesh information - Details

Total Nodes	11845
Total Elements	7048
Maximum Aspect Ratio	11.117
% of elements with Aspect Ratio < 3	99.2
Percentage of elements with Aspect Ratio > 10	0.0568
Percentage of distorted elements	0
Time to complete mesh(hh:mm:ss):	00:00:01
Computer name:	

Sensor Details

No Data



Resultant Forces

Reaction forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	0.0260782	0.000964046	0.00253344	0.0262187

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

Free body forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	0.00546551	-0.348148	0.0246442	0.349062

Free body moments

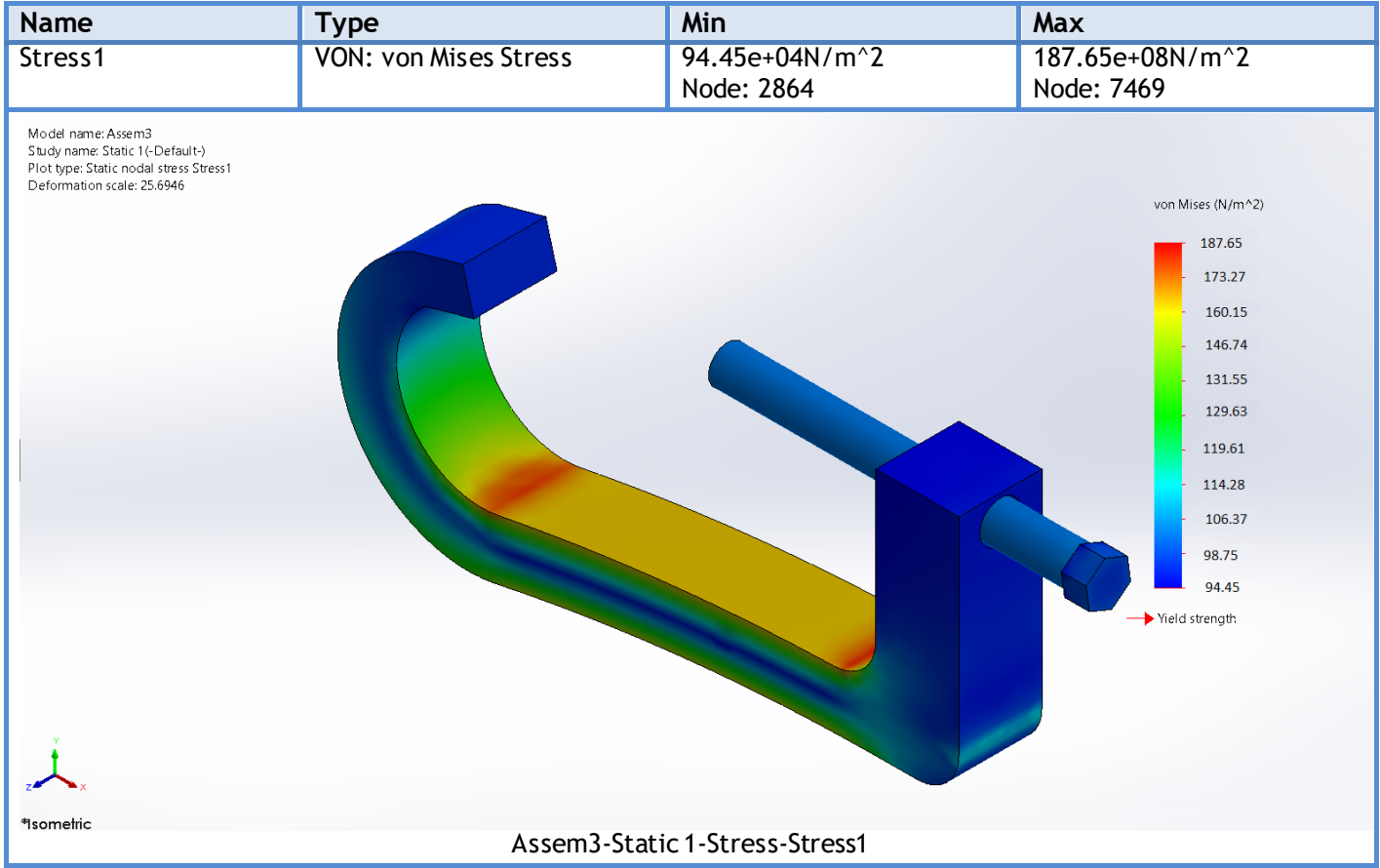
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	1e-33

Beams

No Data

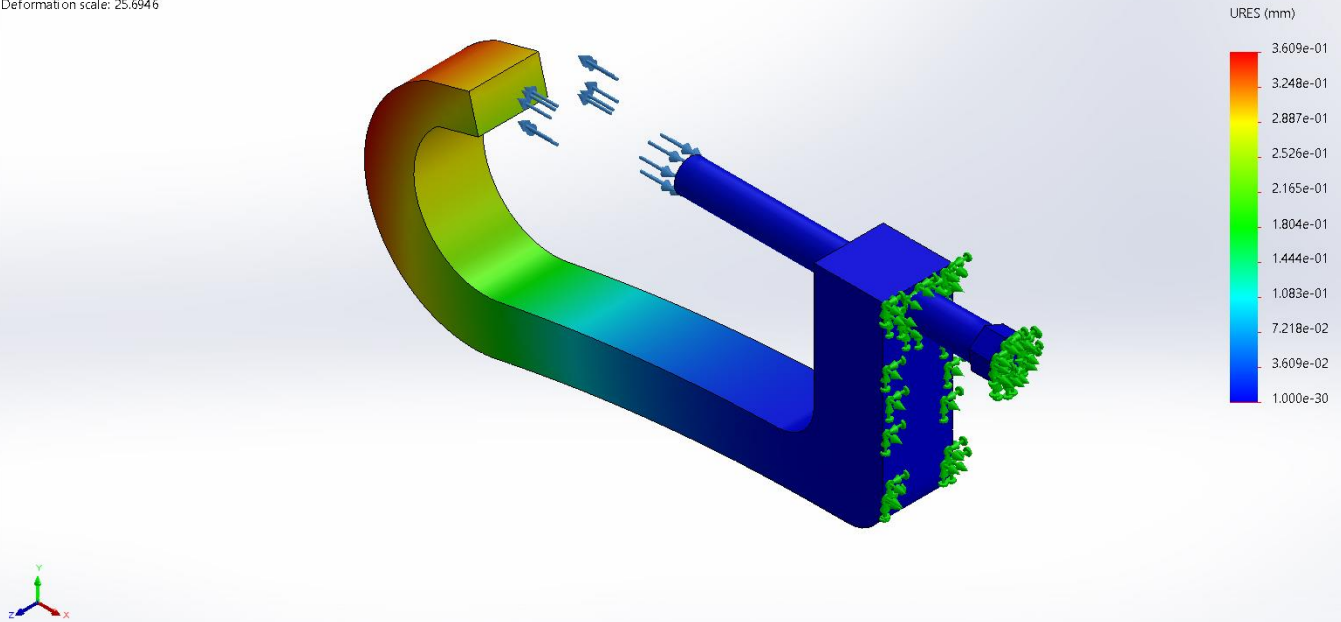


Study Results



Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 9	3.609e-01mm Node: 9596

Model name: Assem3
Study name: Static 1 (-Default-)
Plot type: Static displacement Displacement1
Deformation scale: 25.6946

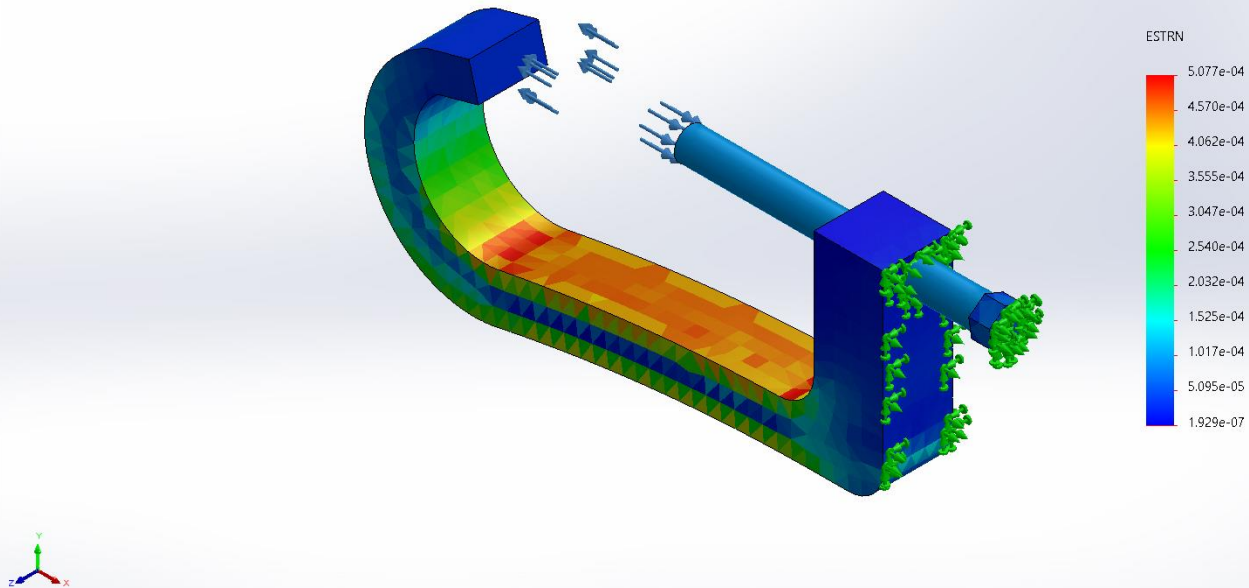


Assem3-Static 1-Displacement-Displacement1



Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	1.929e-07 Element: 2615	5.077e-04 Element: 4520

Model name: Assem3
Study name: Static 1 (-Default-)
Plot type: Static strain Strain1
Deformation scale: 25.6946

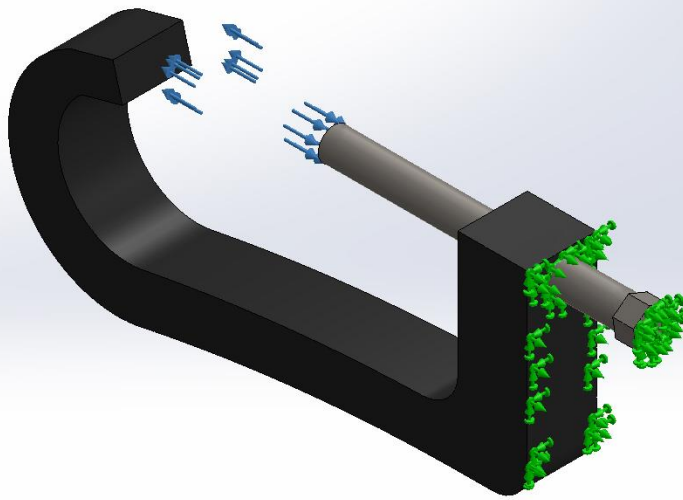


Assem3-Static 1-Strain-Strain1

Name	Type
Displacement1{1}	Deformed shape



Model name: Assem3
Study name: Static 1 (-Default-)
Plot type: Deformed shape Displacement1{1}
Deformation scale: 25.6946



Assem3-Static 1-Displacement-Displacement1{1}

Conclusion



نتیجه گیری

همانطور که مشاهده کردید در تحلیل دستی تنش های ماکسیموم و مینیمم در نقطه A و B را بدست آوردیم و بعد که به سراغ تحلیل نرم افزاری رفتیم تا تنش ها را در آنجا بدست آوریم متوجه شدیم که جوابرها دقیقا مِث هم هستن و فقط چند دهم درصد اختلاف ناچیزی داشتند که طبیعی بود که طبیعتا باید فرقی بین تحلیل دستی با فرمول ها و تحلیل با نرم افزار داشته باشد .