# *GENESIS* Structural Optimization for ANSYS® Mechanical

An Integrated Extension that adds Structural Optimization to ANSYS® Environment

## New Features and Enhancements

***Release 2018.05***

***GENESIS* VERSION 17.0**

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# 1 Introduction

*GENESIS* Structural Optimization for ANSYS® Mechanical (GSAM) is an integrated extension that adds structural optimization to the ANSYS environment. The extension provides an easy-to-use interface which allows the user to setup Structural optimization problems, post-process them and export the optimization results within the ANSYS environment.

GSAM is a super set of GTAM (*GENESIS* Topology Optimization for ANSYS® Mechanical). GSAM can perform any function that GTAM does. The extra functionality is to perform topography, freeform, sizing and topometry design.

This document covers the new features and enhancements added to GSAM/GTAM version 17.0, which matches the version of *GENESIS* engine.

# 2 Executive Summary

The key new features and enhancements include the following:

**New Global von Mises Stress Response:** A new response type, von Mises Index (VMINDEX), is now available. VMINDEX can be used to economically and efficiently impose von Mises stress constraints in topology and other types of optimization.

**New RMS/PSD Stress Responses for Random Vibration:** PSD stress (PSDSTR) and RMS stress (RMSSTR) are available to be used as objective or constraints. For RMS stress, in addition to the stress tensor components, the von Mises stress value is also available. These new responses are compatible with all types of optimization (shape, sizing, topology, etc.).

**Progressive Topology Optimization:** A new method to progressively change the power rule that connects topology design variables to element stuffiness has been added. Corresponding parameters for this method can be set from Analysis Settings

**New Alternative Method for Topology Optimization:** A new method for associating topology design variables to elements, named the Hybrid method, can result in more sharp and more polarized topology answers. This new method can be activated using the new DOPT parameter POLEM.

**Tolerance for Badly Shaped Solid Elements:** Second order elements that are flat or near flat are allowed in the model. When finding such elements, the software will ignore them.

**Support Post-processing for Binary OUTPUT2 Format:** Now the default format for output files is set as binary OUTPUT2. This will help reduce the output file size and improve the speed for post-processing.

**Support Post-processing for More Result Types:** Now the user can post-process reaction force contour plot, dynamic displacement/velocity/acceleration/stress contour plot, RMS displacement/velocity/acceleration/stress contour plot, and frequency response chart plot for dynamic responses.

**Support Importing Results for All Design Cycles:** By default, the optimization results at all design cycles will be imported when post-processing.

# 3 Structural Optimization Enhancement

1. New Progressive Rule for Topology Optimization: A new method to progressively change the topology design variables has been added. This method allows to have more polarized topology answers.

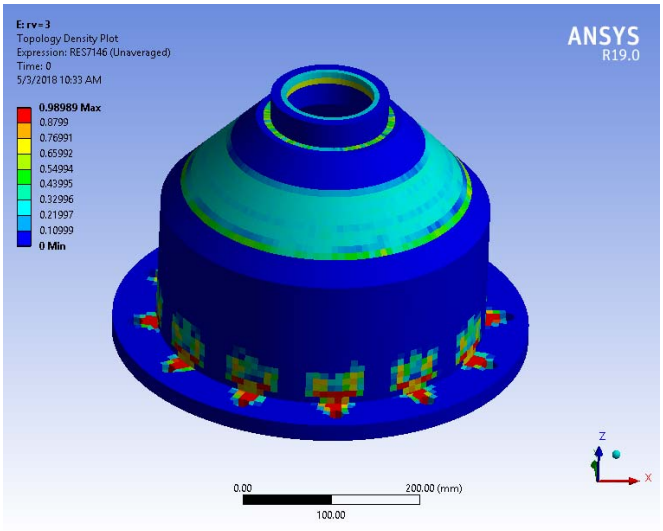



**Figure 3-1.Standard power rule, rv1=3**

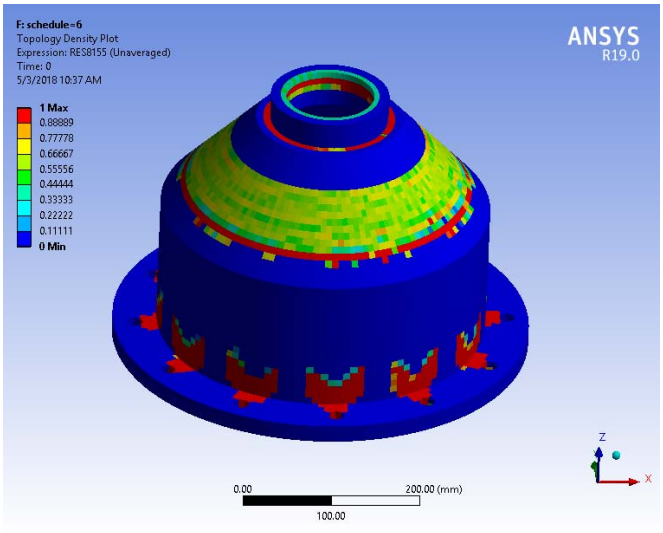



**Figure 3-2.Progressive power rule, schedule = 6**

2. New Hybrid Method for Topology Optimization: A new method named Hybrid method allows the user to get more sharp and more polarized answers. Use DOPT Parameters - POLEM to activate this method.

3. New Global von Mises Stress Response: The new VMINDEX response allows the user to economically and efficiently impose von mises stress constraints in topology and other types of optimization.

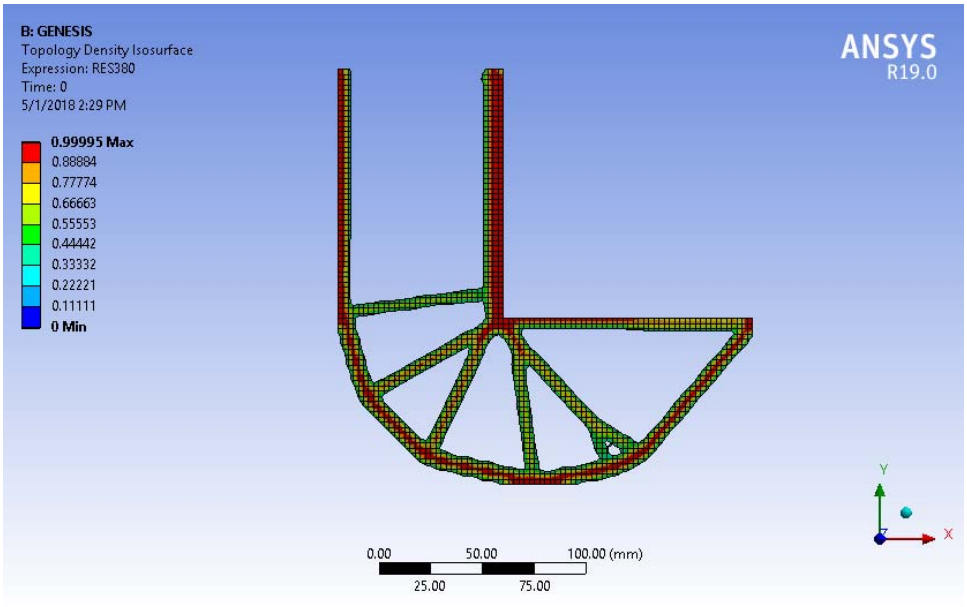



**Figure 3-3.Topology Optimization with von Mises Index constraint**

4. Random Stress Responses are now available for optimization: The Power Spectral Density (PSD) stresses and the Root Mean Square (RMS) stress responses are now available for all shell and solid elements. The type of stresses are all stress tensor components (Normal-x, Normal-y, Shear xy, etc). For RMS stress, the user can also design for von Mises stress.

# 4 Finite Element Enhancement

1. Tolerance for Badly Shaped Solid Elements: Second order elements that are flat or near flat are allowed in the model. When finding such elements, the software will ignore them.

# 5 Post-processing Enhancement

1. Support Post-processing for Binary OUTPUT2 Format: Now the default format for output files is set as binary OUTPUT2. This will help reduce the output file size and improve the speed for post-processing.

2. Support Post-processing for More Result Types: Now the user can post-process the following results in GSAM/GTAM:
   - Reaction force contour plot
   - Dynamic displacement/velocity/acceleration/stress contour plot
   - RMS displacement/velocity/acceleration/stress contour plot
   - Frequency response chart plot for dynamic displacement, velocity, acceleration, stress and ERP

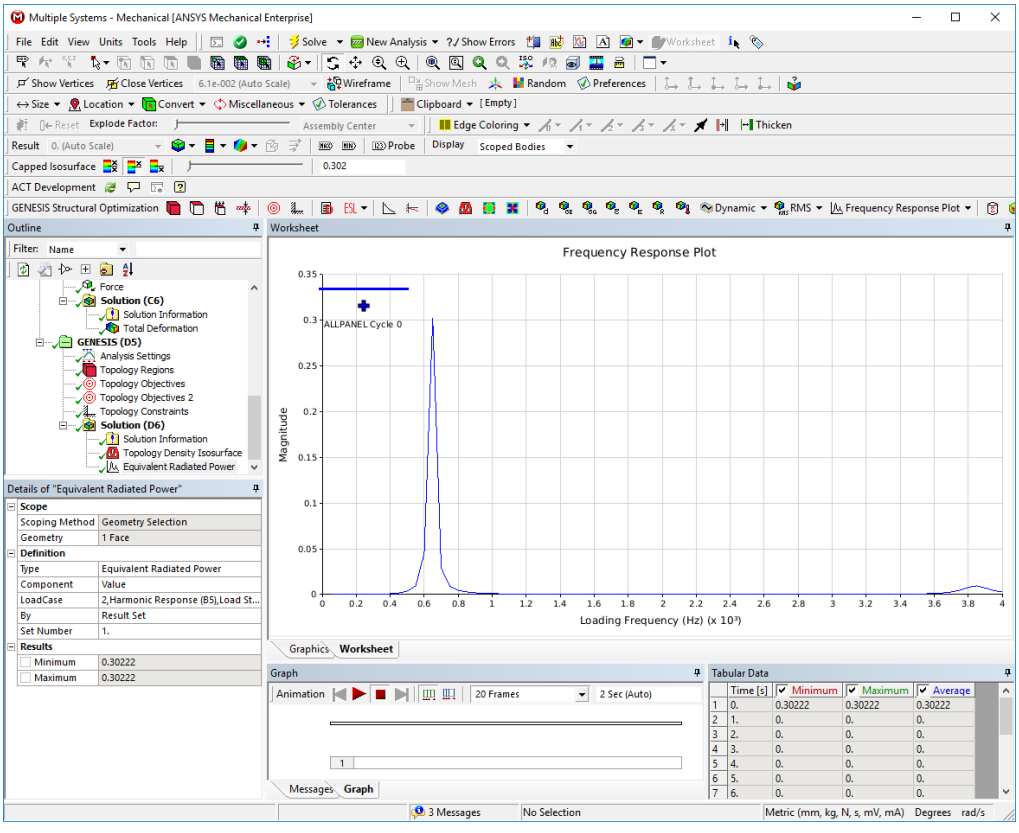



**Figure 5-4.ERP Plot**

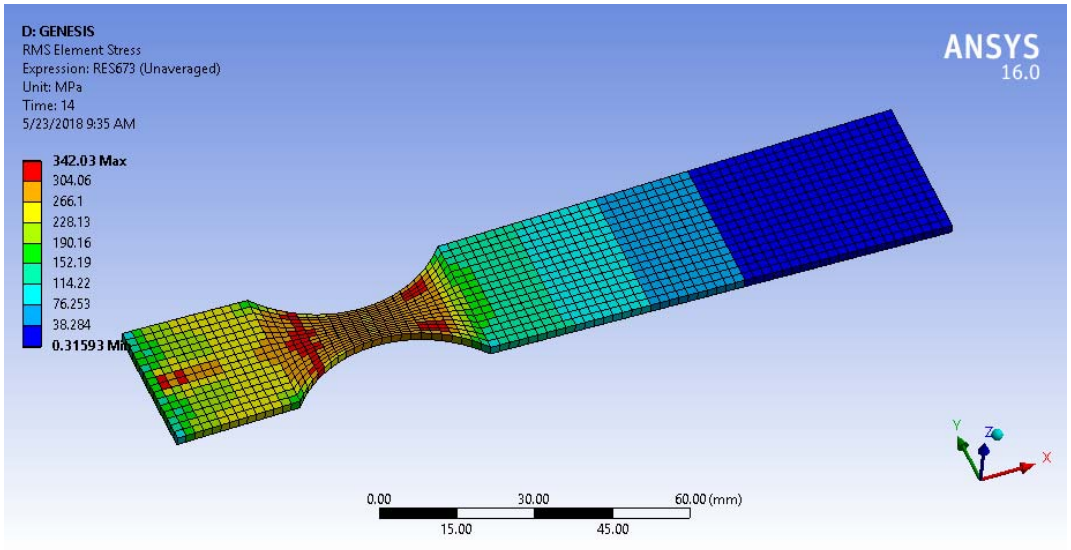



**Figure 5-5.RMS von mises stress plot**

3. Support Importing Results for All Design Cycles: By default, the optimization results at all design cycles will be imported when post-processing. The user can view an animation or view the results at each design cycle by going through all result sets.

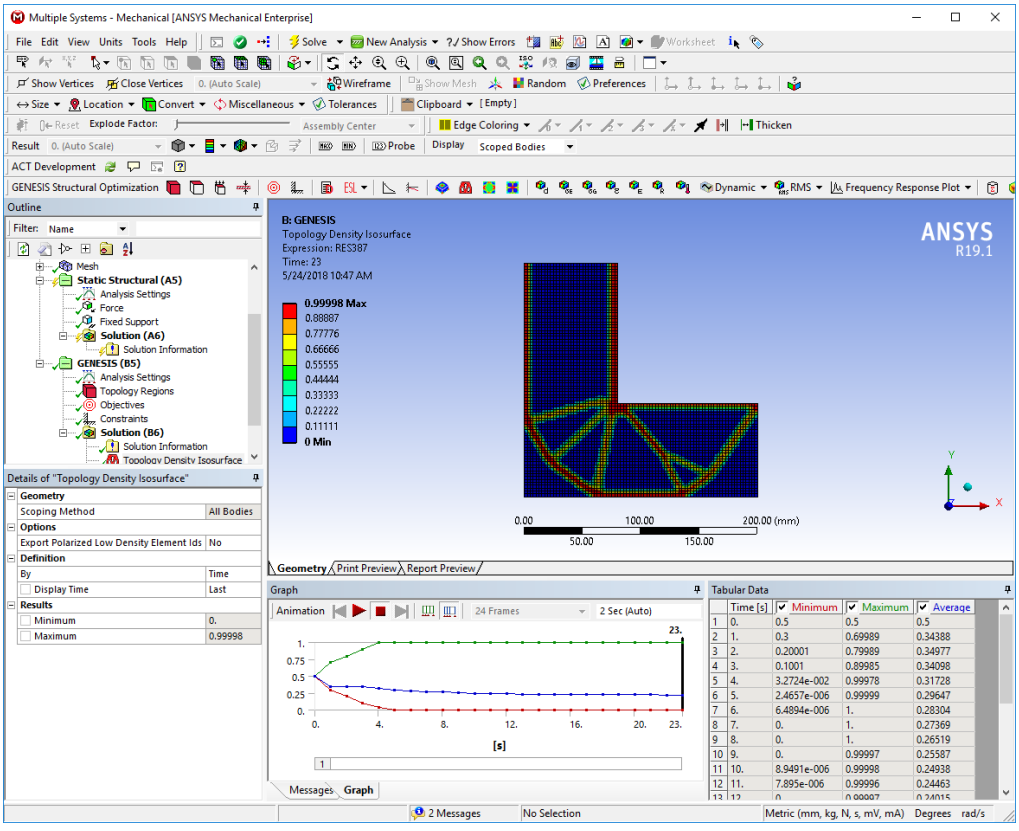
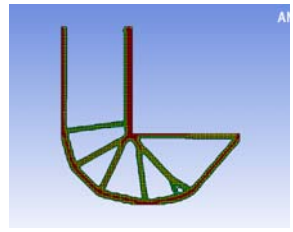
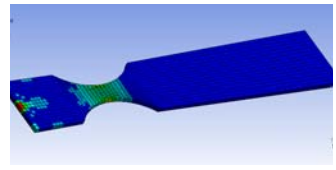



**Figure 5-6.Results for all design cycles are imported**

# 6 New Examples

| File Name | Problem Title | Special Features | Figure |
|---|---|---|---|
| ATP025 | Topology optimization with global von mises stress constraints | • Global Von-mises stress index |  |
| AST003 | Topometry optimization to reduce RSM von mises Stress | • Random RMS Stresses |  |