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STRUCTURAL ANALYZING IN GEAR BOX COVER USING NX-NASTRAN

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Keywords: Displacement, Path length, Stress, Max shear and deflection.

Abstract

At first we used prototype model to analyze the component performance under varying load condition. Before manufacturing we found the capacity of component with the help of prototype. But it had some demerits like as more lead-time and redesign cost. Due to this we introduce new analyzing tools Nx-Nastran and Ansys. Here we selected Nx-Nastran to analyze the gear box cover.
NX Nastran is a powerful, general purpose Finite Element Analysis (FEA) tool with an integrated graphical user interface and model, which is used to analyze linear and nonlinear stress, dynamics, and heat transfer characteristics of structures and mechanical components. It represents the latest in FEA technology with some of the fastest solvers on the market along with accurate solutions that have been trusted for over 20 years by companies in all industries. NX Nastran is available on a wide variety of platforms including 32-bit and 64-bit Windows and Linux operating systems.
NX Nastran (NASA Structural analysis) is a series of commercial software products originally developed under a NASA contract in the late 1960s by MSC Software Corporation using FORTRAN programming language. It uses the Finite Element Method which discritizes geometry into small elements and solves large sparse matrices using linear algebra to find quantities like displacement and stress in order to design structures. It became the industry standard program in part due to MSC buying competitors and in corporating their advances into their products. After an antitrust settlement with the FTC in 2002, their source code was released to various organizations. Alternative Nastran versions were soon created including NEi-Nastran and NX Nastran.

Introduction

Nx-Nastran is Siemens product lifecycle management software inc. Parts of the UG/knowledge fusion software has been provided by Heidi Corporation. This product includes the international components for Unicode software, provided by international business machine co operation and others .We used Nx-Nastran to check the performance of engine cover under varying load condition in two stages.

Stage-1

In this stage we checked the performance of gear box cover under varying load condition without ribs. GBC's performance was graphed under varying load condition. X - Axis represents path length and Y – Axis explains displacement of gear box cover under varying load conditions. We attached the simulation results of gearbox cover with graph.

Gbc without rib's

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Simulation Report

Stage Solution 1

Material Name	Material Category	Material Type	Source	Category Metal
Iron_Cast_G40	METAL	Isotropic	Library	Mass Density (RHO)7.15e-006 kg/mm^3 Young's Modulus (E)1.4e+008 MN/MM^2(KPA) Poisson's .25 Yield Strength345000 MN/MM^2(KPA) Ultimate Tensile Strength570000 MN/MM^2(KPA) Fatigue Strength Coefficient645000 MN/MM^2(KPA) Fatigue Strength Exponent-0.078 Fatigue Ductility Coefficient0.037 Fatigue Ductility Exponent-0.457 Initial Strain0.02 mm/mm Hardening Exponent0.21 Strength Coefficient975.912 N/mm^2(MPA) R0 1.8 R451.8 R901.8

Modeling Objects ummary

Modeling Object Label	Modeling Object Name	Modeling Object Type
1	Bulk Data Echo Request1	Bulk Data Echo Request
2	Structural Output Requests1	Structural Output Requests

Meshes

Total number of meshes in the part	1
Total number of elements in the part	25231
Total number of nodes in the part	46328
Total number of Tetra10 elements in the part	25231

Mesh	Element Family	Elements	Nodes
Solid(1) : PSOLID1 , Iron_Cast_G40 (Material inherited)			
3d_mesh(1)	Tetra10	25231	46328

Solution steps

Number of steps in the solution: 1

Step Name	Number of referenced loads	Loads		
Sub case - Static Loads 1	1			
		Pressure(1)	Type	Pressure - Normal pressure on 2D elements or 3D element faces
			Solver Card Name	PLOAD4
			Layer	1
			Applied to	1 Polygon Face
			Pressure	1500 N/mm^2(MPA)
			Method	Constant

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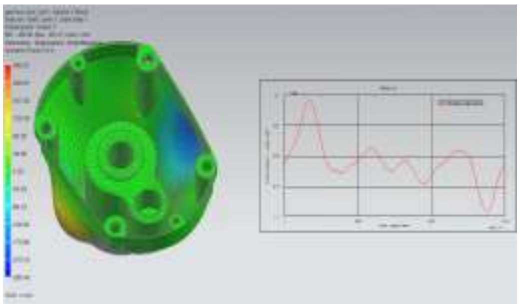
Constraints

Step Name	Number of referenced constraints	Constraints		
Subcase - Static Loads 1	1			
		Fixed(1)	Type	Fixed - Fixed
			Solver Card Name	SPC
			Layer	1
			Applied to	1 Polygon Face
			Description	

Results Summary
Structural results

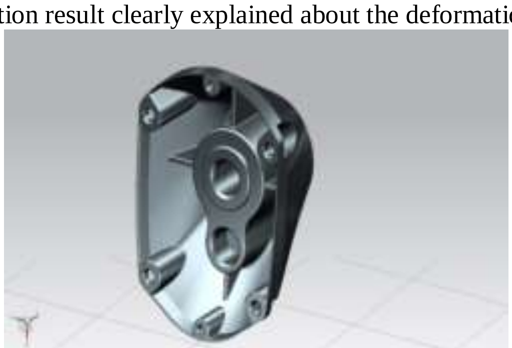
Coordinate System: Absolute Rectangular
Number of load cases: 1

`								
	Displacement (mm)				**Stress (MN/MM^2(KPA))**			
	X	**Y**	**Z**	**Magnitude**	**Von-Messes**	**Min Principal**	**Max Principal**	**Max Shear**
Static Step 1								
Max	2.556e+001	2.522e+002	7.188e+001	2.650e+002	4.202e+008	1.207e+008	5.284e+008	2.188e+008
Min	- 4.034e+001	- 2.555e+002	- 2.891e+001	0.000e+000	5.818e+004	-2.833e+008	-4.156e+007	3.348e+004



Graph result of gbc with out ribs

Stage-2
In this stage we attached the ribs in gear box cover. Here we got high performance rate. Because deformation was less when comparing with first stage. Above simulation result clearly explained about the deformation of GBC.



Graph of gbc with rib's

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Simulation Report

Stage Solution 2

Material Name	Material Category	Material Type	Source	Category Metal
Iron_Cast_G40	METAL	Isotropic	Library	Mass Density (RHO)7.15e-006 kg/mm^3 Young's Modulus (E)1.4e+008 MN/MM^2(KPA) Poisson's0.25 Yield Strength345000 MN/MM^2(KPA) Ultimate Tensile Strength570000 MN/MM^2(KPA) Fatigue StrengthCoefficient645000mN/mm^2(KPA) Fatigue Strength Exponent-0.078 Fatigue Ductility Coefficient0.037 Fatigue Ductility Exponent-0.457 Initial Strain0.02 mm/mm Hardening Exponent0.21 Strength Coefficient 975.912 N/mm^2(MPA) R01.8 R451.8 R901.8

Meshes

Total number of meshes in the part:	1
Total number of elements in the part:	25231
Total number of nodes in the part:	46328
Total number of Tetra10 elements in the part:	25231

Mesh	Element Family	Elements	Nodes
Solid(1) : PSOLID1 , Iron_Cast_G40 (Material inherited)			
3d_mesh(1)	Tetra10	25231	46328

Load

Step Name	Number of referenced loads	Loads
Subcase - Static Loads 1	1	
Pressure(1)	Type	Pressure - Normal pressure on 2D elements or 3D element faces
	Solver Card Name	PLOAD4
	Layer	1
	Applied to	1 Polygon Face
	Description	
	Pressure	1500 N/mm^2(MPa)
	Method	Constant

Constraints

Step Name	Number of referenced constraints	Constraints		
Subcase - Static Loads 1	1			
		Fixed(1)	Type	Fixed - Fixed
			Solver Card Name	SPC
			Layer	1
			Applied to	1 Polygon Face
			Description	

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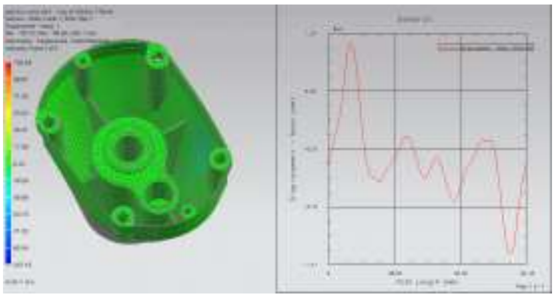
Results Summary
Structural Results

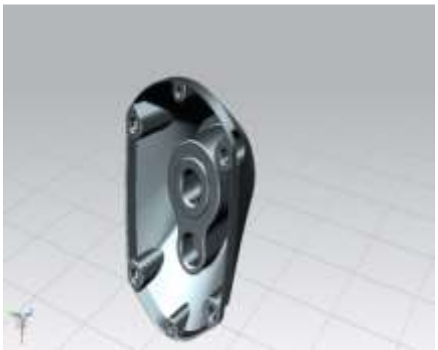
Coordinate System: Absolute Rectangular
Number of load cases: 1

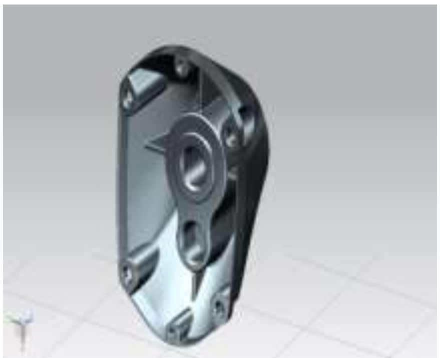
Sub case - Static Loads 1 : Number of Iterations = 1								
	Displacement (mm)				**Stress (mN/mm^2(kPa))**			
	X	**Y**	**Z**	**Magnitude**	**Von-Mises**	**Min Principal**	**Max Principal**	**Max Shear**
Static Step 1								
Max	1.709e+001	1.067e+002	3.340e+001	1.122e+002	3.434e+008	9.241e+007	4.498e+008	1.908e+008
Min	-4.009e+001	-1.072e+002	-9.629e+000	0.000e+000	5.381e+004	-1.873e+008	-4.115e+007	3.085e+004

This graph explained about displacement and path length of GBC's with ribs. Displacement was less. It will be used for heavy load carrying application.



Comparision of simulation results





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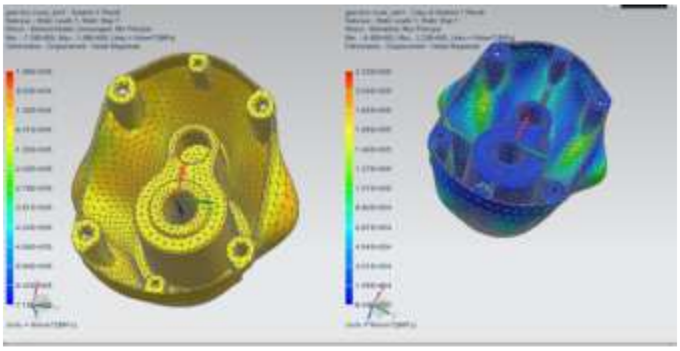
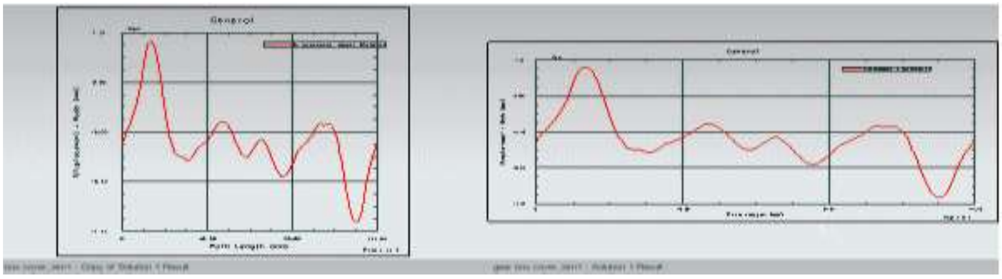


Above figure explains the simulation comparison of gear box cover with ribs and without ribs.



Comparison of graphs

Comparison of results
Stage Solution 1

	Displacement (mm)				Stress (mN/mm^2(kPa))			
	X	**Y**	**Z**	**Magnitude**	**Von-Moses**	**Min Principal**	**Max Principal**	**Max Shear**
Static Step 1								
Max	2.556e+001	2.522e+002	7.188e+001	2.650e+002	4.202e+008	1.207e+008	5.284e+008	2.188e+008
Min	-4.034e+001	-2.555e+002	-2.891e+001	0.000e+000	5.818e+004	-2.833e+008	-4.156e+007	3.348e+004

Stage Solution 2

	Displacement (mm)				Stress (MN/mm^2(kPa))			
	X	**Y**	**Z**	**Magnitude**	**Von-Moses**	**Min Principal**	**Max Principal**	**Max Shear**
Static Step 1								
Max	1.709e+001	1.067e+002	3.340e+001	1.122e+002	3.434e+008	9.241e+007	4.498e+008	1.908e+008
Min	-4.009e+001	-1.072e+002	-9.629e+000	0.000e+000	5.381e+004	-1.873e+008	-4.115e+007	3.085e+004

Conclusion

By using Nx Nastran the gear box cover would be analyzed with help of structural analysis, above comparison of graphs shows the gear box cover with ribs have more power to carry heavy load and also have to absorb more stresses. The displacement value of gearbox cover without rib is higher than the value of with rib gear box cover. In second stage we attached the ribs in gear box cover. So we got high performance rate. Because deformation was less when comparing with first stage. With help of Nx Nastran the displacement, path length, stress, maximum shear and deflection of gear box cover with and without ribs are found and plotted the graph

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