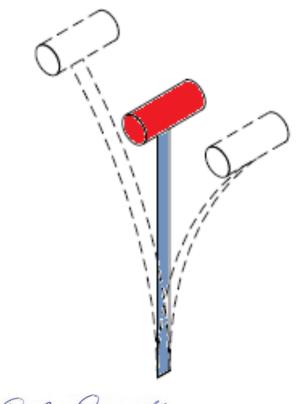
# When is Gravity Loading Necessary for Resonant Vibration Problems?

Run Notes & Keystroke Summary: Vibrations with Gravity Effects

30 June 2014



Prepared By:

David R. Dearth, P.E.

# Applied Analysis & Technology, Inc

16731 Sea Witch Lane Huntington Beach, CA 92649-3054 Telephone (714) 846-4235 E-Mail <u>AppliedAT@aol.com</u> Web Site <u>www.AppliedAnalysisAndTech.com</u>

### 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*.

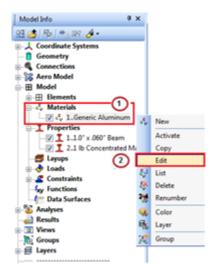
### 2.1 Reviewing Material and Section Properties

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

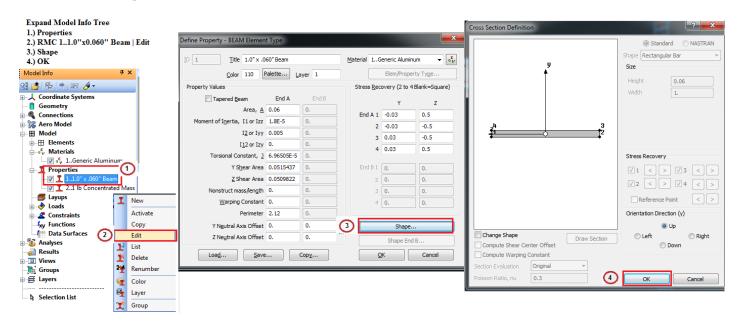
In the "Youngs Modulus, E", box, note  $E = 10.5 \times 10^6 lbs/in^2$  for aluminum. Or expand the Model Info as shown at right.

- 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.

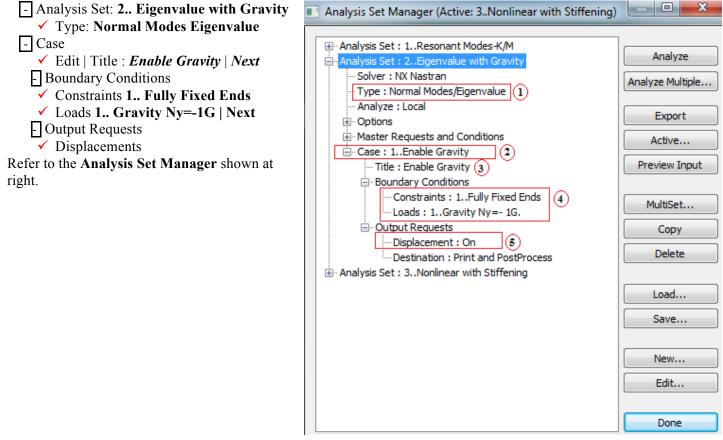
Model Info	Ψ×		
H 🖆 🖓 🐂 🖙 🥖 •			
🧧 Geometry			
Connections			
🖓 🙀 Aero Model			Define Property - MASS Element Type
Model			Define Property - MASS Element Type
⊞ Elements			ID 2 Title 1 lb Concentrated Mass Material
+ Gy Waterials			
Properties		T New	Color 9 Palette Layer 1 Elem/Property Type
2.1 lb Concentrated			
	IVIdSS	Activate	Coordinate System for Offset and Inertia 0Basic Rectangular
Loads		Сору	Property Values
Constraints	$\odot$	Edit	Mass, M or Mx 0.00258799 Inertia, Ixx 0. Ixy 0. Load
w Functions		🗜 List	
1 Data Surfaces		🏌 Delete	My (blank=Mx) 0.00258799 Iyy 0. Iyz 0. Save
The second secon	2	Renumber	Mz (blank=Mx) 0.00258799 Izz 0. Izx 0. Copy
📲 Results		Color	-
Views		Color	Offset from Node
🛅 Groups	ž	Layer	χ 0. γ 0. Ζ 0.
- 🚝 Layers	3	🛫 Group	
			Heat Transfer Properties OK
Selection List			Effective Diameter 0. Cancel
			Cancel

### 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 <u>Approach 1</u>: *Expanding Normal Modes (SOL 103)*

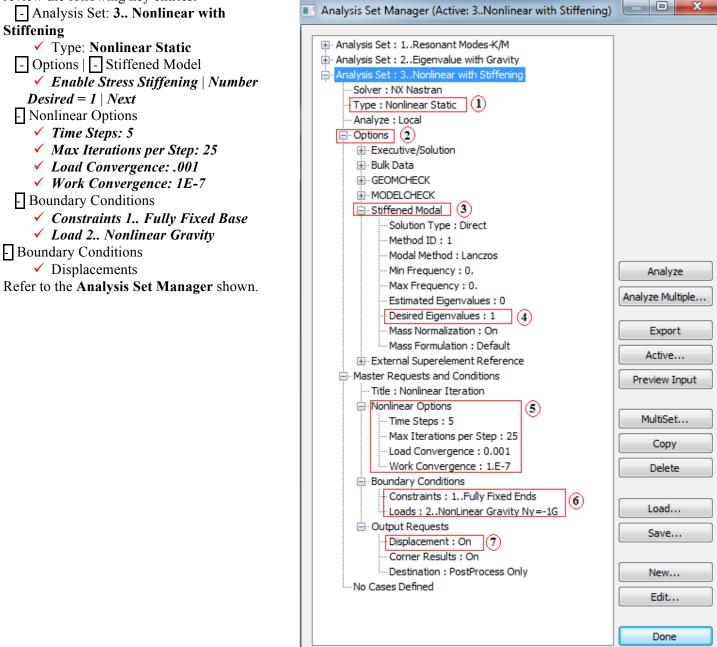
Check **Model-Analysis-**Active and select 2.. Eigenvalue with Gravity, expand parameters by clicking on + and review the following key entries:



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:

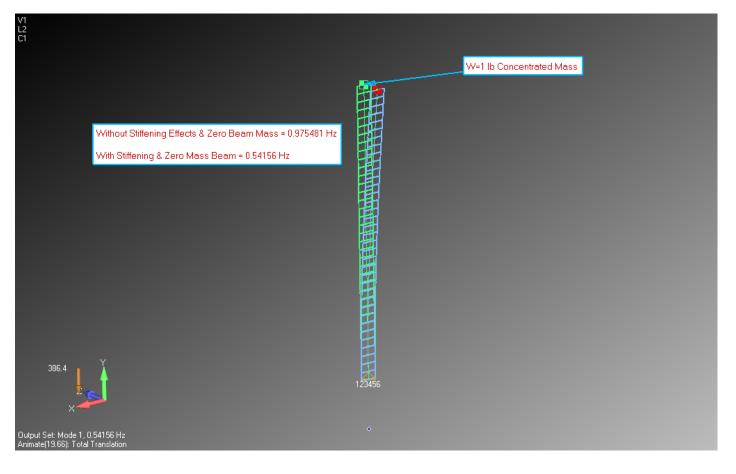


### 4.0 Post Processing Resonant Vibrations Analysis Solution

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 <u>"Output Vectors</u>" 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,

Marta

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.

2 Patran 2012,2 64-Bit	
File Group Viewport noting Deplay Preferences Tools Help Utilities	
Home     Geometry     Properties     Lot     Mething     Analysis     Results     Durability       2000 <th></th>	
I Up Direction v20172.db = default viewport = default view	Control Control Properties  Control C

To inquire on the concentrated mass select **Properties – Modify – W.1lb.mass** to see mass properties. Mass = 1/386.4 = 0.0025880 lb-sec<sup>2</sup>/in See screen print below.

0.0025879999	Real Scalar	III
Coord 0		
<0.0.0.>	Vector	
	Real Scalar	
ield with the icon.		
	Coord 0	Coord 0 Vector Coord 0 Vector Coord 0 Real Scalar Real Scalar Real Scalar Real Scalar Real Scalar Real Scalar

#### **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
- $\checkmark$  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.

Ratran 2012.2 64-Bit		_ B 🛛						
File Group Viewport Viewing Display Preferences Tools Help Utilities		>						
Hone Geometry Program. Loads/BCS Mething Analysis ofts Durability Entries Selected Load, Analysis Bad Subant & Directory 2000 Model Group Sim/Cyrt Deals Analysis Create Existing Deck Optimize (Exploringe	16/119 d3pict Delete Actions							
0 ≪ ♠ ⊕								
Up_Direction_v2012.2.db - default_viev Subcase Parameters	Subcase Parameters							
REAL EIGENVALUE EXTRACTION	Static Noninear iterations Number of Load Increments =	Analysis Solution Type						
Extraction Method:	Total Time:	Solution Type + Object: Entire Model						
Erequency Range of Interest	Matrix Update Method: Automatic Available Subcases	Solution Type: Method: Analysis Deck						
Upper =	Number of iterations per Update = 5	NONLINEAR STATIC     ONONLINEAR STATIC     ONONLINEAR STATIC     ONONLINEAR STATIC     ONONLINEAR STATIC     ONONLINEAR STATIC     ONONLINEAR STATIC						
Estimated Number of Roots = 100	Allowable iterations per increment = 25	O BUCKLING Type: Structural						
Number of Desired Roots = 11 1	Convergence Criteria	O FREQUENCY RESPONSE						
Diagnostic Output Level:	Displacement Tolerance =	TRANSENT RESPONSE     NONLINEAR TRANSENT     DY						
Results Normalization Normalization Mass	Load Error With Gravity	O INPLICIT NONLINEAR						
Normalization Point =	Load Tolerance - Available Load Cases	Select ASET/QSET						
Normalization Component:	Work Error With Gravity	Job Name 2						
Number of Modes in Error Analysis +	Work Tolerance =	Job Description (TITLE) MSC Resonant Vibrations with						
	Arc-Length Method	Solution Sequence: 106 5						
Default Load Temperature = Dynamic Reduction	Normal Modes	SUBTILE						
Contact Table	Normal Modes Buckling Subcase Options	OK Cancel LABEL						
	Default Load Temperature = Subcase Parameters Solvers / Options Output Requests	1st Mode						
OK Cancel	Direct Text Input	Translation Parameters						
	OK Cancel Select Explict MPCs	Solution Type Direct Text Input						
	Apply Cancel	Select Superelements.						
MSCXSoftware	Appy	Subcase Select						
보 \$# The current working directory has been changed to the database location shown.		Apply						
ga_viewport_backgroundhade_set("default_viewport", 0, 7, 3, 1, 0)           bcam_tection_display("BAPN", Beam.06x1.0", [1 ", "0.053933333 ] "", "", 0.)								

### **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.

