Workshop – Composite Panel – Phase B – Baseline Core Thickness Optimization

AN MSC NASTRAN SOL 200 TUTORIAL



Composite Workshop

This workshop is phase B of a 3-phase workshop.

 Workshop – Composite Panel – Phase B – Baseline Core Thickness Optimization Perform a core thickness optimization with a constant thickness core Tools Used: SOL 200 Web App (Viewer and Optimization web apps) and MSC Nastran 	 Workshop – Composite Panel – Phase C – Topometry Optimization to Determine Optimal Core Shape Generate PLY000i Files via Topometry Optimization Tools Used: Patran, MSC Nastran and SOL 200 Web App 	 Workshop – Composite Panel – Phase D – Core Shape and Core Thickness Optimization Input BDF and PLY000i Files Create Core Shapes Perform Core Thickness Optimization Inspect Core Tools Used: SOL 200 Web App (Viewer and Optimization web apps) and MSC Nastran
Baseline Core Thickness Optimization	Core Shape Optimi	zation Core Thickness Optimization



Composite Workshop

This workshop is phase B of a 3-phase workshop.





Goal: Use Nastran SOL 200 Optimization

Before Optimization

- · Weight: 6.153587E-04
- Buckling Load Factor: 3.364003



After Optimization

- Weight: 3.9503E-04
- Buckling Load Factor: 1.064771







[90/+45/-45/0/0_{core}]_s



Adjustments Made to the BDF File

1) Element Normals

For this model, the nodal plane represents the outer mold line (OML). For manufacturing purposes, the composite is to be left of the OML. The placement of the composite is controlled by the Z0 field on the PCOMP entry. The element normals are purposely adjusted to point towards the center of curvature, and doing this offers the convenience of using only Z0=0.0 throughout the optimization procedure. If the element normals are pointed away from the center curvature and to place the composite left of the OML, the PCOMP entry's Z0 field must be updated to be -T, where T is the total thickness of the laminate. This will be tedious when the composite thickness varies throughout the composite.



2) Limit eigenvalues to only positive eigenvalues

For symmetric models, certain loadings will produce both positive and negative buckling load factors. This optimization only considers positive buckling load factors. This is achieved by editing the EIGRL entry and specifying a lower bound of 0.0, i.e. the eignevalue extraction will only extract eigenvalues greater than 0.0. A negative buckling load factor (eigenvalue) indicates buckling if the load were reversed.

Before				
EIGRL	1		1	0
After				
EIGRL	1	0.0	1	0

3) Output the mass to the F06 file

The GRDPNT parameter is added to the BDF file, so the mass it output to the F06 file in the section OUTPUT FROM GRID POINT WEIGHT GENERATOR.

param grdpnt 0



Optimization Problem Statement





Contact me

- Nastran SOL 200 training
- Nastran SOL 200 questions
- Structural or mechanical optimization questions
- Access to the SOL 200 Web App

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Tutorial



Tutorial Overview

- 1. Start with a .bdf or .dat file
- 2. Use the SOL 200 Web App to:
 - Convert the .bdf file to SOL 200
 - Design Variables
 - Design Objective
 - Design Constraints
 - Perform optimization with Nastran SOL 200
- 3. Plot the Optimization Results
- 4. Update the original model with optimized parameters

Special Topics Covered

Core Thickness Optimization - This tutorial demonstrates the process to configure a core thickness optimization when the core is constant thickness.



SOL 200 Web App Capabilities

Compatibility

- Google Chrome, Mozilla Firefox or Microsoft Edge Installable on a company laptop, workstation or
- Windows and Red Hat Linux

server. All data remains within your company.

The Post-processor Web App and HDF5 Explorer are free to MSC Nastran users.

Benefits

entries.

- REAL TIME error detection. 200+
- error validations.
- REALT TIME creation of bulk data •
- Web browser accessible
- Free Post-processor web apps
 - +80 tutorials

Web Apps



Web Apps for MSC Nastran SOL 200 Pre/post for MSC Nastran SOL 200. Support for size, topology, topometry, topography, multi-model optimization.



Shape Optimization Web App Use a web application to configure and perform shape optimization.



Machine Learning Web App Bayesian Optimization for nonlinear response optimization (SOL 400)



Remote Execution Web App Run MSC Nastran jobs on remote Linux or Windows systems available on the local network



PBMSECT Web App Generate PBMSECT and PBRSECT entries graphically



Dynamic Loads Web App Generate RLOAD1, RLOAD2 and DLOAD entries graphically



Ply Shape Optimization Web App Optimize composite ply drop-off locations, and generate new PCOMPG entries



Stacking Sequence Web App Optimize the stacking sequence of composite laminate plies





HDF5 Explorer Web App Create graphs (XY plots) using data from the H5 file



Before Starting

 Ensure the Downloads directory is empty in order to prevent confusion with other files

- Throughout this workshop, you will be working with multiple file types and directories such as:
 - .bdf/.dat
 - nastran_working_directory
 - .f06, .log, .pch, .h5, etc.
- To minimize confusion with files and folders, it is encouraged to start with a clean directory.





The Engineering Lab

Go to the User's Guide

1. Click on the indicated link

• The necessary BDF files for this tutorial are available in the Tutorials section of the User's Guide.

Select a web app to begin Before After Optimization for SOL 200 Multi Model Optimization Machine Learning | Parameter HDF5 Explorer Viewer Study Tutorials and User's Guide (1)Full list of web apps

SOL 200 Web App



Obtain Starting Files

- 1. Find the indicated example
- 2. Click Link
- 3. The starting file has been downloaded

• When starting the procedure, all the necessary BDF files must be collected together.

1 Composite Panel – Phase B – Baseline Core Thickness Optimization

The goal of this 3-phase tutorial series is to optimize a curved composite panel, with a core, and produce a lightweight composite that satisfies constraints on the buckling load factor. This tutorial series focuses exclusively on optimizing the thickness of the core.

This tutorial demonstrates how to configure a basic core thickness optimization where the core has a constant thickness throughout the entire model. The goal of this tutorial is to demonstrate basic actions such as creating variables, a weight objective and constraints on the buckling load factor. The results of this core thickness optimization serve as a baseline for future comparisons. In a subsequent tutorial, the core will be allowed to have a variable thickness throughout the model and will be optimized to minimize weight.

This is the first phase in a 3-phase tutorial series.







Obtain Starting Files

- 1. Right click on the zip file
- 2. Select Extract All...
- 3. Click Extract
- 4. The starting files are now available in a folder

🕽 🔵 🗢 🗽 + caparici 🕨 Downloads 🕨	
Organize ▼ 😭 Open ▼ Share with ▼ ★ Favorites ■ Desktop	New folder 🛛 🐨 🗖 🔞
Downloads I I_starting_files.zip Recent Places I I_starting_files.zip Documents Music Pictures Videos Videos E Computer Local Disk (C:) Screenshots (\\VI Downloads (\\VB Network I_starting_files.zip Date modifie Compressed (zipped) Folder	Open Open in new window Extract All Extract All Edit with Notepad++ Open with Share with Restore previous versions Send to Cut Copy Create shortcut Delete Rename Properties
🕞 🌗 Extract Compressed (Zipped) Folders	×
Select a Destination and Extract Files Files will be extracted to this folder: C:\Users\caparic:\Downloads\1_starting_files I Show extracted files when complete	Browse
	3 Extract Cancel





Open the Correct Page

Click on the indicated link

- MSC Nastran can perform many optimization types. The SOL 200 Web App includes dedicated web apps for the following:
 - Optimization for SOL 200 (Size, Topology, Topometry, Topography, Local Optimization, Sensitivity Analysis and Global **Optimization**)
 - Multi Model Optimization
 - Machine Learning
- The web app also features the HDF5 Explorer, a web application to extract results from the H5 file type.



SOL 200 Web App

Select a web app to begin





Machine Learning | Parameter Study

HDF5 Explorer

Viewer

Tutorials and User's Guide

Full list of web apps



Upload BDF Files

- Click 1. Select Files and select model_curved_panel_with_core.bdf
- 2. Click Upload Files

The process starts by uploading all the necessary BDF files. The BDF files can be files of your own or files found in the Tutorials section of the User's Guide.

Step 1 - Upload .BDF Files





Create Design Variables

- 1. In the search box, type: thickness
- 2. Click on the plus (+) icons to set the 5th layer thickness (T5) as a design variable
- Confirm the design variable has been created
- 4. Make the following changes to the variables
 - Lower Bound: 3.0
 - Upper Bound: 25.0
 - Allowed Discrete Values: 3.0, THRU, 25.0, BY, 1.0
- Each step has hidden functionality for advanced users. The visibility is controlled by clicking + Options.
- If the property entry, e.g. PSHELL, was given a name in Patran, e.g. Car Door, the name can be shown by marking the checkbox titled Entry Name.

SOL 200 Web App - Optimization Upload Variables Objective Constraints Subcases Exporter Results

Size Topology Topometry Topography

Step 1 - Select design properties

+ Options

Create DVXREL1	Property ≑	Property Description $\mbox{$\ddagger$}$	Entry ≑	Entry ID ≑	Current Value 👙
	Search	thickness 1	Search	Search	Search
÷	T1	Thickness of layer 1 (90°)	PCOMP	1	.125
+	T2	Thickness of layer 2 (45°)	PCOMP	1	.125
+	ТЗ	Thickness of layer 3 (-45°)	PCOMP	1	.125
•	Τ4	Thickness of layer 4 (0°)	PCOMP	1	.125
2 🗗	Т5	Thickness of layer 5 (0°)	PCOMP	1	10.

 5
 10
 20
 30
 40
 50

 Number of Visible Rows
 5

Step 2 - Adjust design variables

+ Op	otions									X Delete Visible Rows
	Label \$	Status ≑	Property ≑	Property Description \Leftrightarrow	Entry ≑	Entry ID ≑	Initial Value	Lower Bound	Upper Bound	Allowed Discrete Values
	Search	Search	Search	Search	Search	Search	Search	4 h	Search	Search
×	x1	3 0	Т5	Thickness of layer 5 (0°)	PCOMP	1	10.	3.0	25.0	3.0, THRU, 25.0, BY, 1.0



Create Design Objective

- 1. Click Objective
- 2. Select the plus (+) icon for weight
- 3. The objective has been set to minimize the weight, no further modification is necessary
- The objective must always be a single and global response. A response such as weight and volume are single responses, are independent of load case, and can be used as an objective. Other responses require special care when set as an objective. For example, if the objective is stress, only the stress of a single component, e.g. von Mises, of a single element, of a single load case may be used.

		-	-(1)	oonstrainto	00000303	Exporter	······
Objective	Equation Objective		U				

Select a response

	Response Description 💠	Response Type 💠
	Search	Search
2	Weight	WEIGHT
H	Volume	VOLUME
H	Buckling Eigenvalue/Factor	LAMA
H	Weight from Particular Material or Property ID	WMPID
H	Fractional Mass	FRMASS



Step 2 - Adjust objective

+ Options

	Label	Status	Response Type	Maximize or Minimize	Property Type	ΑΤΤΑ	ATTB	ATTI
×	rO	0	WEIGHT	MIN 🗸	3	3 🗸	3 🗸	



Create Design <u>Constraints</u>

- 1. Click Constraints
- 2. Click the plus (+) icon for Buckling Eigenvalue/Factor to create one constraint
- 3. Set the Buckling Mode Number (ATTA) to 1
- 4. Set the Lower Allowed Limit to 1.0

SOL 200 Web App - Optimization	Upload	Variables	Objective	Constraints	Subcases	Exporter	Results
Constraints Equation Constraints				1			
Step 1 - Select constr	raints						
Select an analysis type							
SOL 105 - Buckling							~

Select a response

		Response Description ≑	Response Type ≑
		Search	Search
	+	Weight	WEIGHT
	•	Volume	VOLUME
2		Buckling Eigenvalue/Factor	LAMA
	+	Weight from Particular Material or Property ID	WMPID
	÷	Fractional Mass	FRMASS

5 10 20 30 40 50

Step 2 - Adjust constraints

+ Options

	Label	Status ≑	Response Type [⊕]	Property Type	¢ ATTA	ATTB ÷	ATTi 🗢	Lower Allowed Limit	Upper Allowed Limit
	St	Seal	Search	Search	Search	Search	Search	Search	Search
×	r1	0	LAMA		1 (3)			1.0 4	Upper



Assign Constraints to Load Cases (SUBCASES)

- L. Click Subcases
- 2. Select all the subcases
- B. Click +Options
- 4. Mark the checkbox for Use Multidisciplinary (MD) Optimization
- 5. For subcase 1, set the Analysis Type as Statics
- 6. For subcase 2, set the Analysis Type as Buckling
- 7. Mark the indicated checkbox
- The r1 constraint has been assigned to SUBCASE 2
- When hundreds of SUBCASEs must be configured, the following options expedite the process:



SOL 200 Web App - Optimization	Upload	Variables	Objective	Constraints	Subcases	Exporter	Results
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Step 1 - Assign constraints to subcases

Glol SUE SUE	bal Constr BCASE 1 BCASE 2	raints	2						
+ Oţ	otions 3)						Uncheck visible boxes	🕑 Check visit
🖌 Use	e Multidiso Status	ciplinary (MD) Label ≑	Optimization Response Type	Analysis Type [⊕]	Description	Global Constraints ≑	SUBCASE 1 \$	SUBCASE 2 🔶	
		Search	Search	Search	Search				
						Analysis Types 🔶	Statics V	6 Buckling V	

(1)



Export New BDF Files

1. Click on Exporter

2. Click on Download BDF Files

 When the download button is clicked a new file named "nastran_working_directory" is downloaded. If the file already exists in your local folder, the folder name is appended with a number, e.g. "nastran_working_directory (1).zip"

BDF Output - Model

assign userfile = 'optimization_results.csv', status = unknown, form = formatted, unit = 52 \$ MSC.Nastran input file created on May 23, 2023 at 07:05:29 by \$ Patran 2022.2 \$ Direct Text Input for Nastran System Cell Section \$ SOL 200 CEND ECHO = PUNCH(NEWBULK) TITLE = MSC.NASTRAN JOB CREATED ON 22-MAY-23 AT 09:49:34 DESOBJ(MIN) = 8000000 \$ DESGLB Slot \$ DSAPRT(FORMATTED, EXPORT, END=SENS) = ALL SUBCASE 1 ANALYSIS = STATICS \$ DESSUB Slot \$ DRSPAN Slot \$ Subcase name : Default SUBTITLE=Default SPC = 2LOAD = 5 DISPLACEMENT(PLOT, SORT1, REAL)=ALL SPCFORCES(PLOT, SORT1, REAL)=ALL SUBCASE 2 ANALYSIS = BUCK DESSUB = 40000002 \$ DRSPAN Slot \$ Subcase name : Default

Download BDF Files

Download BDF Files
 2



Results

Perform the Optimization with Nastran SOL 200

- 1. A new .zip file has been downloaded
- 2. Right click on the file
- 3. Click Extract All
- 4. Click Extract on the following window
- Always extract the contents of the ZIP file to a new, empty folder.

	oen ▼ Share with ▼	New folder	===	•	0				
👉 Favorites	Name	^	Date modifie	ed 1	Туре				
🧮 Desktop	引 nastran_working_	directory.zip	2/25/2019 0.	16 AM (Commress				
bownloads			Open in new winds						
Recent Places			Open in new windo	JVV .					
CneDrive		2	Extract All						
Jibraries			Edit with Notepad+	+					
Documents			Open with						
Music			Share with		- F				
Pictures			Restore previous ve	ersions					
Juleos			Send to		+				
			C.+						
🍣 Homegroup			Cut						
			Сору						
Computer			Create shortcut						
			Delete						
Metwork	4		Rename						
nastran_wo Compressed	rking_directory.zip Date n (zipped) Folder	nodified: 2/25/2 Size: 114 bytes	Properties) 🔒 Exti	ract Com	pressed (Zipped) Fold	ders		
Compressed	rking_directory.zip Date n (zipped) Folder	odified: 2/25/2 Size: 114 bytes	Properties	Select Files wi CAUSE	ract Comp t a Dest II be extra ers\specia w extracte	pressed (Zipped) Fold ination and Extr cted to this folder: I-sunshine\Downloa ed files when comple	ders ract Files ds\nastran_work te	ing_directory	Browse



Perform the Optimization with Nastran SOL 200

- 1. Inside of the new folder, double click on Start MSC Nastran
- Click Open, Run or Allow Access on any subsequent windows
- MSC Nastran will now start
- After a successful optimization, the results will be automatically displayed as long as the following files are present: BDF, F06 and LOG.
- One can run the Nastran job on a remote machine as follows: 1) Copy the BDF files and the INCLUDE files to a remote machine. 2) Run the MSC Nastran job on the remote machine. 3) After completion, copy the BDF, F06, LOG, H5 files to the local machine. 4) Click "Start MSC Nastran" to display the results.

Using Linux?

Follow these instructions: 1) Open Terminal 2) Navigate to the nastran working directory cd ./nastran_working_directory 3) Use this command to start the process ./Start MSC Nastran.sh

In some instances, execute permission must be granted to the directory. Use this command. This command assumes you are one folder level up.

sudo chmod -R u+x ./nastran working directory

COC Working_directory > + +	Search nastran_working_	dir 🔎	
Organize Include in library Share with New folder		0	Open File - Security Warning
★ Favorites Name ■ Desktop ■ app ● Downloads ■ design_model.bdf ■ Recent Places ■ model.bdf ▲ OneDrive ■ Start MSC Nastran	Date modified 1 2/24/2018 1:57 PM F 2/24/2018 1:57 PM F 2/24/2018 1:57 PM F 2/24/2018 1:57 PM F 2/24/2018 1:57 PM F	Type File folder BDF File BDF File Shortcut	Do you want to open this file? Name:astran_working_directory\Start MSC Nastran.Ink Publisher: Unknown Publisher
Ibraries Documents Image: Im			Iype: Shortcut From: C:\Users\special-sunshine\Downloads\nastran 2 Open Cancel V Always ask before opening this file
🤣 Homegroup			While files from the Internet can be useful, this file type can potentially harm your computer. If you do not trust the source, do not open this software. What's the risk?
Network Vetwork Vetwork Vetwork Vetwork Vetwork		•	



Questions? Email: christian@ the-engineering-lab.com



X

SOL 200 Web App - Status

Status

Republic Python MSC Nastran

Status

1. While MSC Nastran is running, a status page will show the current state of MSC Nastran

Name	Status of Job	Design Cycle	RUN TERMINATED DUE TO
model.bdf	Running	None	

 The status of the MSC Nastran job is reported on the Status page. Note that Windows 7 users will experience a delay in the status updates. All other users of Windows 10 and Red Hat Linux will see immediate status updates.



Review Optimization Results

After MSC Nastran is finished, the results will be automatically uploaded.

- Ensure the messages shown have green checkmarks. This is indication of success. Any red icons indicate challenges.
- 2. The final value of objective, normalized constraints and design variables (not shown) can be reviewed.
- The final max normalized constraint is negative, indicating the design is feasible. The fact the objective was minimized and the final design is feasible indicates this has been a successful optimization.

Final Message in .f06



RUN TERMINATED DUE TO HARD CONVERGENCE TO AN OPTIMUM AT CYCLE NUMBER = 3. AND HARD FEASIBLE DISCRETE DESIGN OBTAINED

Objective

0

0



Design Cycle





Review Optimization Results

- 1. A plot of the change of the design variables during the optimization is displayed
- The continuous variable optimization, design cycles 1-3, yielded a value of ~4.8
- 3. Since the variable is only allowed to take on specified discrete values, the optimizer performs a 3D design cycle, where D stands for discrete. Ultimately, the value ~4.8 becomes 5.0, where 5.0 is one of the discrete values.



Results

Before Optimization

- Weight: 6.153587E-04
- Buckling Load Factor: 3.364003



After Optimization

- Weight: 3.9503E-04
- Buckling Load Factor: 1.064771





Baseline Model

- The composite in this tutorial currently uses a core layer, with a fixed thickness, that spans the entire panel. A future tutorial will demonstrate how to optimize the core thickness for different sections of the model.
- This core thickness optimization was performed to establish a baseline of results. The optimal mass, 3.9503E-04, and a buckling load factor of 1.064771, from this tutorial are recorded in the table shown. The results after core shape optimization in phases C and D will be <u>compared</u> with this baseline model.

	Starting Design	Design After Topometry Optimization	Design After Core Shape and Core Number Optimization
	Tutorial Phase B	Tutorial Phase C	Tutorial Phase D
Total Mass	3.9503E-04		
Mass of Non-design Region (Plies)	1.746926E-04		
Mass of Design Region (Core)	2.203330E-04		
Buckling Load Factor, Subcase 2	1.064771 (OK)		



- 1. The original input files, e.g. DAT, BDF, etc., contains the original values for the designed properties. These original values must be updated to use the new and optimized values.
- 2. A new BDF file has been created in nastran_working_directory/workspace_b/ model_final.bdf.
- 3. The file model_final.bdf is a copy of the original input files but the original values for the designed properties have been updated to use the optimized values.

Coord and a stran_v	working_directory > workspace_b	Search workspace 🔎
Organize 🔻 Include in	n library 🔻 Share with 👻 New folder	:= - 1 🔞
☆ Favorites	Name	Date modified Ty
📃 Desktop	imodel_final.bdf	7/20/2022 2:32 PM No
Downloads		
Recent Places		
Cibraries -	۲. III	۰.

Original Input Files

Updated BDF File (model_final.bdf)

🔚 model_cu	urved_panel_with_com	e.bdf 🔀							nodel	Emodel_final.bdf 🖸										
32	PCOMP	1	0.0		90.	HILL			SYM		95	PCOMP		1 0.0	0.0	90.	HI	LL 0.0	0.0	SYM
33		101	.125	90.	YES						96		10	.125	90.	YES	1	01 .125	45.	YES
34		101	.125	45.	YES						97		10	.125	-45.	YES	1	01 .125	0.0	YES
35		101	.125	-45.	YES						98		50	5.	0.0	YES				
36		101	.125	0.	YES						99	\$ Pset:	"pcomp	will	be impor	ted as: "	pcomp.	1"		
37		501	10.	Ο.	YES						100	CQUAD4	641	1	(3)	726	798	724	0.	0.
38	\$ Pset:	"pcomp.	" Will]	oe impoi	rted as:	"pcomp.1"					101	CQUAD4	642	1	6	727	799	798	0.	0.
39	CQUAD4	641	1	1 25	726	798	724	0.	0.		102	CQUAD4	643	1	727	728	800	799	0.	0.
40	CQUAD4	642	1	26	727	799	798	0.	0.		103	CQUAD4	644	1	728	729	801	800	0.	0.
41	CQUAD4	643	1	727	728	800	799	0.	0.		104	CQUAD4	645	1	729	730	802	801	0.	0.
42	CQUAD4	644	1	728	729	801	800	0.	0.		105	CQUAD4	646	1	730	731	803	802	0.	0.







 It should be noted that since this was a multidisciplinary optimization, the update to the file model_fina.bdf is incomplete. Manually copy the section above the BEGIN BULK delimiter from the original file (model_curved_panel_with_core.bdf) to the new file (model_final.bdf).

 If you were using multiple INCLUDE files, model_final.bdf is a combination of all INCLUDE files. The next few slides discuss an alternative method of using the PCH to BDF web app to update the values for the designed properties while preserving separate INCLUDE files.

nodel_curved_panel_with_core.bdf 🖾	🔚 model final bdf 🖸
1 § MSC.Nastran input file created on May 23, 2023 at 07:05:29 by	1 \$ Message from the SOL 200 Web App
2 \$ Patran 2022.2	2 \$ This file was generated as follows:
3 \$ Direct Text Input for Nastran System Cell Section	3 \$ - The head, or every line above the BEGIN BULK line, was sourced
4 S	4 \$ from model.bdf
5 SOL 105	5 \$ - The head is only added if the following conditions are met:
6 CEND	6 \$ - There exists no INCLUDES
7 TITLE = MSC.NASTRAN JOB CREATED ON 22-MAY-23 AT 09:49:34	7 \$ - There is only one ANALYSIS type used
8 ECHO = NONE	8 \$ - SOL 200 was changed to its respective SOL number
9 SUBCASE 1	9 S - The bulk data section was sourced from model.pch
10 \$ Subcase name : Default	10 \$ MSC.Nastran input file created on May 23, 2023 at 07:05:29 by
1 SUBTITLE=Default	11 \$ Patran 2022.2
2 SPC = 2	12 \$ Direct Text Input for Nastran System Cell Section
.3 LOAD = 5	13 \$
4 DISPLACEMENT (PLOT, SORT1, REAL) =ALL	14 SOL 105
5 SPCFORCES (PLOT, SORT1, REAL) =ALL	15 CEND
6 SUBCASE 2	16 TITLE = MSC.NASTRAN JOB CREATED ON 22-MAY-23 AT 09:49:34
7 \$ Subcase name : Default	17 ECHO = NONE
8 SUBTITLE=Default	18 SUBCASE 1
$-9 \qquad SPC = 2$	19 \$ Subcase name : Default
METHOD = 1	20 SUBTITLE=Default
1 VECTOR (PLOT, SORT1, REAL) = ALL	SPC = 2
2 SPCFORCES (PLOT, SORT1, REAL) =ALL	22 LOAD = 5
3 STATSUB = 1	23 DISPLACEMENT (PLOT, SORT1, REAL) = ALL
4 BEGIN BULK	24 SPCFORCES (PLOT, SORT1, REAL) = ALL
5 param grdpnt 0	25 SUBCASE 2
6 HDF50UT PRCISION 32 CMPRMTHD LZ4 LEVEL 5	26 \$ Subcase name : Default
7 PARAM PRIMAXIM YES	27 SUBTITLE=Default
28 EIGRL 1 0.0 1 0	28 SPC = 2
S Elements and Element Properties for region : pcomp.1	29 METHOD = 1
S Composite Property Reference Material: pcomp.502	30 VECTOR (PLOT, SORT1, REAL) =ALL
31 S Composite Material Description :	31 SPCFORCES (PLOT, SORT1, REAL) = ALL
32 PCOMP 1 0.0 90. HILL SYM	32 STATSUB = 1
101 .125 90. YES	33 BEGIN BULK
101 .125 45. YES	34 S************************************
35 101 .125 -45. YES	35 S*
101 .125 0. YES	36 S* Design Model



- Click Results
- 2. Click PCH to BDF



Select a Results App







Local Optimization (.f06)



Parameter Study (.f06)



And Address of the local

Responses (.f06)

1000-00 1000-00 5000000 1000-00 1000-00 500000 1000-00 1000-00 500000

Global Optimization Type 2 (.f06)







Topology Viewer (.des)

Miscellaneous Apps

HEQVIE 1 MAR(SAVE, PS, E, L, SD2H4) = 7.40 * L**2 * SD2H4) GEOR = P20(1) * DAG(**2*5)	M2 4 11.00 10 40	
BECKLONE + -PO * NUM / DOWN	90 1 11.0 10 11 11	
	360 v 11.00 vo 11 vo	
	MM	
NEBUTS STREES	ME - 1.00 - 1.0 - 00	
((31,71) 0 7.60 " 76.60"*2 " (1) DENEMA (5.5418 * (1)"*2*1.60*) BUCHLING #	MM 1 11.00 00 11 00	
-1.35 * g / BRADK	00 0 1140 m 11 m	
Quere de la		



The original .bdf/.dat file has old information about the properties. The properties will be updated.

- Select the model.pch file
- 2. Select the original file: model_curved_panel_with_core.bdf
- 3. A summary of updates that will be performed are shown
- Click Download and a new updated BDF file is downloaded

CHE	Entries									
BEGIN B	JLK									
PARAM	GRDPNT Ø									
HDESOUT		20		174	I EVEI	5				
NUF 500 I	PRCISION :	52	CMPRMTHD	124	LEVEL	2				
PARAM	PRTMAXIM Y	YES								
ARAM	PRTMAXIM)	YES								
				90	нти	0.0	0.0	SYM		
PCOMP	1	0.0	0.0	30.	11466	0.0				
PCOMP	1 101 .	0.0 .125	0.0 90.	YE:	5 101	.125	45.	YES		

SOL 200 SOL 200 Web App - PCH to BDF

2 1. Select files model_curved_panel_with_core.bdf List of Selected Files **BDF Entries** BEGIN BULK param grdpnt 0 HDF50UT PRCISION 32 CMPRMTHD LZ4 LEVEL 5

PCOMP	1							
	-	0.0		90.	HILL			SYM
	101	.125	90.	YES				
	101	.125	45.	YES				
	101	.125	-45.	YES				
	101	.125	0.	YES				
	501	10.	0.	YES				
	4.04	20500	0070	26				
MAIS	101	38600.	8270.	.26	4140.			1.005-9
	8.6	22.1		1062.	610.	31.	118.	72.

Step 3 - Download New BDF Files

On download, the PCH entries will replace older BDF entries.



Questions? Email: christian@ the-engineering-lab.com



Step 2 - Select BDF Files

1. Note the entries have been updated with the optimized properties

model_cury	ed_panel_with_con	- hdf 🖂								1										
32	PCOMP	1	0.0		90.	HILL			SYM	^	32	PCOMP	1	0.0	0.0	90.	HIL	L 0.0	0.0	SYM
33		101	.125	90.	YES						33		101	.125	90.	YE	s 10	1.125	45.	YES
34		101	.125	45.	YES						34		101	.125	-45.	YE	S 10	1.125	0.0	YES
35		101	.125	-45.	YES						35		501	5.	0.0	YE	S			
36		101	.125	0.	YES						36	\$ Pset:	"pcomp.1	" will	be import	ted as:	"pcomp.1			
37		501	10.	0.	YES						37	CQUAD4	641	1	725	726	798	724	0.	0.
38	\$ Pset:	"pcomp.	1" will	oe impor	ted as:	"pcomp.1					38	CQUAD4	642	1	726	727	799	798	0.	0.
39	CQUAD4	641	1	725	726	798	724	0.	0.		39	CQUAD4	643	1	727	728	800	799	0.	0.

Original BDF/DAT File

Downloaded BDF/DAT File



Open the Correct Page

1. Click on the indicated link

- MSC Nastran can perform many optimization types. The SOL 200 Web App includes dedicated web apps for the following:
 - Optimization for SOL 200 (Size, Topology, Topometry, Topography, Local Optimization, Sensitivity Analysis and Global Optimization)
 - Multi Model Optimization
 - Machine Learning
- The web app also features the HDF5
 Explorer, a web application to extract results from the H5 file type.





Open the Viewer

- 1. Navigate to the Composites section
- 2. Click Viewer

SOL 200 Web App - List of Web Apps

Beams





Upload BDF Files

- 1. Click Upload BDF
- 2. Click Select files
- 3. Click workspace_b
- 4. Select the indicated files
- 5. Click Open
- 6. Click Upload files
- 7. Click Background Color (Optional)

BDF		File Upload
	Select	Directory
2 1. Select files model_final.bdf		
		Center Model
	Inspecting: 100%	25 Fit Model
6 2. Upload files		Model Display Pan
	Lista di en 100 %	
	opioauliig. Tuu %	View
List of Selected Files		• Front
		⊗ Rear IIIs
O Open		▲ Top
😋 🔾 🗢 📕 « nastran_working_dir 🕨 workspace	e_b Search workspace_b	✓ Bottom
Organize 🔻 New folder		✓ Left > R
	0 * 🛄 🐨	
Favorites Name	Date modified Type	Results
✓ Favorites Name Image: Desktop Image: Desktop Image: Downloads Image: Downloads Image: Desktop Image: Desktop Image: Downloads Image: Desktop Image: Desktop Image: Desktop Image: Downloads Image: Desktop Image: Desktop Image: Desktop Image: Downloads Image: Desktop Image: Desktop Image: Deskt	Date modified Type 5/10/2023 11:14 AM Notepad+	Results
✓ Favorites ∧ □ Desktop ↓ □ Downloads ↓ □ Libraries ↓ □ Documents ↓ □ Pictures ↓ □ Videos ↓	Date modified Type 5/10/2023 11:14 AM Notepad+	Results
✓ Favorites Name □ Desktop Image: Computer □ Downloads Image: Computer □ Libraries Image: Computer □ Libraries Image: Computer □ Computer Image: Computer □ File name: model_final.bdf		Results



Display Plies

- 1. Click Model Display Panel
- 2. Click Left
- 3. Right click and hold the right mouse button, and move the mouse to translate the model into view. Use the scroll wheel to zoom into the model.
- 4. Click the indicated icon
- 5. Click the indicated icon
- 6. Click the indicated icon to recolor the plies
- 7. The core, along with the plies, is now displayed



v

z





Display Plies

- 1. Click Model Display Panel
- 2. Rotate and/or zoom out to view the entire model





End of Tutorial

