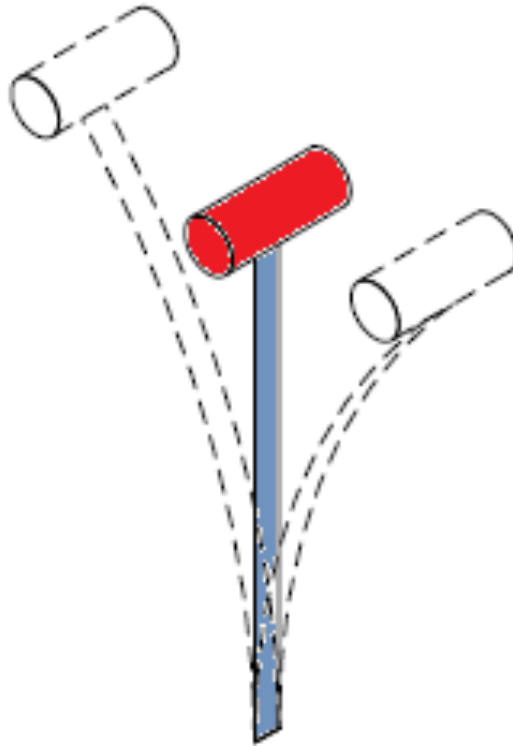


When is Gravity Loading Necessary for Resonant Vibration Problems?

Run Notes & Keystroke Summary: Vibrations with Gravity Effects

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1.0 Introduction

The input data files for the FEA model outlined in this document may be downloaded by contacting *Applied Analysis & Technology* at AppliedAT@aol.com.

The input data files and keystroke summaries are for use with **FeMap v11.1** and *Patran 2012r2* or later.

User notes for *Patran* are contained in *Appendix A*. *Patran* users may download “*Up_Direction_v2012.2.db*” and “*Up_Direction_wStiffening.bdf*”.

2.0 Getting Started

After first starting the program at the top menu bar: **File–Open** and locate the file “*Up_Direction_v11.1.modfem*” from your download directory. Listed below are keystroke operations to lead one through this sample problem. “*Up_Direction_v11.1.modfem*” contains complete pre-programmed data files and solutions from processing all cases; follow the notes closely. The keystroke summaries are condensed operations to speed one through this sample problem and are not intended to replace tutorial example problems that can be found at web sites for users of *FeMap*, *Nastran* and *Patran*.

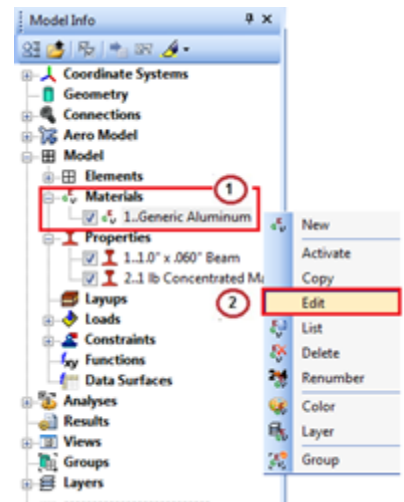
2.1 Reviewing Material and Section Properties

- To check units on material nonlinear stress-strain data, at the top menu bar check **Modify–Edit–Material** **OK**.

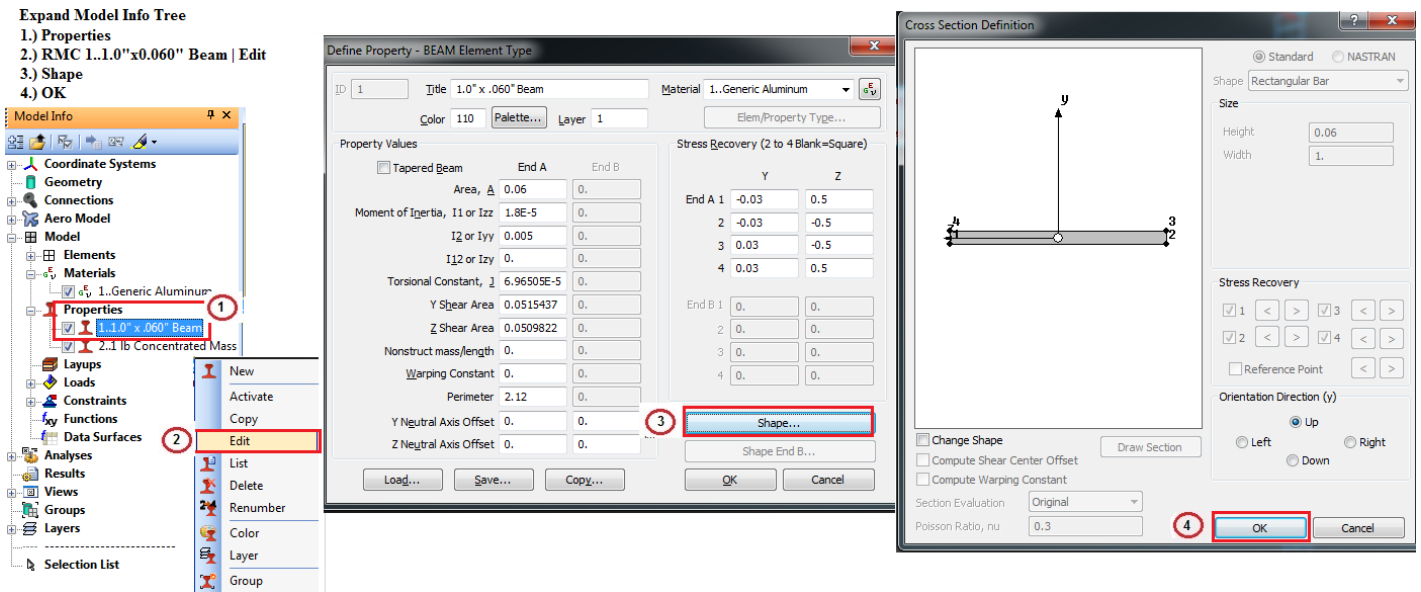
In the “**Youngs Modulus, E**”, box, note $E = 10.5 \times 10^6 \text{ lbs/in}^2$ for aluminum.

Or expand the **Model Info** as shown at right.

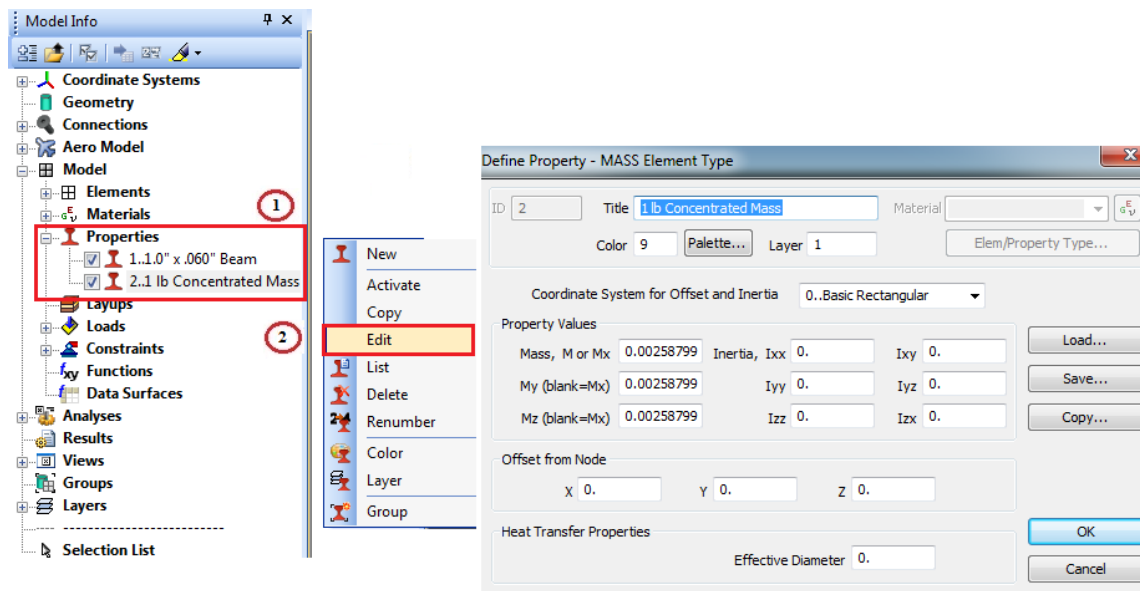
- Materials
 - ✓ Generic Aluminum | Edit



- To check the beam cross sectional properties, **Modify-Edit-Property** and select **ID =1**, or expand the **Model Info** and follow the steps shown below.



- To check the concentrated mass, **Modify-Edit-Property** and select **ID =2**, or expand the **Model Info** and follow the steps shown below.



3.0 Processing and Viewing Solutions

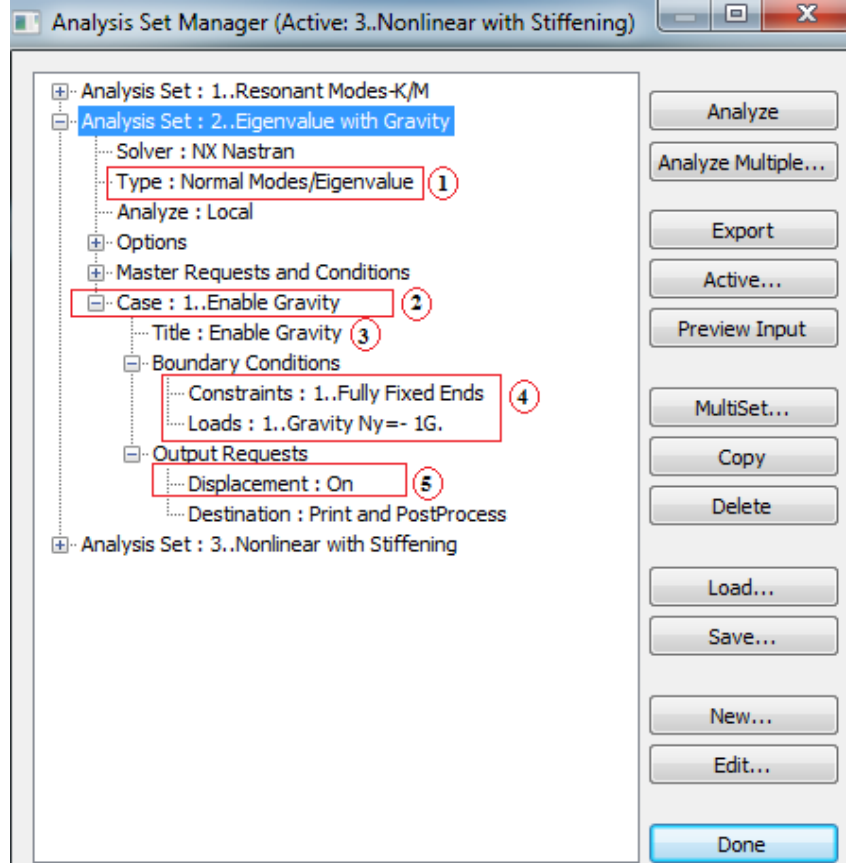
There are two approaches available for processing the solutions, (1.) Expanding the Normal Modes (Sol 103) and (2.) Nonlinear Static (SOL 106).

3.1 Approach 1: *Expanding Normal Modes (SOL 103)*

Check **Model-Analysis-Active** and select **2.. Eigenvalue with Gravity**, expand parameters by clicking on **+** and review the following key entries:

- Analysis Set: **2.. Eigenvalue with Gravity**
 - ✓ Type: **Normal Modes Eigenvalue**
- Case
 - ✓ Edit | Title : **Enable Gravity | Next**
 - Boundary Conditions
 - ✓ Constraints **1.. Fully Fixed Ends**
 - ✓ Loads **1.. Gravity Ny=-1G | Next**
 - Output Requests
 - ✓ Displacements

Refer to the **Analysis Set Manager** shown at right.



After verifying the entries in the dialog box show, Select **Done**. Next Select **File - Analyze**. Processing should begin to run and automatically.

3.2 Approach 2: *Nonlinear Statics (SOL 106)*

Check **Model-Analysis-Active** and select **3.. Nonlinear with Stiffening**, expand parameters by clicking on **+** and review the following key entries:

Analysis Set: **3.. Nonlinear with Stiffening**

✓ Type: **Nonlinear Static**

Options | Stiffened Model

✓ **Enable Stress Stiffening** | *Number*

Desired = 1 | Next

Nonlinear Options

✓ **Time Steps: 5**

✓ **Max Iterations per Step: 25**

✓ **Load Convergence: .001**

✓ **Work Convergence: 1E-7**

Boundary Conditions

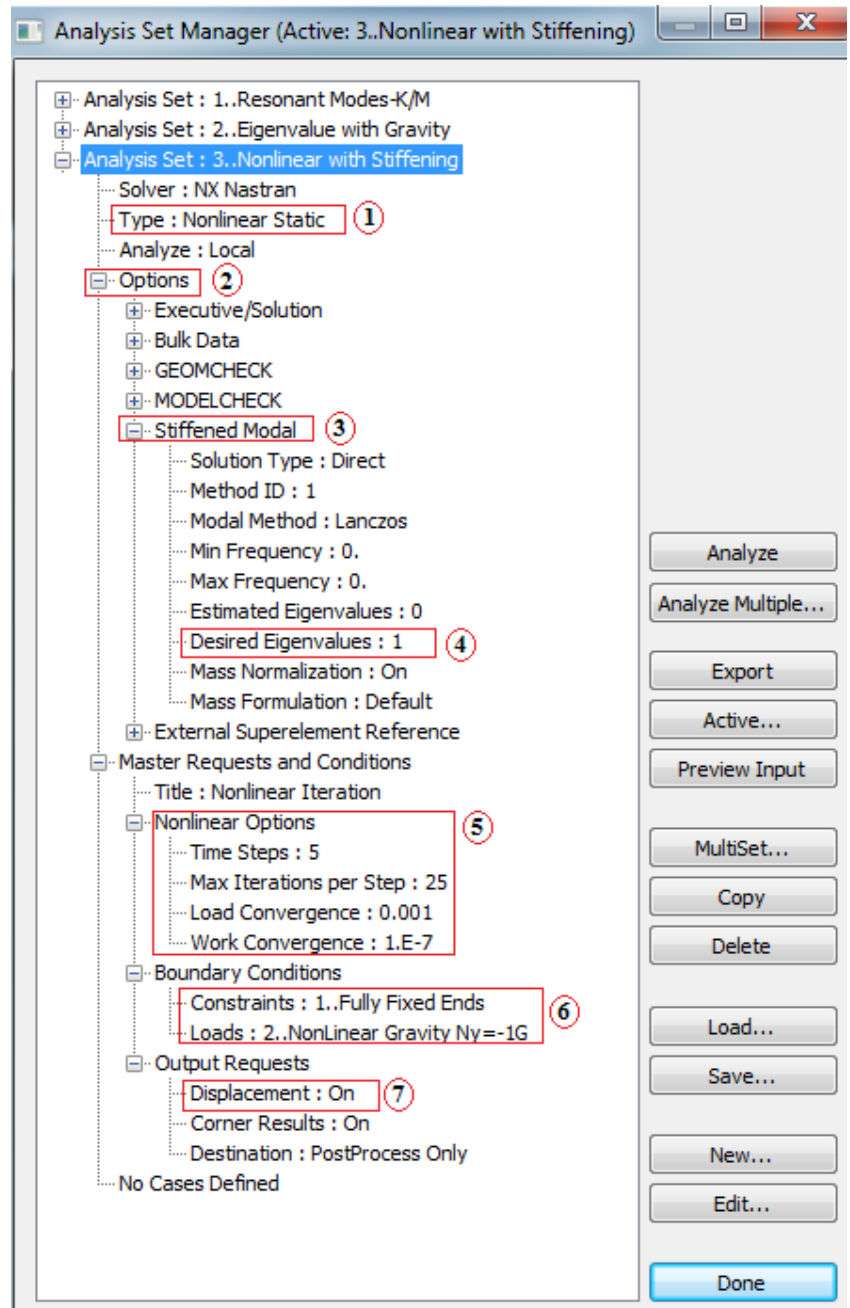
✓ **Constraints 1.. Fully Fixed Base**

✓ **Load 2.. Nonlinear Gravity**

Boundary Conditions

✓ Displacements

Refer to the **Analysis Set Manager** shown.

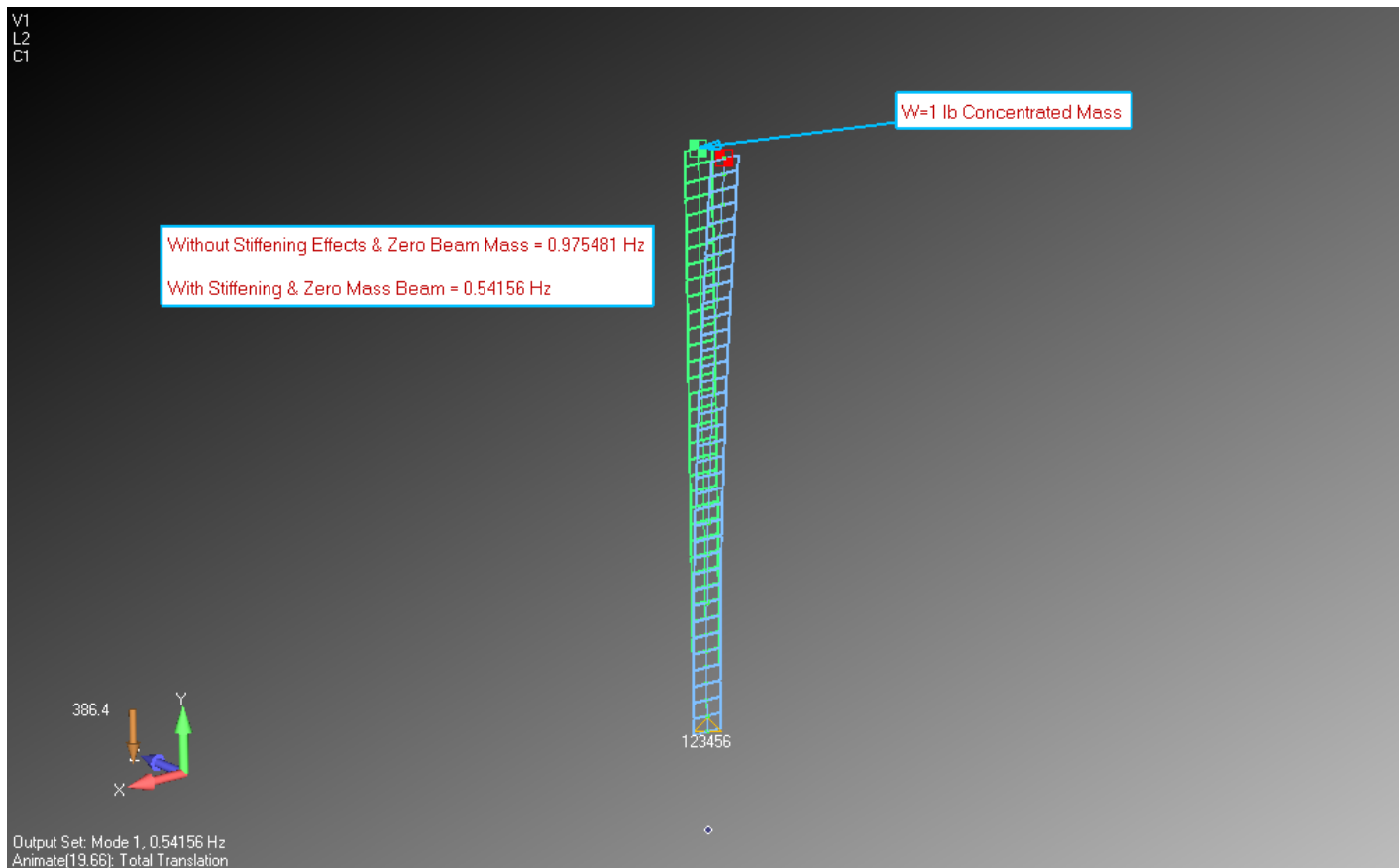


4.0 Post Processing Resonant Vibrations Analysis Solution

To View the static solution results press Function Key “F5” – View Select Options. The *View Select Options* have been preprogrammed. Select • **Animate** for Deformed Style. Click on **Deformed and Contour Data** Box.

The *Select Post Processing Data* options have been pre-selected. One can review the available stored solution data or use the results you have just processed.

- Select “**Output Set**” 1.. **Mode 1, 0.54156 Hz**
- In the “**Output Vectors**” Deform dialog box note 1...**Total Translation**.
- Press **OK** and **OK** again. The model idealization should display a stress contour plot similar to the one below for the resonant frequency analysis.



For any questions you may have regarding this FAX/memorandum, please call at (714) 846-4235, E-Mail at AppliedAT@aol.com.

Regards,

David R. Dearth, P.E.

Appendix A

Run Notes for use with Patran

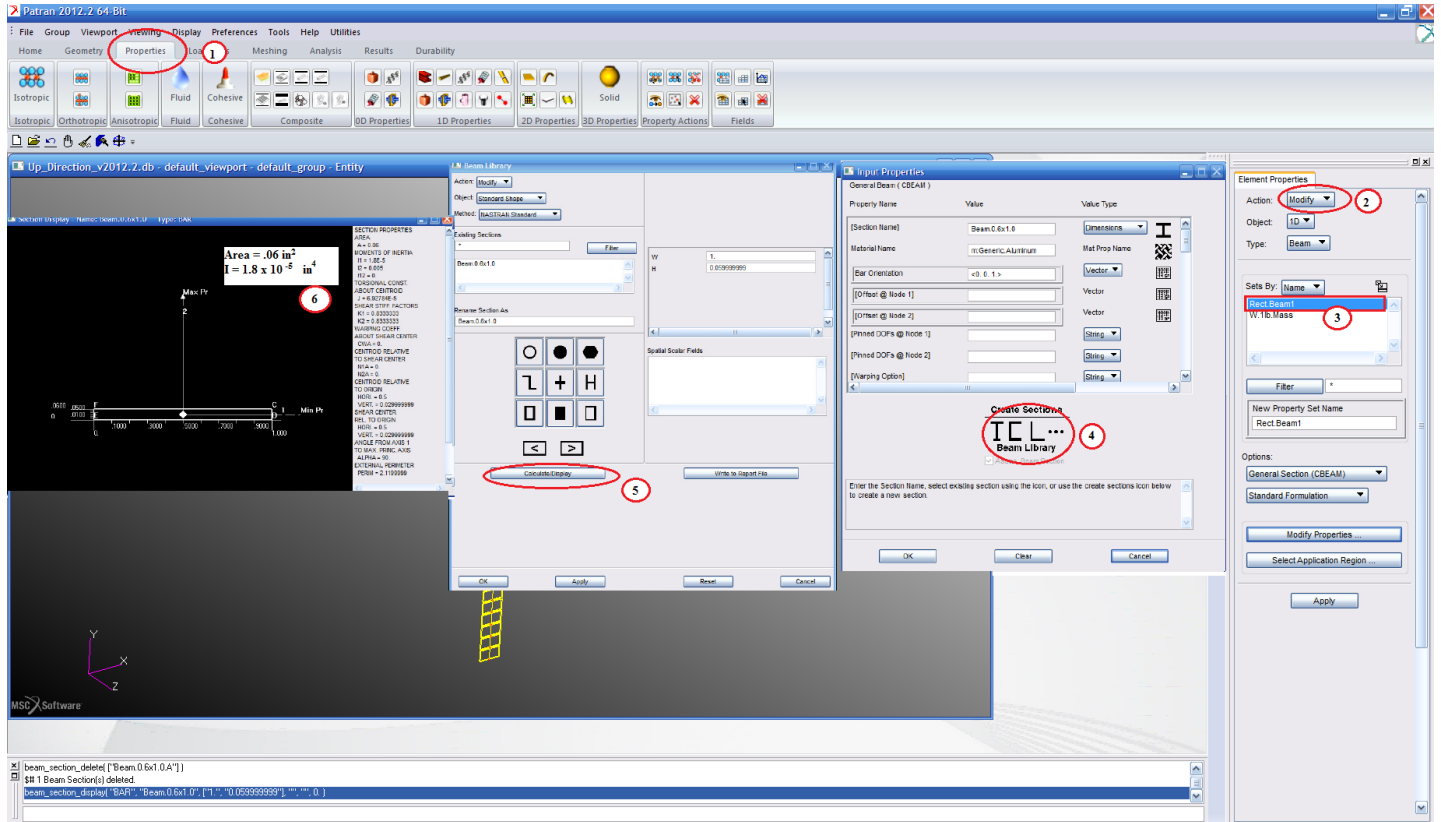
These run notes are highly condensed for use by experienced Patran users.

Patran users might find the following reference commands helpful.

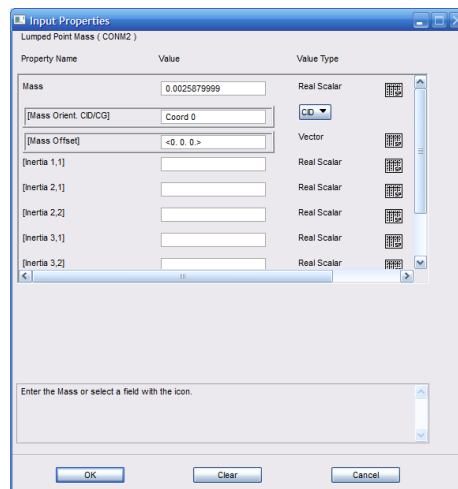
The following files is needed to review results: *Up_Direction_v2012.2.db*”.

Review Beam Properties Input

To inquire on the beam properties select **Properties – Modify – Rect.Beam1 – Click on “Beam Library” – Calculate Display** to see section properties arithmetic. See screen print below.



To inquire on the concentrated mass select **Properties – Modify – W.1lb.mass** to see mass properties. Mass = $1/386.4 = 0.0025880 \text{ lb-sec}^2/\text{in}$ See screen print below.



Review Analysis Run Options

To inquire on the analysis run options select:

Analysis – Analysis Deck – “Up_Direction_wStiffening” – Solution Type. Note the following:

- ✓ Nonlinear Static
- ✓ Solution Sequence 106

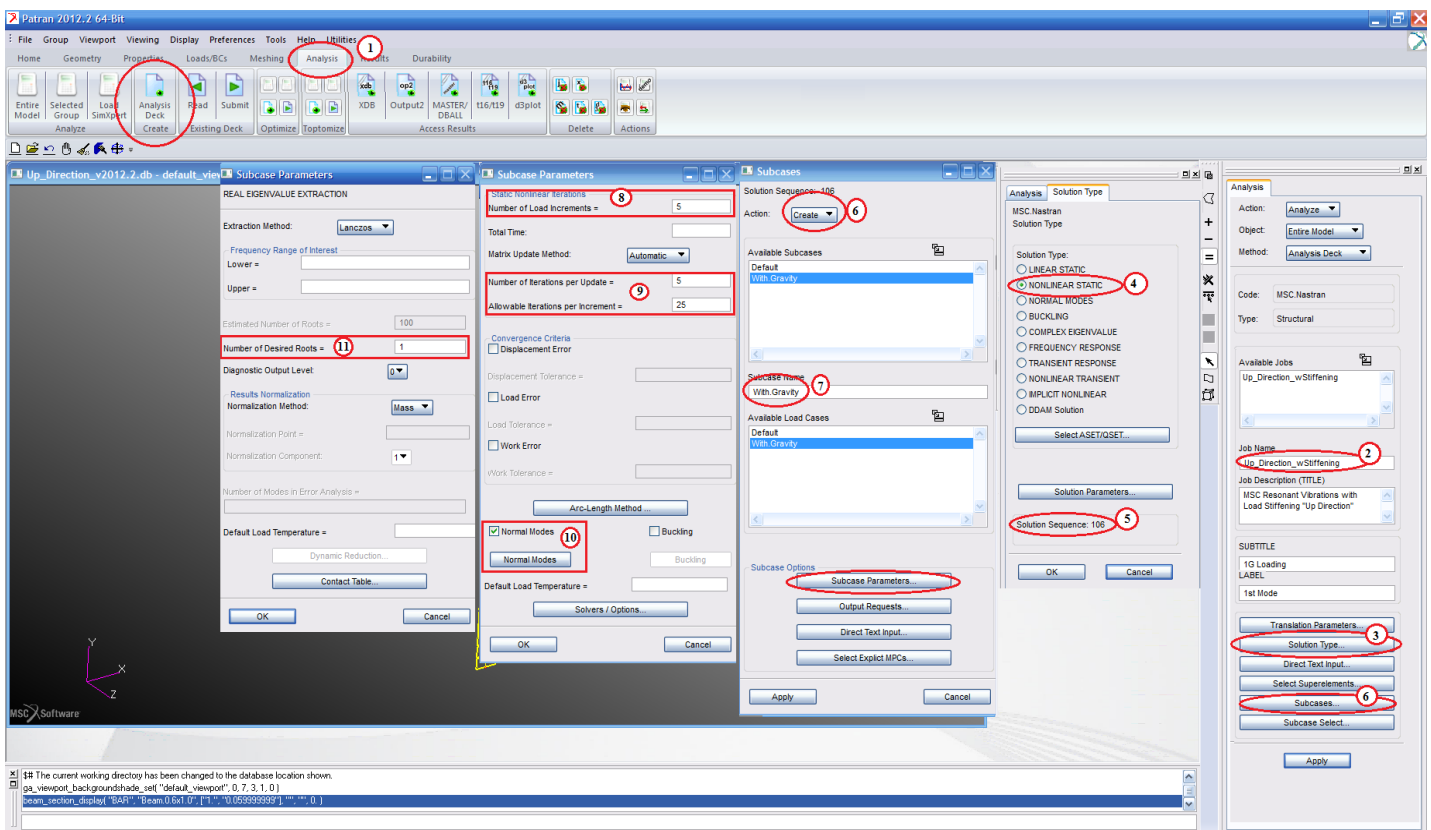
Subcases – Create – Select “With Gravity” – Subcase Parameters Note the following:

- ✓ Number of Load Increments = 5
- ✓ Number of Iterations per Update = 5
- ✓ Allowable Iterations per Increment = 25

Normal Modes Note the following:

- ✓ Number of Desired Roots= 1

See screen print below.



Review Results

To inquire on the analysis results:

Results – **Create** – **Deformation** – Select Results Case “With Gravity, A1:Mode 1: Freq. 0.54156; ...” – Select Deformation Result “Eigenvectors, Translational” – Animate - **Apply**.

See screen print below.

