Stress analysis of hinge back RP

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1. Introduction

This is a check of a rapid proto type design with closed surfaces. The thought being that one could inprove the stiffness for a given mass of material.

Note:

Do not base your design decisions solely on the data presented in this report. Use this information in conjunction with experimental data and practical experience. Field testing is mandatory to validate your final design. COSMOSWorks helps you reduce your time-to-market by reducing but not eliminating field tests.

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2. Description

Material: nylon similar to Rapid prototyping sintered plastic
Structure: hollow shell (1 mm wall) with reinforced tabs for hinge connection, model is incomplete – designed for stiffness and stress testing only.
Analysis: mixed shell and solid, modeled as bonded pieces, where really it would all be one unit.

Load: 15 lb in z on the top hinge tab.

The results should be compared with the heavier more conventional CNCable nylon model. Note this hollow shell design is more difficult to construct in a CAD model than the CNCable version, so there has to be a significant advantage in the shell design to proceed along these lines.

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3. File Information

Model name:	hinge back RP
Model location:	C:\Documents and Settings\Howard Wieman\My Documents\aps project\mechanical\HFT Alice July 2007 restore\HFT Alice July 2007\hinge back RP.SLDASM
Results location:	C:\Program Files\SolidWorks\COSMOS\work
Study name:	test 2 (-Default-)

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4. Materials

No.	Part Name	Material	Mass	Volume
1	hinge back plate RP-1	[SW]Nylon 6/10	0.238214 lb	4.70982 in^3
2	hinge china hat B LR-1	[SW]Nylon 6/10	0.0357979 lb	0.707773 in^3
3	hinge china hat U Right-1	[SW]Nylon 6/10	0.048995 lb	0.968698 in^3
4		[SW]Nylon 6/10	0 lb	0 in^3

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5. Load & Restraint Information

Restraint	
Restraint-1 <hinge back plate RP-1>	on **1 Face(s)** fixed.
Description:	

Load	
Force-1 <hinge china hat U Right-1>	on **1 Face(s)** apply force **15 lb** normal to reference plane with respect to selected reference **Front** using uniform distribution
Description:	

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6. Study Property

Mesh Information	
Mesh Type:	Mesh
Mesher Used:	Standard
Automatic Transition:	Off

Smooth Surface:	On
Jacobian Check:	4 Points
Element Size:	0.17871 in
Tolerance:	0.0089356 in
Quality:	High
Number of elements:	10815
Number of nodes:	21206
Time to complete mesh(hh;mm;ss):	00:00:09
Computer name:	WIEMAN-M90

Solver Information	
Quality:	High
Solver Type:	Direct sparse solver
Option:	Include Thermal Effects
Thermal Option:	Input Temperature
Thermal Option:	Reference Temperature at zero strain: 298 Kelvin

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7. Contact

Contact state: Touching faces - Bonded

Contact Set-1	Bonded contact pair: Between selected faces of **hinge china hat U Right-1** and **hinge back plate RP-1**
Description:	
Contact Set-2	Bonded contact pair: Between selected faces of

	hinge china hat B LR-1 and **hinge back plate RP-1**
Description:	

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8. Results

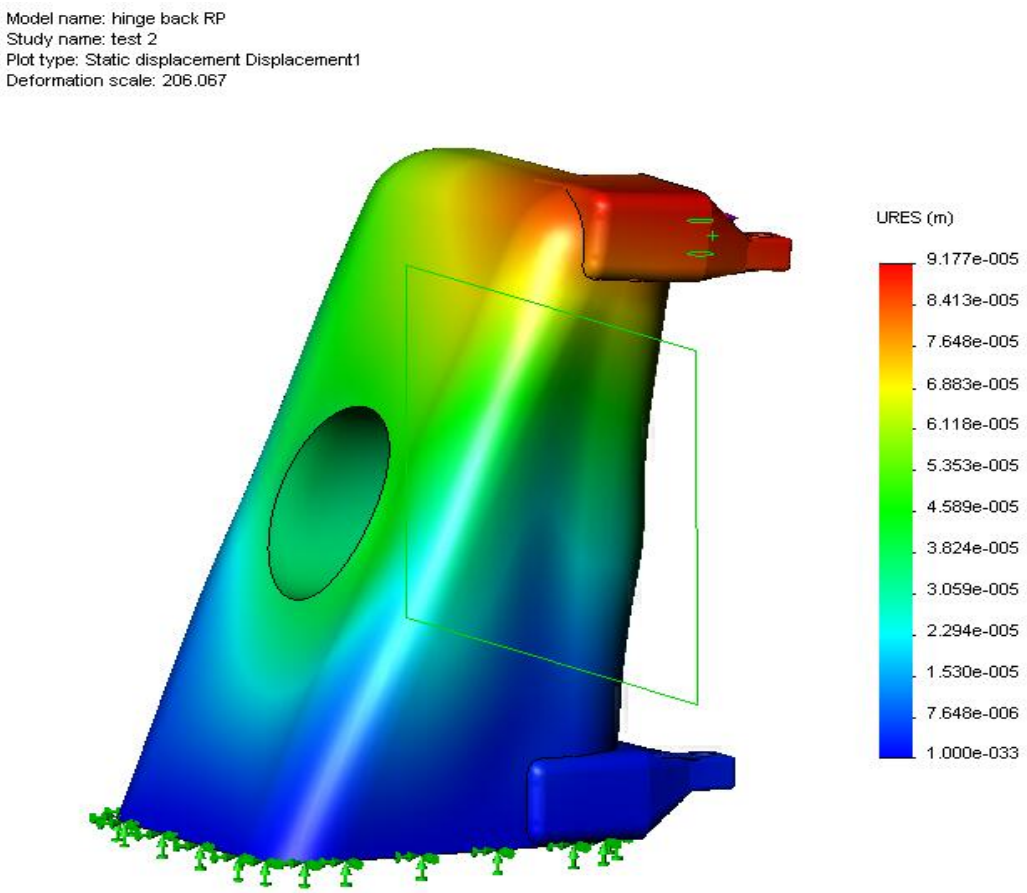
8a. Default Results

Name	Type	Min	Location	Max	Location
Displacement1	URES: Resultant displacement	0 m Node: 6506	(-1.25 in, -3.65 in, -8.63347e-016 in)	9.1774e-005 m Node: 5672	(-2.00134 in, 3.63486 in, 1.09274e-015 in)
Strain1	ESTRN: Equivalent strain	0 Element: 4835	(-1.90756 in, -3.65 in, -0.686953 in)	0.000289822 Element: 6311	(-0.990102 in, -0.350327 in, -2.86998 in)
Stress2	VON: von Mises stress	0 psi Node: 6969	(2.41704e-008 in, -3.65 in, -3.81818 in)	424.781 psi Node: 6224	(-0.970942 in, -0.239316 in, -2.83196 in)
Displacement3	UZ: Z Displacement	-7.39524e-	(-1.49724 in,	8.99803e-005 m	(-2.00153 in,

		010 m Node: 1441	-3.65 in, -0.0419221 in)	Node: 4839	3.63478 in, -1.1 in)

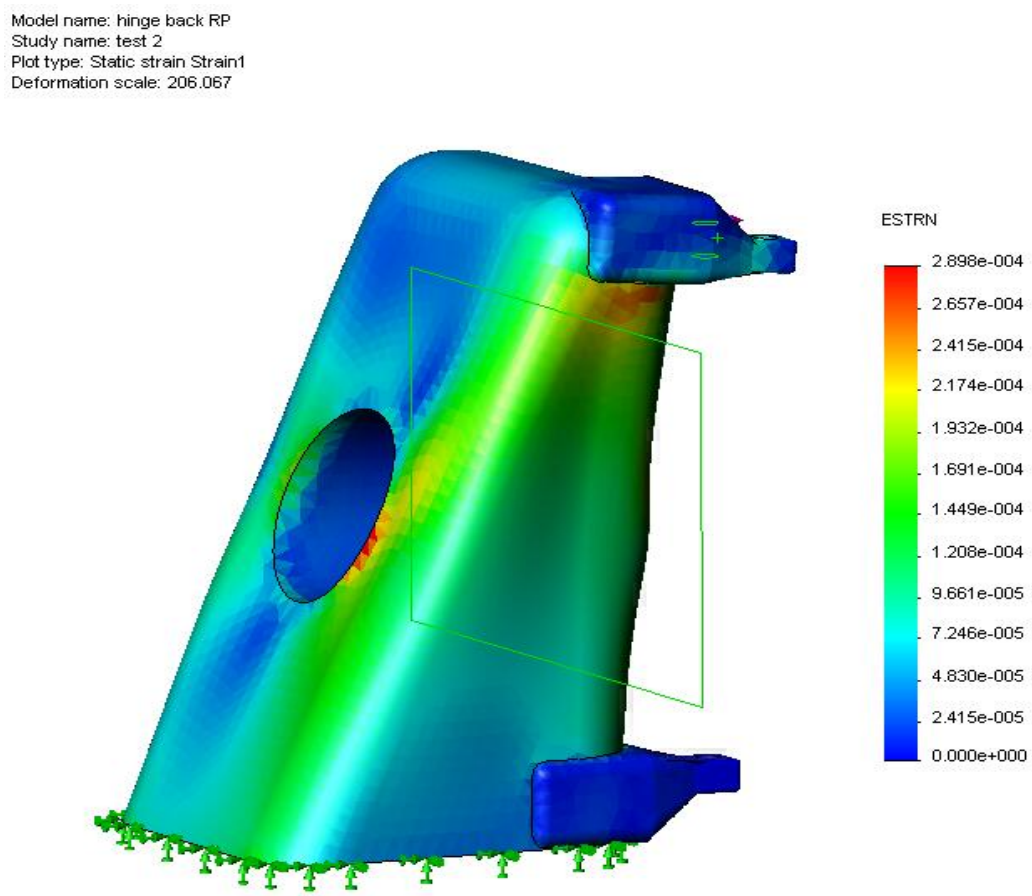
hinge back RP-test 2-Displacement-Displacement1

JPEG



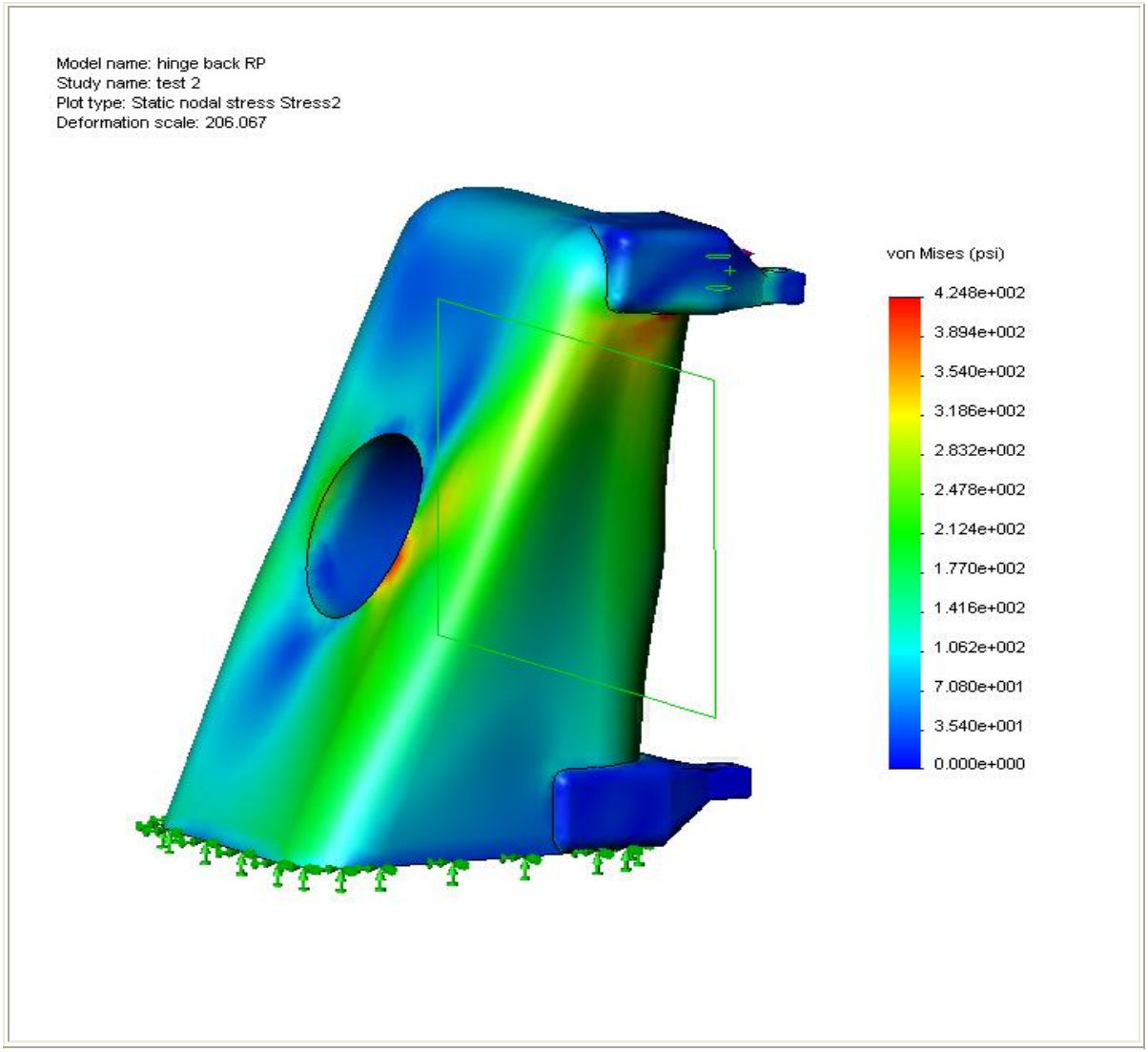
hinge back RP-test 2-Strain-Strain1

JPEG



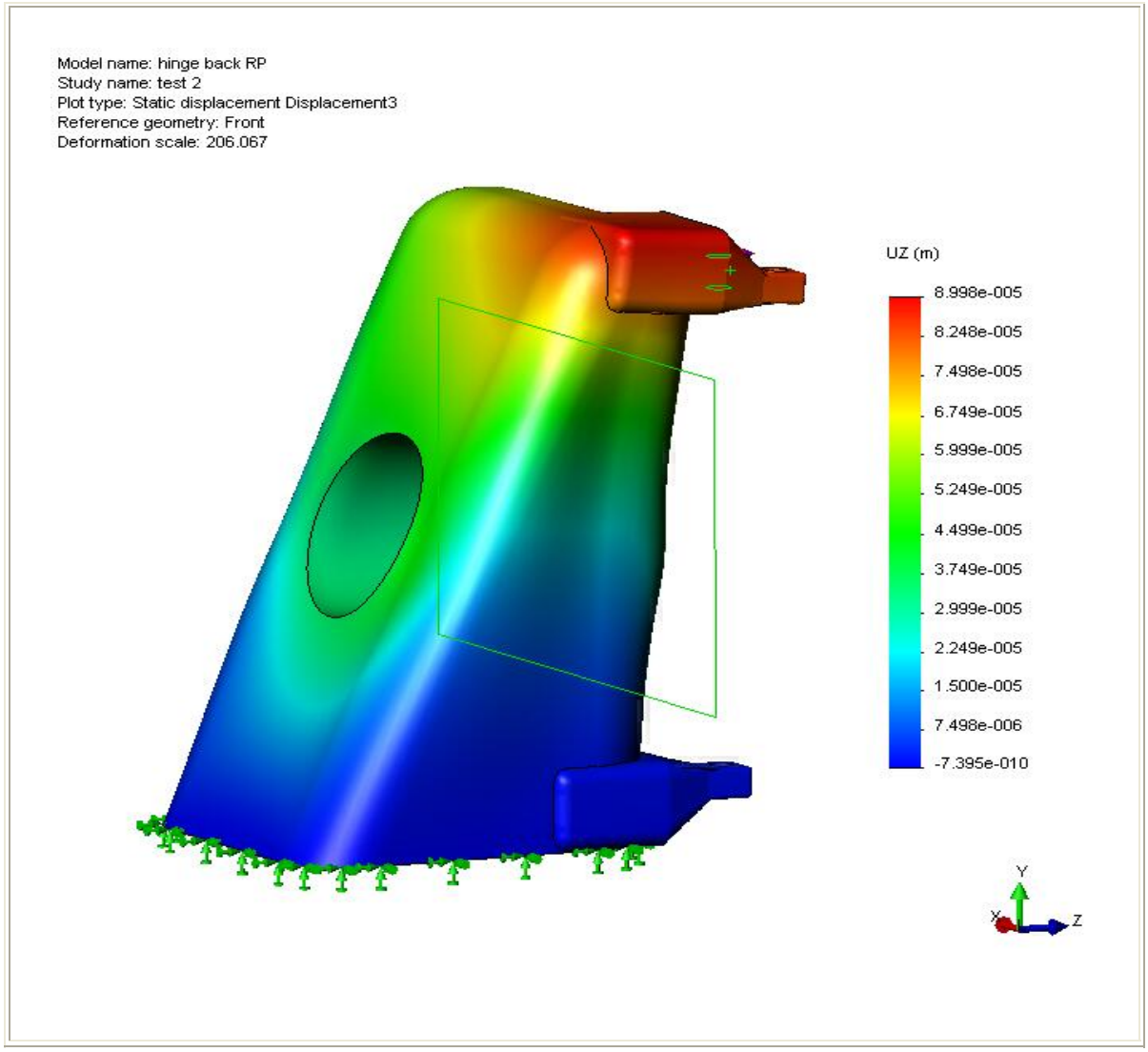
hinge back RP-test 2-Stress-Stress2

JPEG



hinge back RP-test 2-Displacement-Displacement3

JPEG



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9. Conclusion

Max von Mises stress: 425 psi max
Yield safety factor: 47
displacement in z: 90 microns
weight: 0.32 lb

10. Appendix

Material name: [SW]Nylon 6/10

Description:

Material Source: Used SolidWorks material

Material Library Name:

Material Model Type: Linear Elastic Isotropic

Property Name	Value	Units	Value Type
Elastic modulus	1.2038e+006	psi	Constant
Poisson's ratio	0.28	NA	Constant
Shear modulus	4.6412e+005	psi	Constant
Mass density	0.050578	lb/in^3	Constant
Tensile strength	20676	psi	Constant
Yield strength	20167	psi	Constant
Thermal expansion coefficient	1.6667e-005	/Fahrenheit	Constant
Thermal conductivity	7.0886e-006	BTU/(in.s.F)	Constant
Specific heat	0.35834	Btu/(lb.F)	Constant