International Journal on Recent and Innovation Trends in Computing and Communication
Volume: 3 Issue: 7

ISSN: 2321-8169
4803 - 4805

Study of Thermal Stresses on Plain Carbon steel, grey cast iron and Stainless steel at Elevated Temperature

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***Abstract*—** The main processes include the study of heating affects of different materials with respect to the temperature. We are calculating the heating stresses as well as the residual stresses with respect to the different temperature. The commonly used materials taken for study as well as for experimental purpose are plain carbon steel, grey cast iron and stainless steel. These material vary in their compositions and effect of heating stresses may increase or decrease which depends on the increment or decrement of temperature. On the overall study it has been found that the heating stresses in plain carbon steel are greater than the grey cast iron and stainless steel. These variations in the three materials are find out at 1000 Kelvin and the results are tabulated at solid works.

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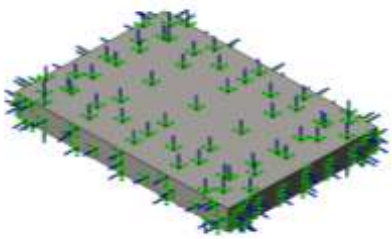
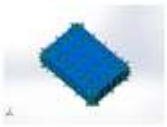
Stress Calculated at Plain Carbon Steel

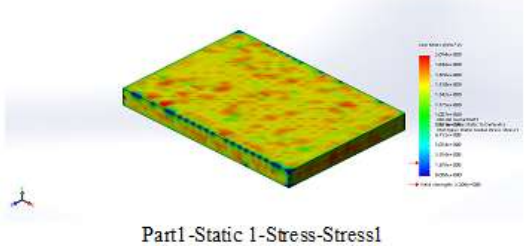
In the simulation a plate of uniform thickness and having isometric properties is subjected to a constant temperature of 1000 Kelvin for some duration of time. The composition of plain carbon steel contains approximately 0.05–0.15% carbon making it malleable and ductile.



Model Reference	Properties	
Boss-Extrude1 	Name:	Plain Carbon Steel
	Model type:	Linear Elastic Isotropic
	Default failure criterion:	Unknown
	Yield strength:	2.20594e+008 N/m^2
	Tensile strength:	3.99826e+008 N/m^2
	Elastic modulus:	2.1e+011 N/m^2
	Poisson's ratio:	0.28
	Mass density:	7800 kg/m^3
	Shear modulus:	7.9e+010 N/m^2
	Thermal expansion coefficient:	1.3e-005 /Kelvin

Solid Bodies		
Document Name and Reference	Treated As	Volumetric Properties
Boss-Extrude1 	Solid Body	Mass:0.546 kg Volume:7e-005 m^3 Density:7800 kg/m^3 Weight:5.3508 N

Name	Type	Min	Max
Stress1	VON: von Mises Stress	0 N/m^2 Node: 1	2.01375e+009 N/m^2 Node: 560



Part1-Static 1-Stress-Stress1

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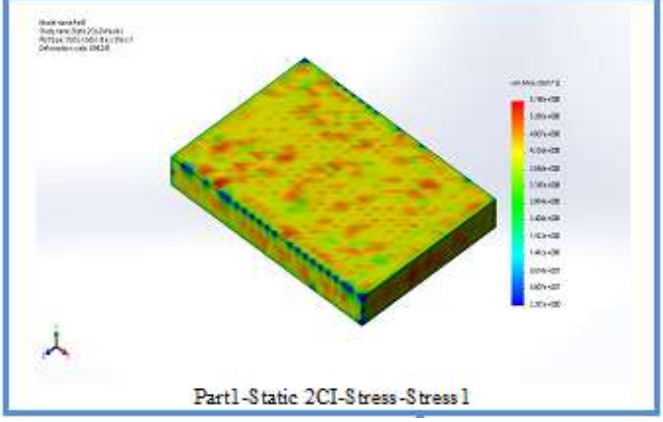
Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm Node: 1	0.013522 mm Node: 9803

Document Name and Reference	Treated As	Volumetric Properties
 **Boss-Extrude1**	Solid Body	Mass:0.504 kg Volume:7e-005 m^3 Density:7200 kg/m^3 Weight:4.9392 N

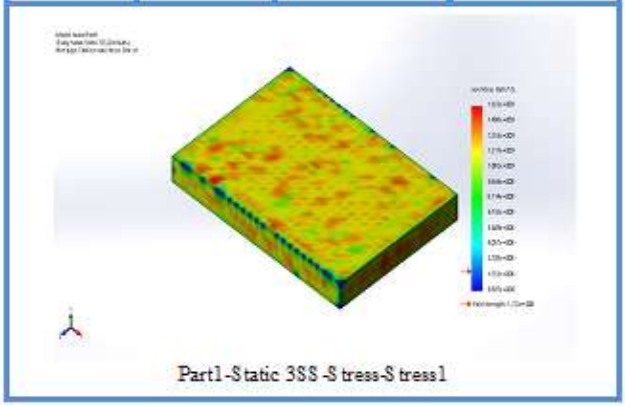
Name	Type	Min	Max
Stress 1	VON: von Mises Stress	2.28492 N/m^2 Node: 10068	5.76849e+008 N/m^2 Node: 560



Stress Calculated at Stainless Steel

Model Reference	Properties	
	Name:	Stainless Steel (ferritic)
	Model type:	Linear Elastic Isotropic
	Default failure criterion:	Max von Mises Stress
	Yield strength:	1.72339e+008 N/m^2
	Tensile strength:	5.13613e+008 N/m^2
	Elastic modulus:	2e+011 N/m^2
	Poisson's ratio:	0.28
	Mass density:	7800 kg/m^3
	Shear modulus:	7.7e+010 N/m^2
	Thermal expansion coefficient:	1.1e-005 /Kelvin

Name	Type	Min	Max
Stress1	VON: von Mises Stress	6.50712 N/m^2 Node: 10068	1.6228e+009 N/m^2 Node: 560



Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm Node: 1	0.0127612 mm Node: 9803

Results & Conclusion

Results have been tabulated separately for plain carbon steel, grey cast iron and stainless steel at elevated temperature of 1000 Kelvin. The mass of the plate is about 0.54 kg for the three cases but the difference is between the composition of the material of the plates. The density of the plate also differs with their compositions depending upon the percentage of carbon in each of the following.

The model studied for each of the following cases is linear elastic isotropic. The Thermal stress for plain carbon steel is found to be maximum as compared to grey cast iron and stainless steel when subjected to the same temperature of 1000 kelvin. The thermal stresses find out by simulation is 2.04x10^9 N/m^2 which is larger than the stresses of the grey cast iron and stainless steel. This variation of increment in the case of plain carbon steel is propionate at different values of temperature as compared to grey cast iron and stainless steel.

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