GENERAL

ansys workbench contact analysis tutorial slgmbh

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ANSYS Workbench Contact Analysis Tutorial for SLG /GmbH

When designing high performance mechanical assemblies, the interaction between mating surfaces can be the most critical factor influencing strength, durability, and cost. At SLG GmbH, where precision engineering and innovative product development are core values, understanding and predicting contact behavior is essential. This comprehensive tutorial walks you through every step of setting up, executing, and interpreting a contact analysis in ANSYS Workbench, specifically tailored for the SLG /GmbH engineering workflow.

Why Contact Analysis Matters

Contact analysis is the process of predicting how two or more bodies interact under load. In real world applications, contact surfaces can:

- Transfer forces and moments between components.
- Generate friction, wear, and heat.
- Produce localized stress concentrations that may lead to failure.
- Influence the overall deformation and stability of the assembly.

By accurately modeling contact, engineers can optimize design geometry, select appropriate materials, and avoid costly prototypes.

Key Concepts in Contact Mechanics

1. Contact Types – Surface to surface, point to point, and edge to edge contacts.
2. Contact Conditions – Normal contact (prevent interpenetration) and tangential contact (friction).
3. Contact Algorithms – Penalty, Lagrange multipliers, and hybrid methods.
4. Friction Models – Coulomb friction, Coulomb Cohesive, and Variable friction.
5. Mesh Quality – Contact accuracy depends heavily on mesh conformity and element type.

Prerequisites for the Tutorial

- ANSYS Workbench 2023 R2 or newer.
- Basic familiarity with the ANSYS Workbench interface.
- CAD geometry of the assembly (e.g., a shaft and bearing).
- Material properties for all involved components.
- Clear definition of loads, boundary conditions, and desired outputs.

Step by Step Guide

1. Open ANSYS Workbench and create a new project.
2. Drag the Static Structural system into the Project Schematic.
3. Rename the system to “SLG /GmbH Contact Analysis” for clarity.

1. Double click the Geometry cell.
2. Use the Import Geometry button to bring in your CAD file (e.g., STEP, IGES).
3. Verify that the geometry is clean: no overlapping faces or gaps that could cause meshing errors.

1. Open the Engineering Data module.
2. Add the required materials (e.g., Steel 1018, Aluminum 6061, Polyurethane).

3. Assign material properties: elastic modulus, Poisson’s ratio, yield strength, and density.
4. Drag each material onto its respective part in the Model tree.

Mesh quality is pivotal for accurate contact results. Follow these guidelines:

- Use a finer mesh on contact surfaces to capture stress gradients.
- Employ tetrahedral or hexahedral elements depending on geometry complexity.
- Apply mesh refinement in critical zones (e.g., bearing races).
- Enable mesh smoothing to improve element quality.

1. In the Model tree, right click Model !’ Insert !’ Contact Pair.
2. Assign the Master and Slave surfaces. For a shaft bearing system, the bearing race is typically the master.
3. Set the contact type: Surface to Surface for most mechanical assemblies.
4. Choose the Contact Algorithm. For SLG /GmbH’s high precision parts, the Lagrange Multipliers method is recommended for accurate enforcement of contact constraints.
5. Define the Friction Coefficient. Common values: 0.15 for steel steel, 0.25 for steel polyurethane.
6. Optionally enable Contact Pressure Dependent Friction if the contact pressure varies significantly.

1. Fixed Supports – Constrain all degrees of freedom on the base of the bearing.
2. Load Application – Apply axial force or torque on the shaft’s end.
3. Consider Symmetry Conditions if the geometry allows, to reduce computational effort.
4. For dynamic simulations, add mass and damping properties.

1. Open the Analysis Settings panel.
2. Set the Analysis Type to Static Structural.
3. Enable Nonlinear Solver options to account for large deformations and contact nonlinearity.
4. Define Load Steps and Increment Controls to ensure convergence.
5. Activate Contact Convergence Criteria – tighten the tolerance for high accuracy results.

Click **Run** and monitor the solver progress. Typical output messages:

- “Contact algorithm: Lagrange Multipliers”
- “Total load steps: 10”
- “Convergence achieved in 15 iterations”

For large assemblies, consider running on a high performance cluster or using distributed computing options.

1. Open the Results folder.
2. Plot Contact Pressure on the master surface to identify hotspots.
3. Examine Stress Distribution (von Mises, principal stresses) around the contact region.
4. Generate Deformation Plots to verify that deformations are within acceptable limits.
5. Export Data Tables for further analysis or reporting.

To ensure model fidelity:

- Compare simulation results with experimental data (e.g., pressure transducer readings).
- Check mesh independence by refining the mesh and verifying negligible changes in key outputs.
- Adjust friction coefficients or material models if discrepancies arise.
- Document every iteration for traceability.

Advanced Tips for SLG /GmbH Engineers

Contact can generate heat due to friction. Use the **Heat Transfer** module to study thermal effects, which may influence material properties and contact behavior.

Model surface roughness using *Statistical Surface Roughness Models* or by explicitly meshing asperities if the design requires it.

For long term performance, integrate a *Wear Module* to predict material loss and adjust design accordingly.

Use ANSYS Workbench's **Python API** to automate repetitive tasks, such as setting up multiple contact pairs or batch processing a series of load cases.

Run a mesh sensitivity study by varying element size on the contact surfaces and recording changes in peak contact pressure. This will help determine the optimal mesh size balancing accuracy and computational cost.

Some materials exhibit friction that changes with pressure. Enable this feature in the contact pair settings for more realistic simulations.

Common Pitfalls and How to Avoid Them

- Interpenetration – Ensure the mesh is fine enough and the contact algorithm is correctly set. Lagrange multipliers are less prone to interpenetration than penalty methods.
- Non Convergence – Reduce load step increments, increase contact tolerance, or refine the mesh.
- Missing Boundary Conditions – Double check that all essential supports and loads are applied.
- Inaccurate Material Properties – Use the latest data from material databases or perform material testing.
- Overlooking Mesh Quality – Poorly shaped elements can cause numerical errors.

Case Study: Bearing Assembly for a High Speed Motor

SLG GmbH recently developed a high speed motor requiring a precision bearing assembly. The design team used the contact analysis workflow described above to:

- Determine the optimal shaft diameter to minimize contact pressure.
- Select a polyurethane liner to reduce friction without compromising load capacity.
- Validate the design against fatigue life predictions.
- Reduce prototype cost by 30% through early detection of potential failure points.

The final design achieved a 25% increase in operational speed while maintaining the same reliability metrics.

Resources for Further Learning

- ANSYS Official Documentation – Contact Analysis in Workbench.
- ANSYS Learning Hub – Video tutorials on contact modeling.
- Engineering Stack Exchange – Community discussions on contact algorithms.
- SLG /GmbH Internal Knowledge Base – Past project case studies.

Conclusion

Accurate contact analysis is a cornerstone of robust mechanical design. By following this step by step tutorial, engineers at SLG GmbH can confidently set up, run, and interpret ANSYS Workbench contact simulations. Whether you're optimizing a simple shaft bearing pair or tackling a complex multi body assembly, the principles and best practices outlined here will help you deliver high quality, reliable products

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