SIMULIA TOSCA STRUCTURE 8.0

STRUCTURAL OPTIMIZATION

TOSCA STRUCTURE DELIVERS POWERFUL OPTIMIZATION SOLUTIONS FOR DESIGN OF LIGHTWEIGHT, STIFF AND DURABLE PARTS AND ASSEMBLIES WITHIN SHORTER DEVELOPMENT CYCLES.

SIMULIA TOSCA STRUCTURE 8.0

Tosca Structure is a modular system for non-parametric structural optimization that enables topology, shape, bead and sizing optimization in combination with standard finite element solvers. This allows for a seamless integration in existing CAE environments and guarantees easily interpretable and reliable results. The set-up is very simple as no model parameterization is necessary and existing solver input files can directly be used for optimization setup.

TOSCA ANSA ENVIRONMENT

Tosca ANSA environment supports the complete optimization workflow:
- Setup of the optimization task
- Check model consistency
- Run optimization
- Postprocessing and visualization
- Generation of smoothed results
- Automatic model verification
- Based upon the executable finite element input deck of the initial or design space model, all optimization settings are defined interactively.

Tosca ANSA environment does not support sizing and shape/morphing.

GENERAL CAPABILITIES

- Solver interfaces: Abaqus, ANSYS, MSC Nastran
- Stable and fast optimization algorithms
- Direct use of existing models
- Efficient handling of very large models
- Support of unlimited number of load cases
- Consideration of multiple FE analyses for response combination
- Optimization in combination with non-linear analysis (non-linear material, contact, large deformation)
- Pre- and postprocessing of optimization jobs in Tosca ANSA environment
- Result visualization with Tosca Structure view
- Combination of postprocessing data to vtfx reports and office or html documents
- Result preparation for CAD transfer using Tosca Structure smooth

Setup with Tosca ANSA environment

Tosca Structure.gui

The classical user interface Tosca Structure gui also supports the complete optimization workflow. An easy-to-use wizard allows the setup of standard optimization tasks in only a couple of mouse clicks. For sizing no wizard is available.

Setup with Tosca Structure gui
Tosca Structure.topology

Topology optimization determines an optimum design proposal starting with a given maximum design domain. All loads and boundary conditions from the finite element model are taken into consideration during the automatic modification procedure.

- Free choice of objective function terms and constraints of the following design responses: volume, mass, compliance, displacements, rotations, reaction forces, reaction moments, internal forces, natural frequencies, center of gravity, moments of inertia, frequency response analysis results (amplitudes, phases, velocities and accelerations), acoustic measures (surface velocities, sound pressure), stress
- Demolding constraints for casting and forging components. Consideration of stamping conditions and tightness
- Various symmetry constraints (plane, rotational, cyclic) and link conditions
- Minimum and maximum membersize filters for wall thickness constraints
- Fully automated generation and analysis of verification models

With Tosca Structure bead, the static stiffness and the vibration behavior can be improved.

- Definition of objective function terms and constraints using the following response types: compliance, natural frequencies, displacements, reaction forces, reaction moments, internal forces, results from frequency response analysis (amplitudes, phases, velocities and accelerations), acoustic responses (surface velocities)
- Symmetry constraints
- Penetration checks to neighbouring parts
- Definition of maximum bead height
- Mesh-independent approach
- Easy interpretation of the results

Tosca Structure.shape

In shape optimization, the component’s surface is modified to reduce local stress or damage peaks. For the setup of a shape optimization problem in Tosca Structure no model parameterization is necessary. The design area is simply defined via group definitions in the finite element model or directly in Tosca ANSA environment.

- Minimization of combinations of equivalent stress values (various stress hypotheses available)
- Maximization of selected natural frequencies
- Specification of a volume constraint
- Mesh-independent manufacturing constraints for casting, forging, stamping, extrusion and drilling
- Minimum and maximum member size
- Various symmetry constraints: plane, rotational, cyclic symmetry and their combination
- Penetration checks to neighboring parts
- Mesh smoothing in each design cycle to keep high quality meshes during optimization

Tosca Structure.sizing

The new SIMULIA Tosca Structure sizing module is a tool for optimizing sheet metal components by modifying the individual sheet thicknesses of single layered shells.

- Free choice of objective function terms and constraints of the following design responses: volume, mass, compliance, displacements, rotations, reaction forces, reaction moments, internal forces, natural frequencies, center of gravity, moments of inertia, frequency response analysis results (amplitudes, phases, velocities and accelerations)
- Various symmetry constraints (plane, rotational, cyclic) and link conditions
- Minimum membersize filters for wall thickness constraints
- Clustering of shell element thicknesses for element areas with constant thickness

Tosca Structure.bead

Bead optimization is used to determine the optimum location and orientation of bead stiffeners for sheet metal components.

- Definition of objective function terms and constraints using the following response types: compliance, natural frequencies, displacements, reaction forces, reaction moments, internal forces, natural frequencies, center of gravity, moments of inertia, frequency response analysis results (amplitudes, phases, velocities and accelerations), acoustic responses (surface velocities), stress
- Symmetry constraints
- Penetration checks to neighbouring parts
- Definition of maximum bead height
- Mesh-independent approach
- Easy interpretation of the results

Tosca Structure.smooth

Tosca Structure.smooth supports the preparation of validation models and the export to CAD-systems:

- Calculation of smoothed isosurfaces of the material distribution after topology optimization depending on isovalue or target volume
- Generation of patched surface geometries for shape and bead optimization
- Visualization in Tosca Structure view
- Data reduction for CAD transfer
- Calculation of cutting splines and export as IGES files
- Export of patched surfaces in CAD compatible formats (STL, IGES)
- Export as FE surface mesh for manual remeshing and analysis or automatic reconstruct and verification run
**POSTPROCESSING**

Tosca Structure.view and an included report generator provide you with easy and reproducible postprocessing:

- **Tosca Structure.report**
  - Collection of 3D animation sequences of the optimization history and x-y-plots of constraint and objective function values
  - Export to platform independent, binary and compact vtfx archives

- **Tosca Structure.view**
  - Free, high-performance 3D viewer for Tosca Structure data in vtfx format
  - Available for Windows and Linux
  - Plug-in for Office applications or Internet Explorer on Windows
  - Export of images and avi files
  - Tosca Structure Report Builder
  - Automatic generation of reports for office and html documents
  - User defined templates for customized layout

**ADVANCED MODULES**

For high level optimization applications Tosca Structure offers additional modules that allow to use advanced functionalities:

- **Durability**
  - Shape optimization based on results of fatigue simulation
  - Use of FEMFAT, FE-Safe, Falancs, nCode, DesignLife, Femsite or user specific fatigue code possible

- **Nonlinear**
  - Topology and shape optimization of contact models
  - Topology and shape optimization using non-linear material behavior
  - Topology and shape optimization based upon geometric non-linear analysis
  - Bead and sizing optimization support all non-linearities outside the design area

- **NVH**
  - Support of acoustic measures (surface velocities, sound pressure)
  - Support of results from frequency response analysis (amplitudes, phases, velocities, accelerations)

- **Morph**
  - Highly flexible mesh manipulation tool for quick and easy geometry changes
  - Automatic generation of model variants and submission of analysis runs for these models
  - Derivation of optimum start design for a subsequent local shape optimization possible
  - Definitions for design variables (design variable constraints and mesh smooth definitions) also apply to morphing areas

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