Workshop – Configure a 0 Hz Frequency Response and Statics Analysis

AN MSC NASTRAN SOL 200 TUTORIAL

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Goal

The MSC Nastran Dynamic Analysis User's Guide proposes an analysis strategy for dynamic analysis, see figure 15-1.

One step in the procedure is to perform a frequency response analysis at 0 Hz and compare the results to a static analysis. Per the guide,

"The results should be the same if direct frequency response (without structural damping) is used. If the results are not equal, then there is probably an error in the specification of the dynamic load, and you should check the LSEQ and DAREA entries. If modal frequency response (without structural damping) is used, then the 0.0 Hz results should be close to the static results; the difference is due to modal truncation."

Goal: This exercise details the procedure to configure a 0Hz frequency response analysis and an equivalent statics analysis.

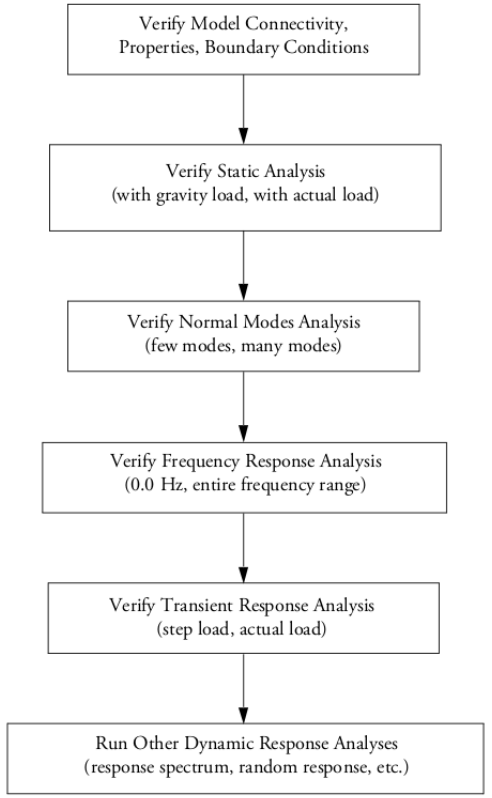


Figure 15-1 Simplified Flow Chart of the Overall Analysis Strategy

Details of the structural model

Dynamic Response Optimization

This example demonstrates structural optimization when the structural loads are frequency dependent. The system considered is a flat rectangular plate clamped on three edges and free along the fourth, as shown in Figure 8-21. The problem investigates minimization of the mean square response of the transverse displacement at the midpoint of the free edge, while constraining the volume of the structure (and hence, weight) to be equal to that of the initial design. A pressure loading with an amplitude of $1.0\ lb_f/in^2$ is applied across a frequency range of 20.0 to 200.0 Hz. A small amount of frequency-dependent modal damping has also been included.

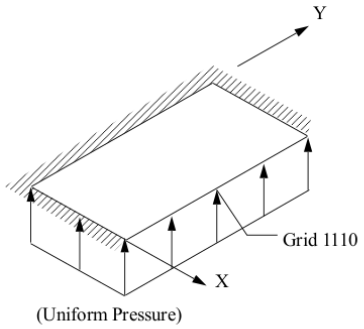
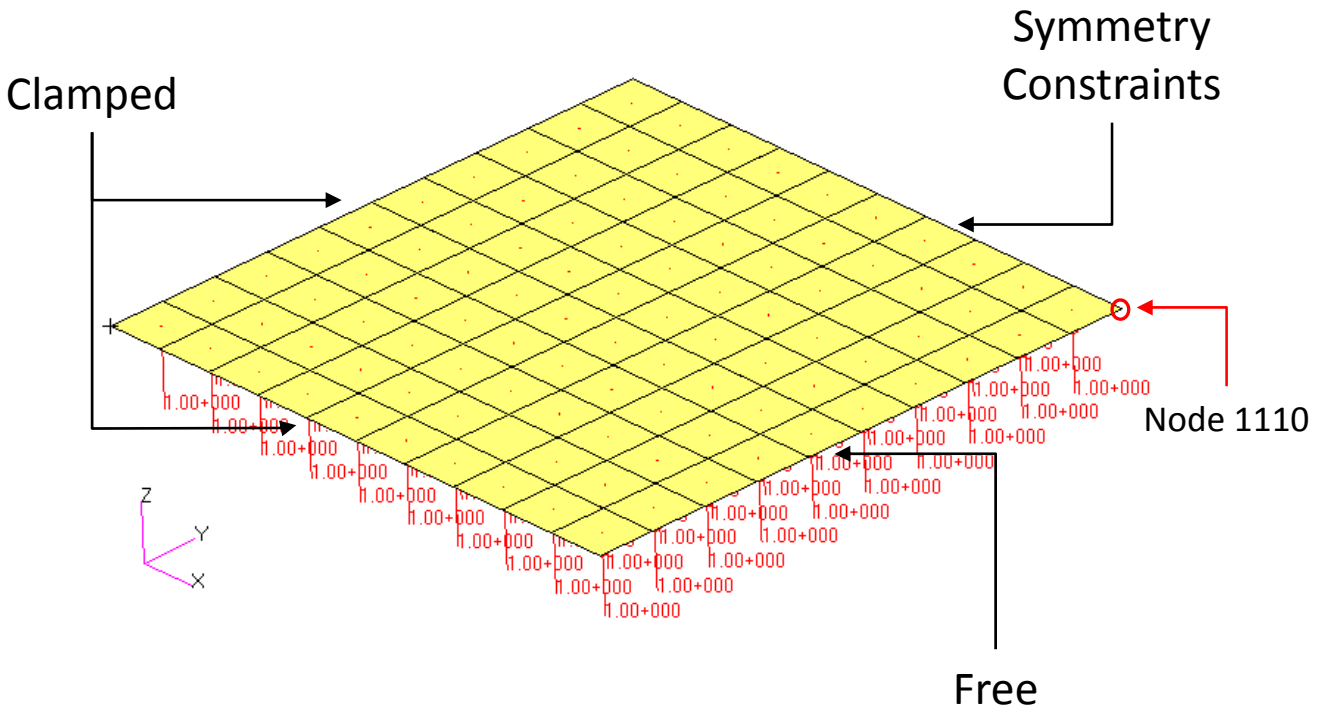


Figure 8-21 Pressure-Loaded Flat Plate

MSC Nastran Design Sensitivity and Optimization User's Guide
Chapter 8 - Example Problems - Dynamic Response Optimization



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:
   - Configure both a 0 Hz frequency response and statics analysis
   - Remove damping
3. Inspect the displacements of both the 0 Hz frequency response and statics analysis

Special Topics Covered

Validating a Frequency Response Analysis - The process of validating a model is extensive. For frequency response analysis, one strategy to validate the frequency response analysis has been properly configured is to perform a frequency response analysis at 0Hz and compare the results to a statics analysis. If the results are equivalent or nearly equivalent, the frequency response analysis has been configured properly. This exercise details how to configure both a 0 Hz frequency response analysis and statics analysis.

SOL 200 Web App Capabilities

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

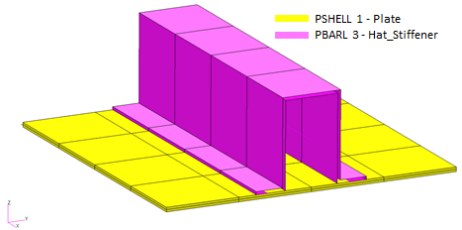
Compatibility

- Google Chrome, Mozilla Firefox or Microsoft Edge
- Windows and Red Hat Linux
- Installable on a company laptop, workstation or server. All data remains within your company.

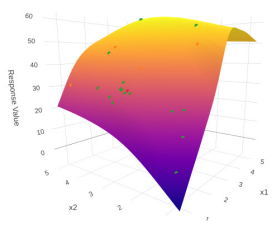
Benefits

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

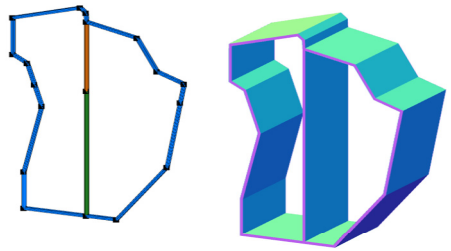
Web Apps



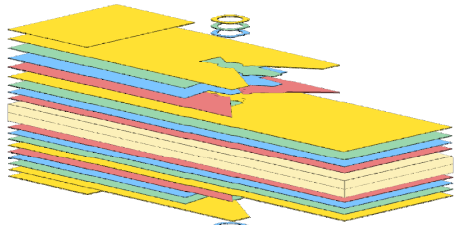
Web Apps for MSC Nastran SOL 200
Pre/post for MSC Nastran SOL 200. Support for size, topology, topometry, topography, multi-model optimization.



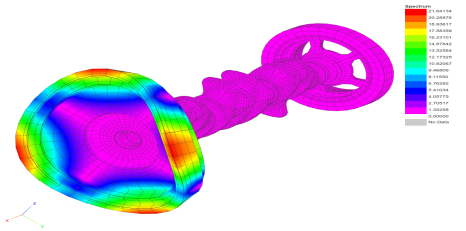
Machine Learning Web App
Bayesian Optimization for nonlinear response optimization (SOL 400)



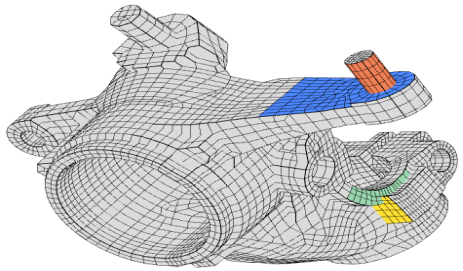
PBMSECT Web App
Generate PBMSECT and PBRSECT entries graphically



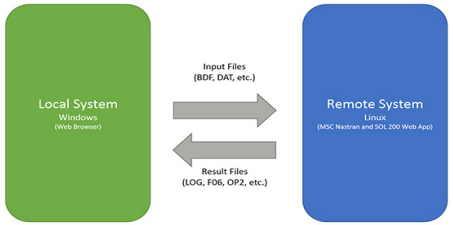
Ply Shape Optimization Web App
Optimize composite ply drop-off locations, and generate new PCOMPG entries



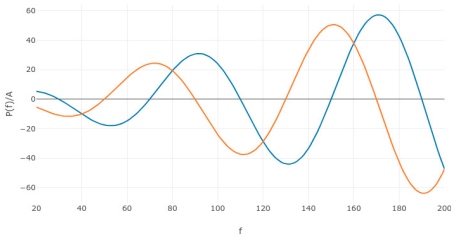
Post-processor Web App
View MSC Nastran results in a web browser on Windows and Linux



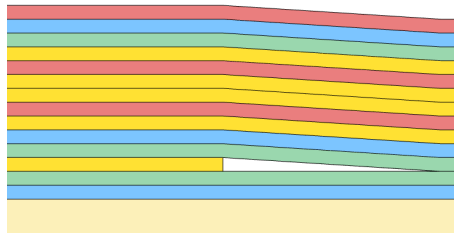
Shape Optimization Web App
Use a web application to configure and perform shape optimization.



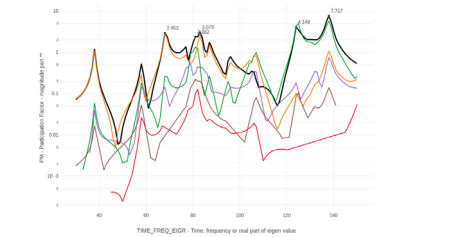
Remote Execution Web App
Run MSC Nastran jobs on remote Linux or Windows systems available on the local network



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



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

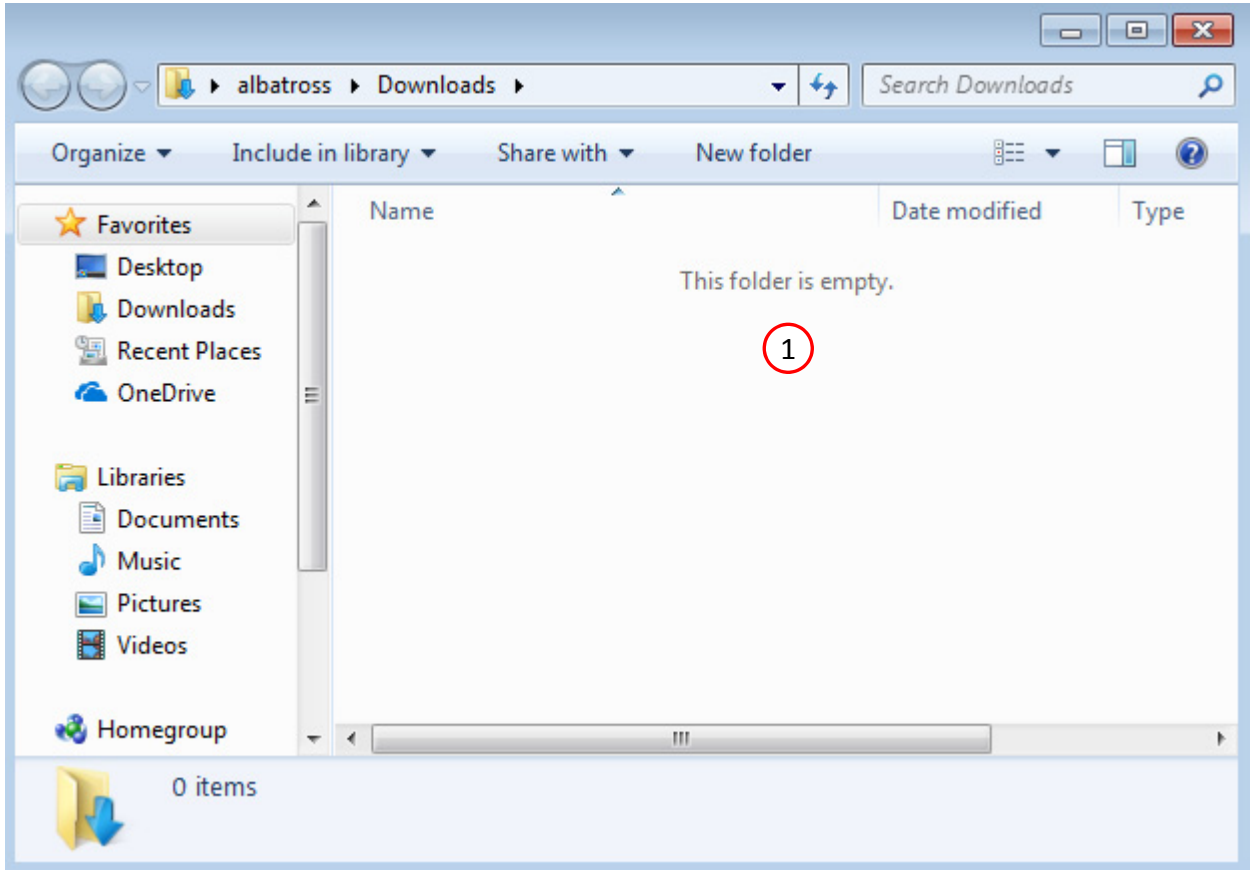


HDF5 Explorer Web App
Create graphs (XY plots) using data from the H5 file

Before Starting

1. 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.



Go to the User's Guide

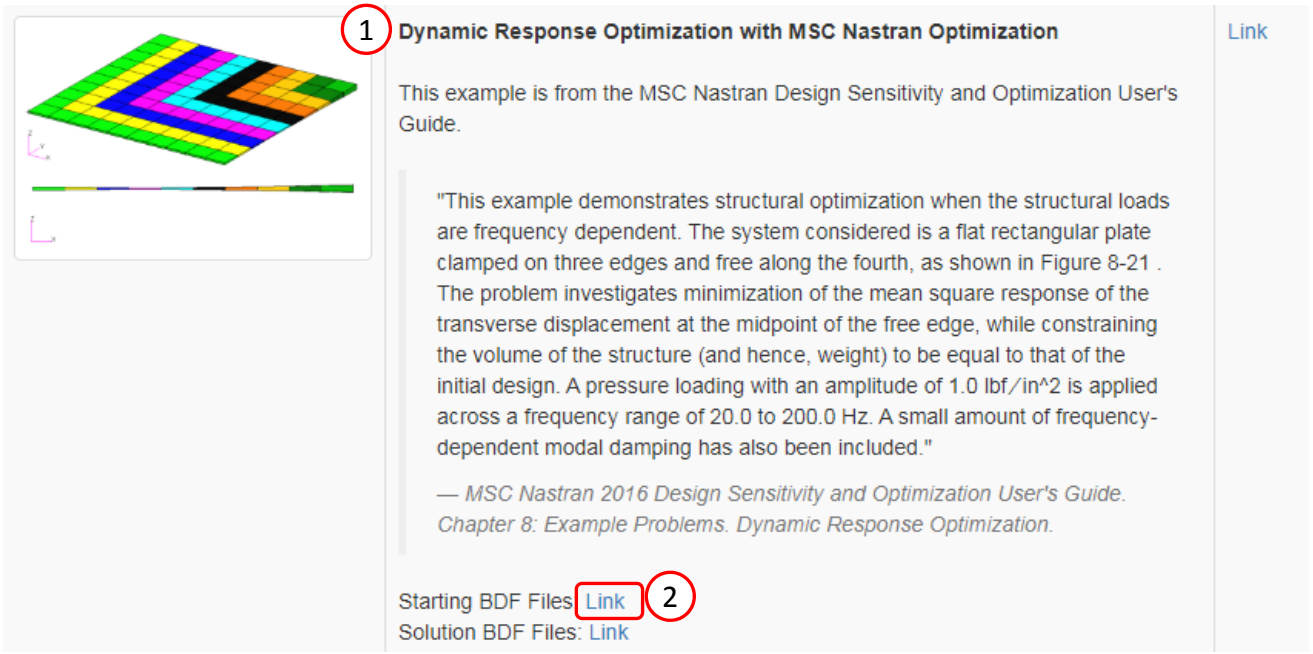
1. Click on the indicated link

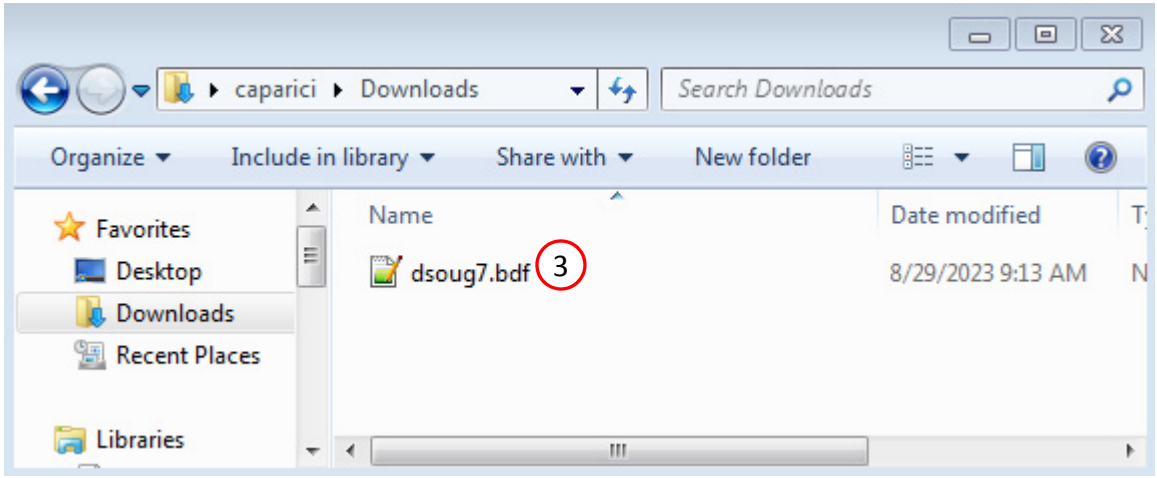
- The necessary BDF files for this tutorial are available in the Tutorials section of the User's Guide.

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.





Open the Dynamic Loads Web App

1. Click on the indicated link

Open the Dynamic Loads Web App

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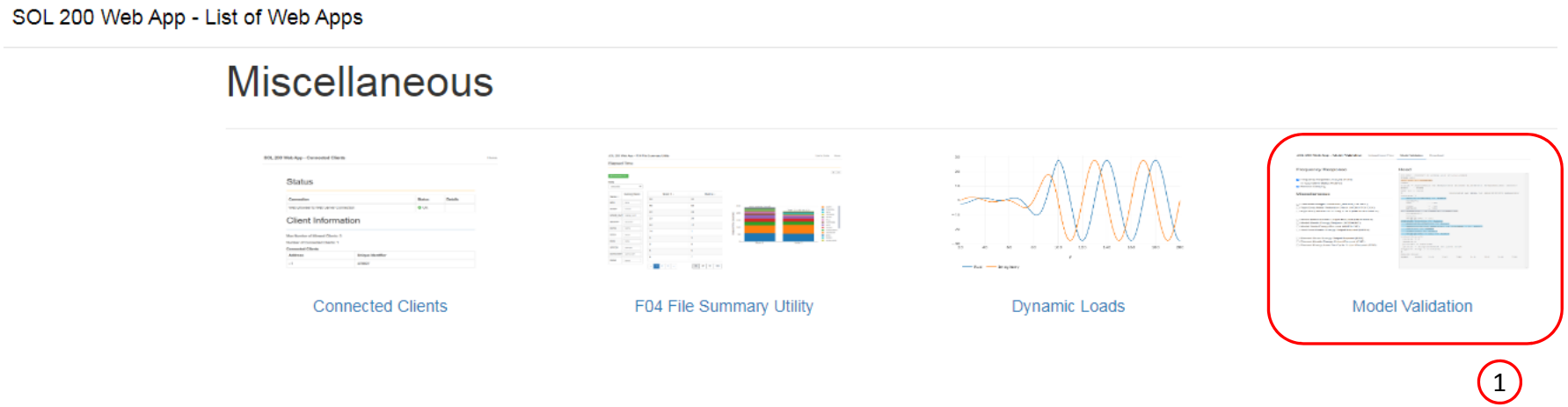
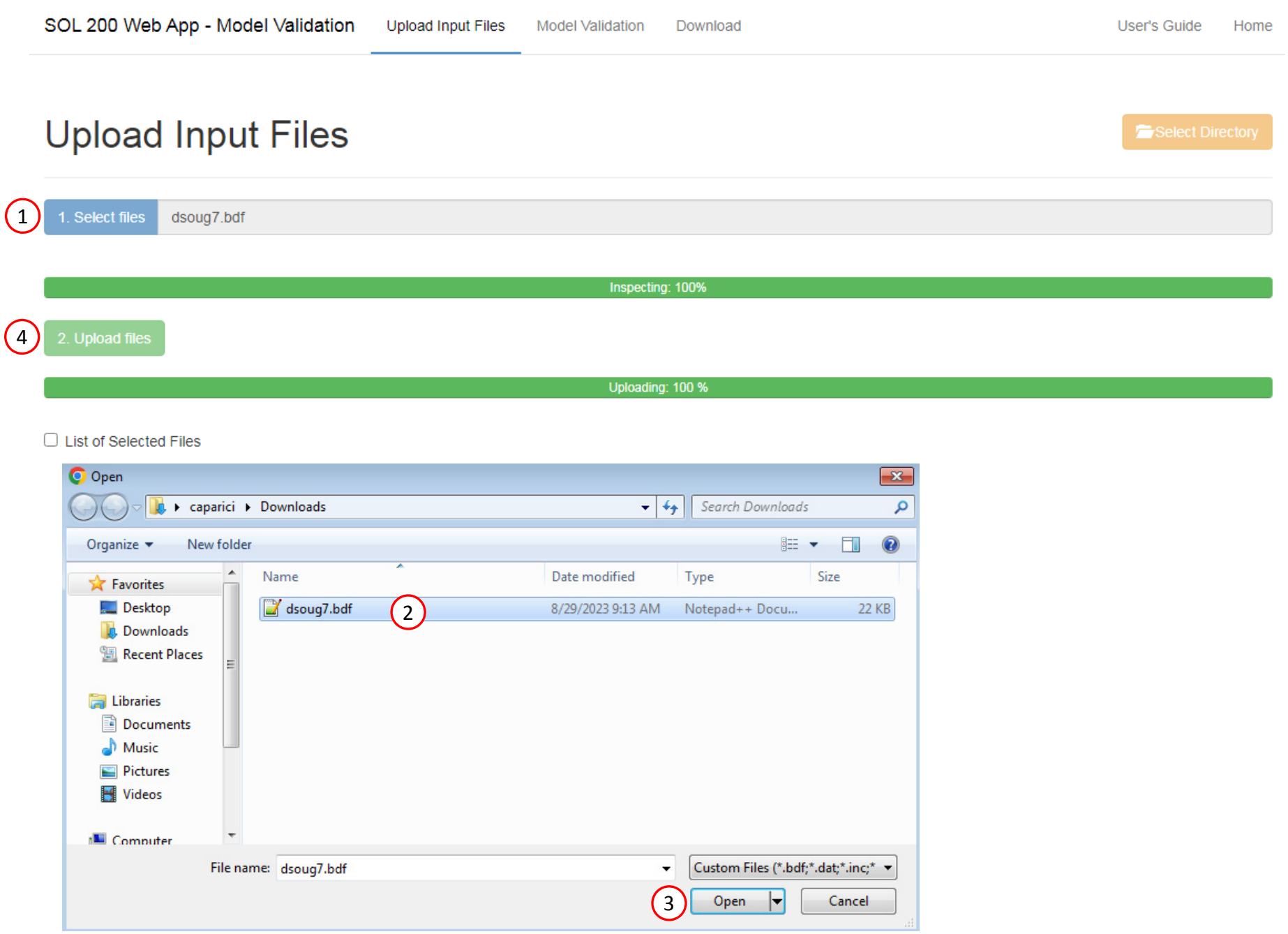


Upload BDF File

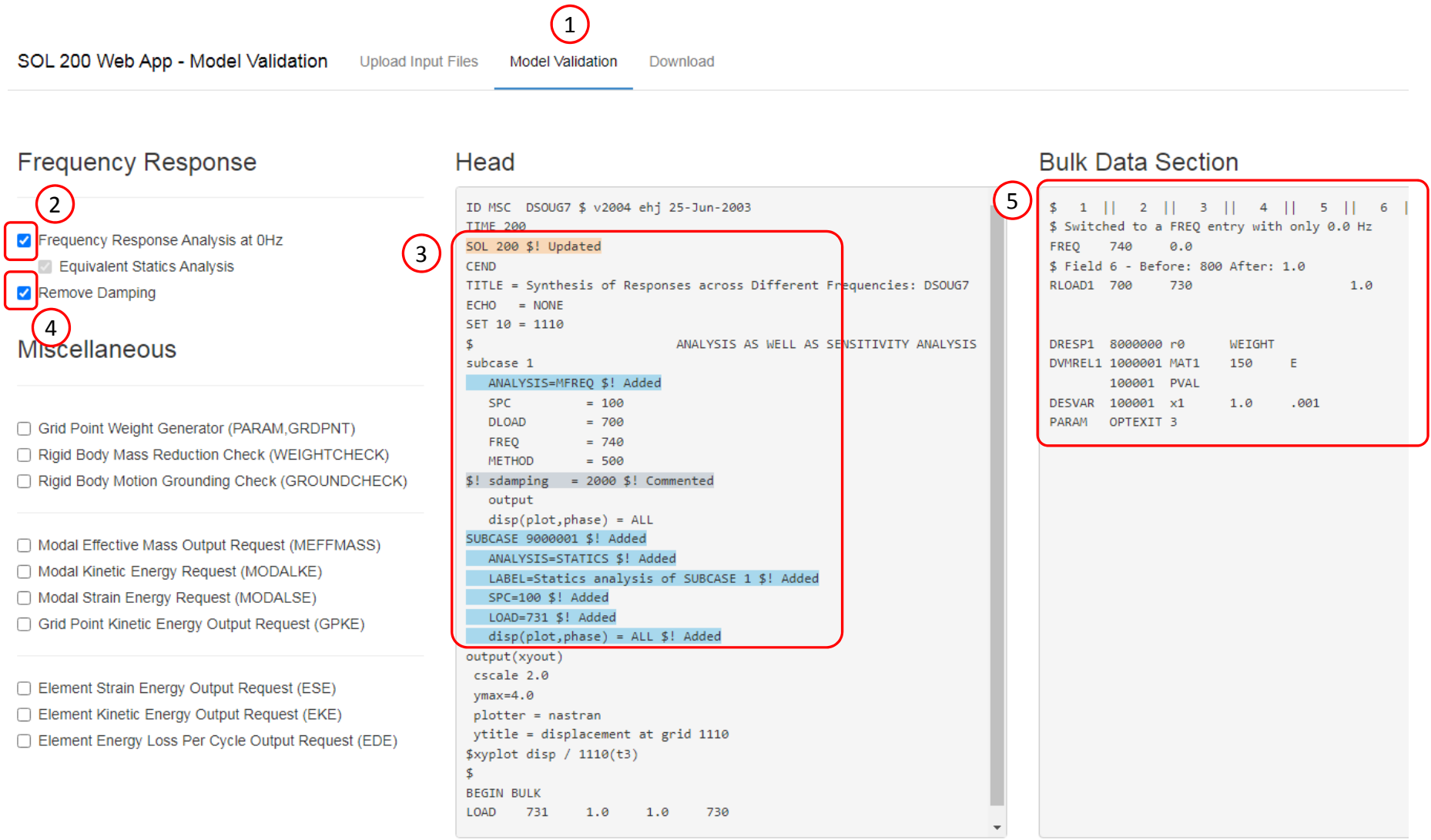
1. Click Select files
2. Select the indicated file
3. Click Open
4. Click Upload files



Model Validation

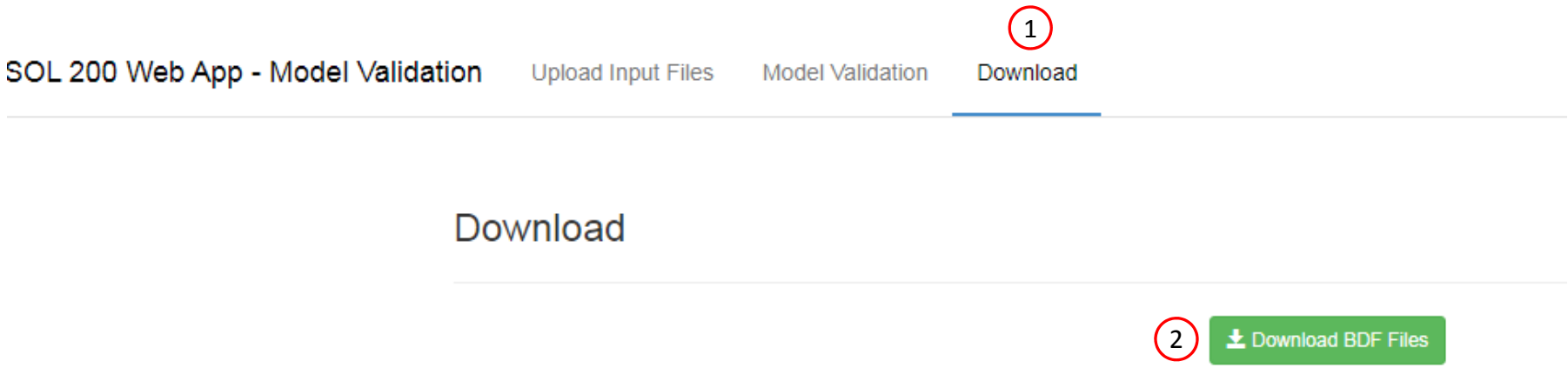
1. Click Model Validation
2. Mark the checkbox Frequency Response Analysis at 0Hz
3. Note the case control section of the BDF file has been updated to perform both a frequency response and statics analysis
4. Mark the checkbox Remove Damping.
   - Note that in the head, the case control command SDAMPING has been commented which effectively removes damping from the analysis.
5. The Bulk Data Section contains a summary of changes to the bulk data entries. For example, the FREQ entry has been configured for only one frequency at 0.0 Hz.

- Important! If the results of a 0 Hz frequency response and statics analysis will be compared, damping should be removed. Make sure the checkbox Remove Damping is marked.
- Different validations are available for statics and normal modes analysis. If a linear static analysis is performed, an option to configure 1G gravity test load cases is available.



Download

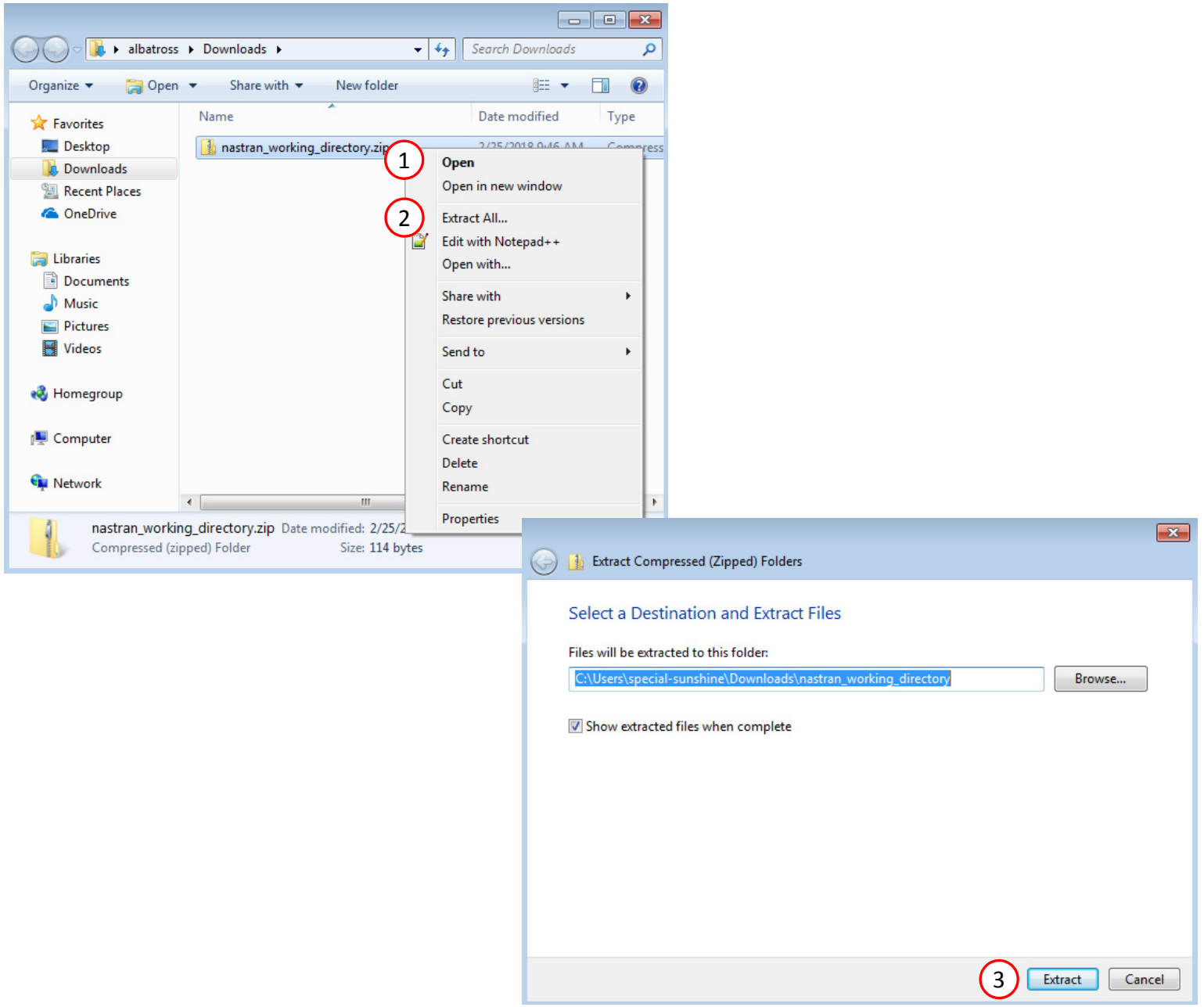
1. Click Download
2. Click Download BDF Files



Run MSC Nastran

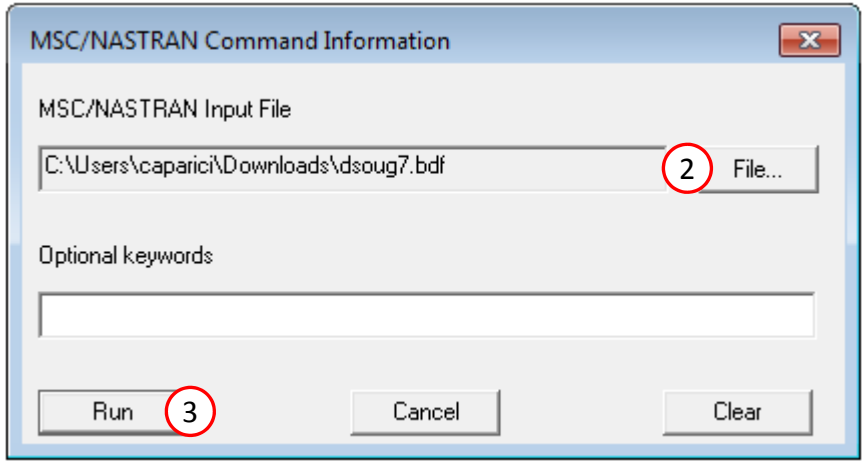
1. A new .zip file has been downloaded
2. Right click on the file and click Extract All
3. Click Extract on the following window

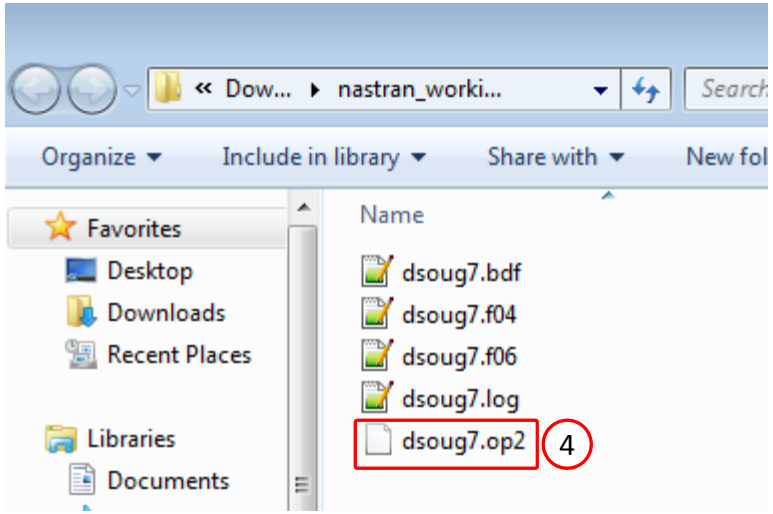
- Always extract the contents of the ZIP file to a new, empty folder.



Run MSC Nastran

1. Double click the desktop shortcut to open MSC Nastran
2. Click File and select file dsoug7.bdf
3. Click Run to start the analysis
4. After the analysis is complete, a file dsoug7.op2 has been generated and contains the results of the 0 Hz frequency response and statics analysis





Compare Displacements

Use your preferred post-processor to display the displacement for the 0 Hz frequency response and statics analysis.

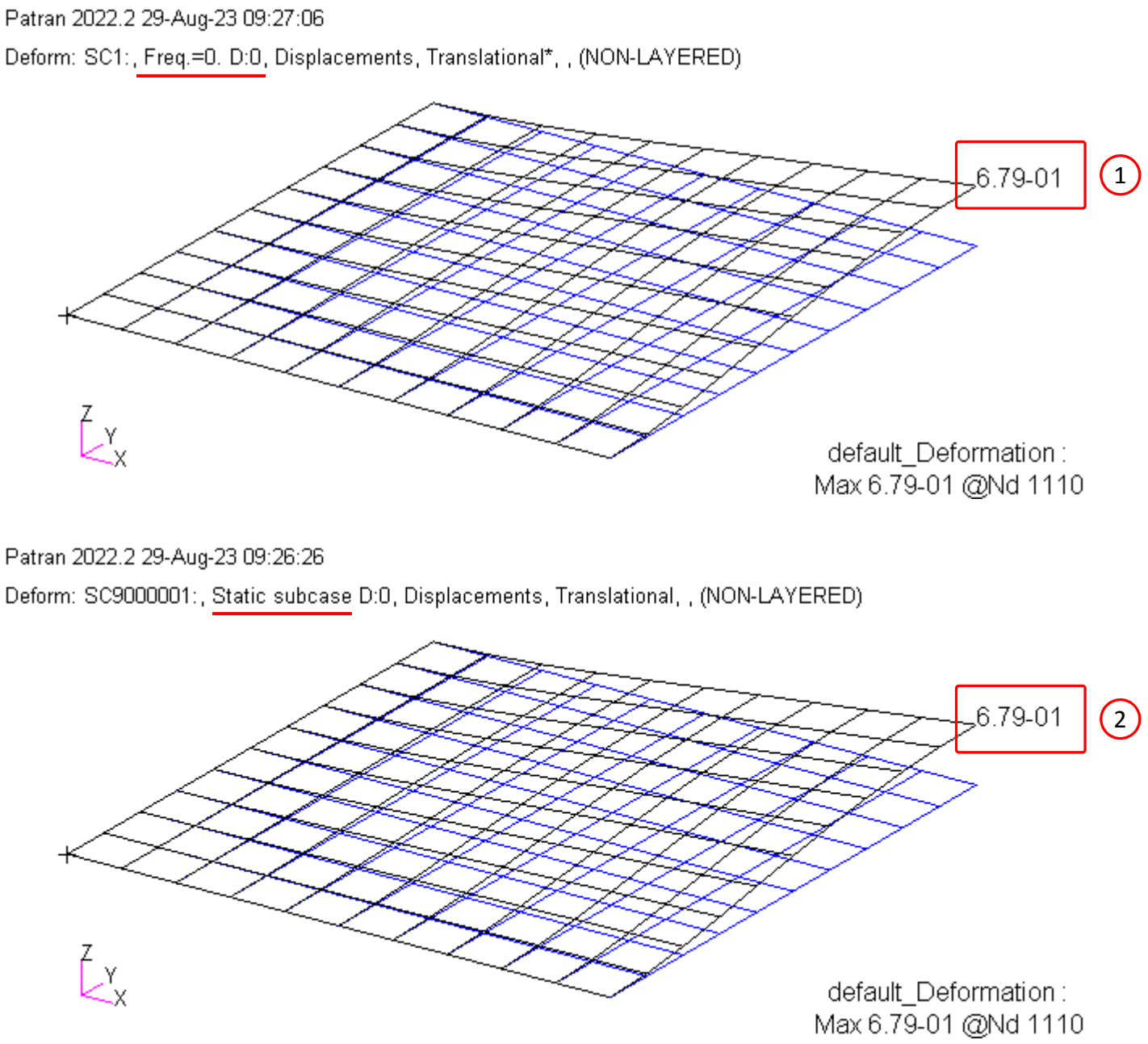
1. The 0 Hz frequency response analysis yielded a displacement of 6.79E-1 at GRID 1110.

2. The statics analysis yielded a displacement of 6.79E-1 at GRID 1110.

Per the MSC Nastran Dynamic Analysis User's Guide

"The results should be the same if direct frequency response (without structural damping) is used. If the results are not equal, then there is probably an error in the specification of the dynamic load, and you should check the LSEQ and DAREA entries. If modal frequency response (without structural damping) is used, then the 0.0 Hz results should be close to the static results; the difference is due to modal truncation."

For this exercise, the displacements are equal. Therefore, this step in the analysis strategy has been a success.



End of Tutorial