

CDS Models Workflow Manual

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This manual explains which records and model choices supply each calculation in CDS. Follow the workflow from constituents through micromechanics and laminate definition to the applicable load and response. Thermal, moisture and electromagnetic studies have distinct input requirements; a link in the workflow must reflect an actual dependency, not an assumed coupling.

Preface

This manual is for a reader who knows the engineering question but needs to choose a suitable path through CDS. It explains which information belongs to a material, a ply, a laminate, a geometry, a case and a simulation. The order follows the preparation of a connected study rather than the order in which models happen to appear in a directory.

Read a chapter before building that part of the input chain. Its discussion explains why the inputs are needed, the checks to make before proceeding and what the next calculation receives. The model directory is a reference section, not a sequence of instructions to run every model. A visible link must represent a supported transfer; it does not establish a physical coupling by itself.

How to use this manual

Read the assumptions before choosing a model. Keep units consistent, inspect solver notices and use the recorded checks to distinguish a completed calculation from a validated result. Chapter links lead to the interactive website; exercise links open the Workbench. Account-controlled database downloads and classroom materials remain subject to their existing access rules.

Equations are editable Word mathematics. This PDF is exported from the same Word document. Historical reference chapters retain their stated scope; the current workflow and exercise chapters describe the available CDS implementation.

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1 Define the engineering question

Online chapter

A study begins with a question about a particular material or structure. The question may concern stiffness under load, temperature during a manufacturing cycle, or deformation after cooling. These questions require different inputs and do not necessarily use the same solver. Before opening the model directory, describe the response you need, the conditions under which it matters, and the evidence that would make the answer useful.

The following chapters develop the input chain in the order in which an engineer prepares it. Material records establish the property basis; micromechanics supplies an effective ply where needed; the laminate records the layer arrangement. Processing histories, geometry and boundary conditions then define the calculation. This order also provides a way to diagnose an unexpected result: trace the response back through the records that supplied it, rather than adjusting several unrelated settings at once.

1.1 Fully integrated Micro to Macro Engineering

03 / Workflow

Follow one connected engineering record through materials, micromechanics, laminates, processing, structural design, and the CDS cloud.

Connected engineering flow

From material definition to engineering result

Follow the linked physics from constituent data through micromechanics, laminate response, equipment and processing, structural analysis and specialist studies.

Original master model workflow: Materials, Micromechanics, Laminates, Processing and Structural Analysis sections on the left, with connected model blocks across each layer — part 1 of 2

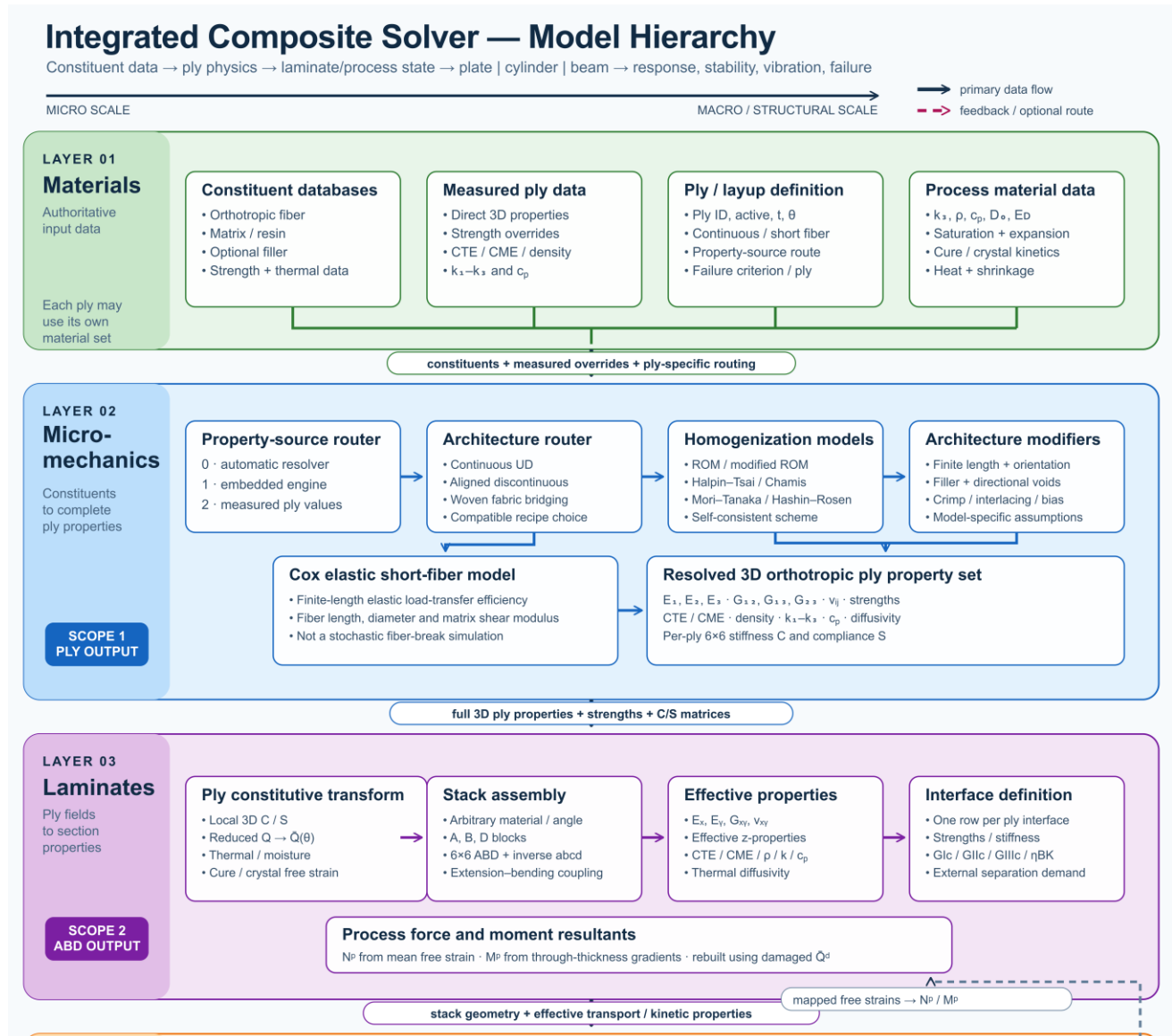


Figure 1. Original master model workflow: Materials, Micromechanics, Laminates, Processing and Structural Analysis sections on the left, with connected model blocks across each layer

Original master model workflow: Materials, Micromechanics, Laminates, Processing and Structural Analysis sections on the left, with connected model blocks across each layer — part 2 of 2

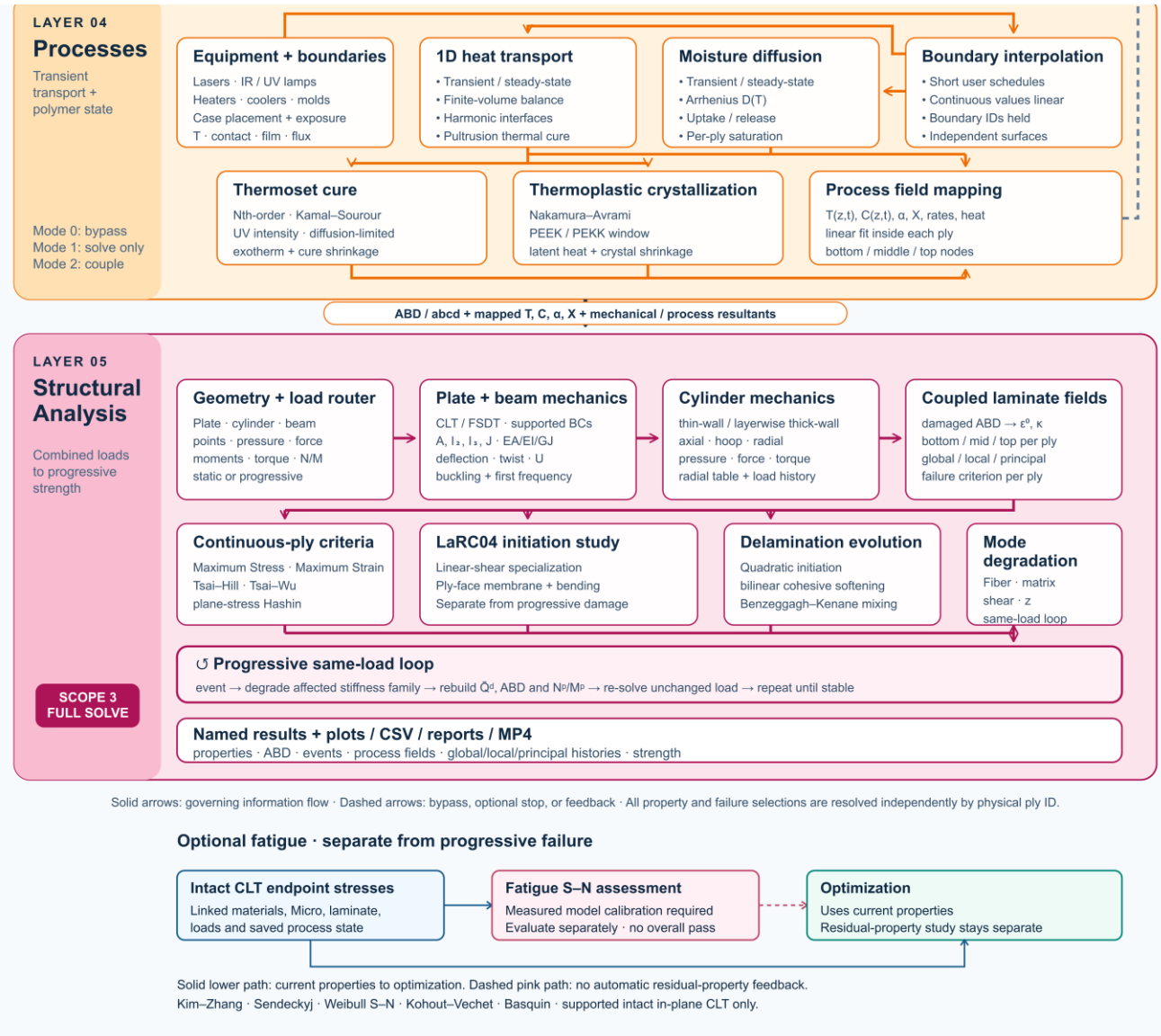


Figure 2. Original master model workflow: Materials, Micromechanics, Laminates, Processing and Structural Analysis sections on the left, with connected model blocks across each layer

Select a stage or model block for its theory and workflow. [Open full-size diagram](#) · [Explore current model availability and limits](#). This hierarchy shows the model relationships, not a single simulation with every connection enabled.

[Model Map now has a permanent home in Theory](#)

Interactive model map

Choose the physics Follow the connections

Start with an engineering application, then expand its branch to see models, inputs, results and theory. These six topics cover all 43 current model families, including the specialist studies.

Materials micromechanics

Design a ply or reinforced feedstock

Explore 1 family · 9 model choices

Micromechanics · 9

Models browser → Micromechanics · source: Micro

Representative exercise workflow · supplied records remain in place; only used connections have arrows.

Exercise workflow · [Open full-size map](#)

Only blocks on the exercise path are shown. This changes the view only, not the exercise records.

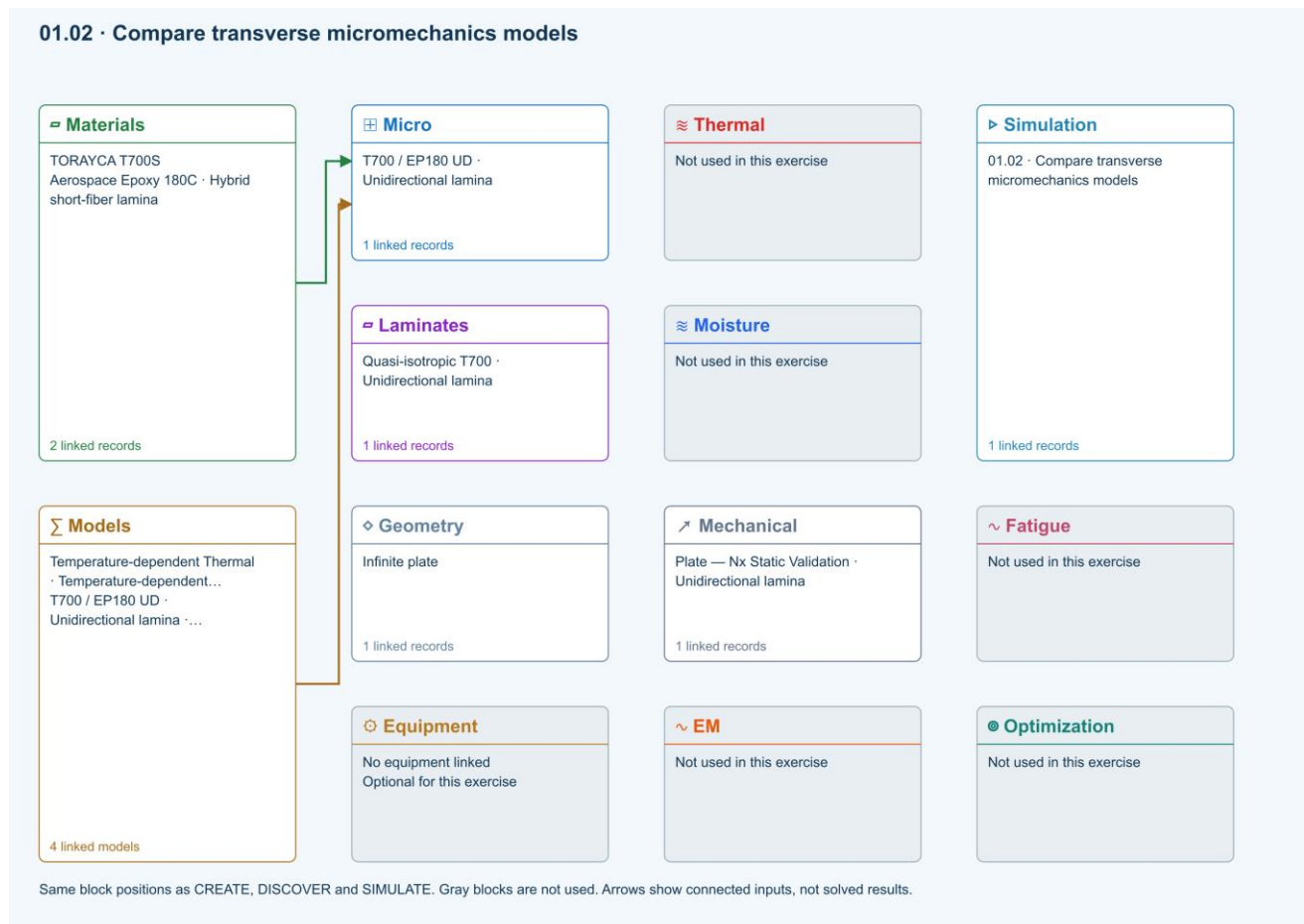
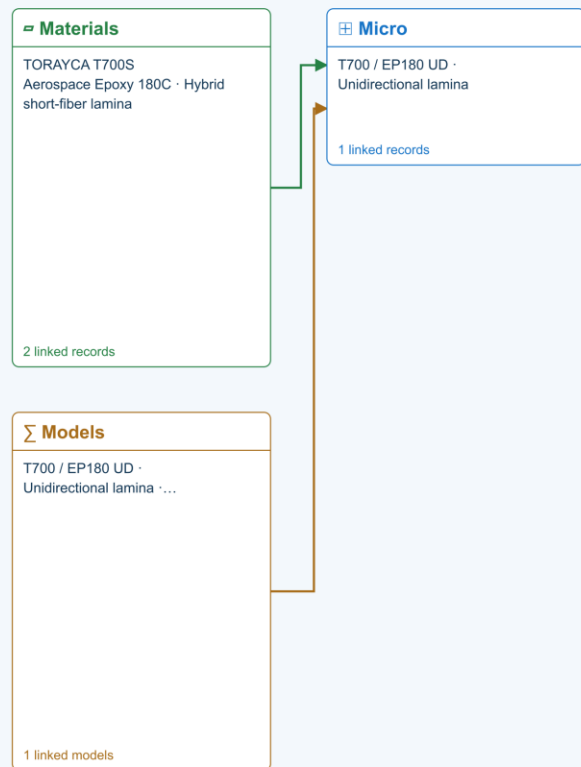


Figure 3. Micromechanics · Fixed layout with all supplied blocks · not solved results

01.02 · Compare transverse micromechanics models



Used blocks keep their fixed positions. Hidden records are preserved. Arrows show connected inputs, not solved results.

Figure 4. Micromechanics · Used records in the universal fixed layout · not solved results

Inputs Constituents, architecture, fractions and calibrated modifiers Results / handoff Reference ply properties for each linked laminate ply

- Halpin-Tsai
- Rule of mixtures
- Modified rule of mixtures
- Chamis
- Mori-Tanaka
- Hashin-Rosen
- Self-consistent scheme
- Woven fabric bridging
- Cox shear-lag elastic

One compatible homogenization model per Micro recipe. Use separate recipes for comparisons; they are not combined in a single ply.

Heat moisture manufacturing

Cure, pultrusion, conditioning and tool release

Explore 5 families · 15 model choices

Cure, crystallization & material transport · 8

Models → material-model folders · assigned through Materials

Representative exercise workflow · supplied records remain in place; only used connections have arrows.

Exercise workflow · [Open full-size map](#)

Only blocks on the exercise path are shown. This changes the view only, not the exercise records.

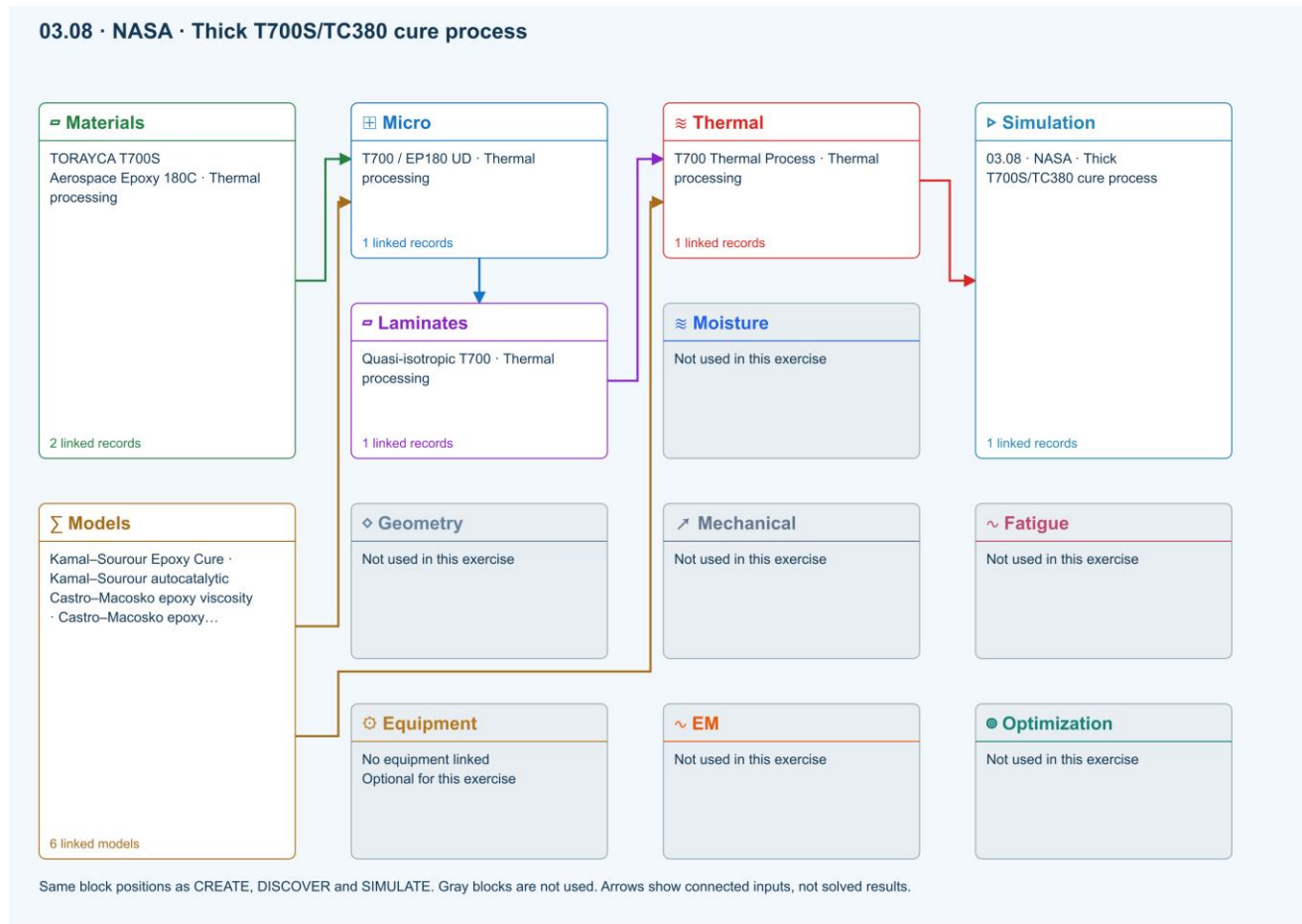


Figure 5. Cure, crystallization & material transport · Fixed layout with all supplied blocks · not solved results

03.08 · NASA · Thick T700S/TC380 cure process

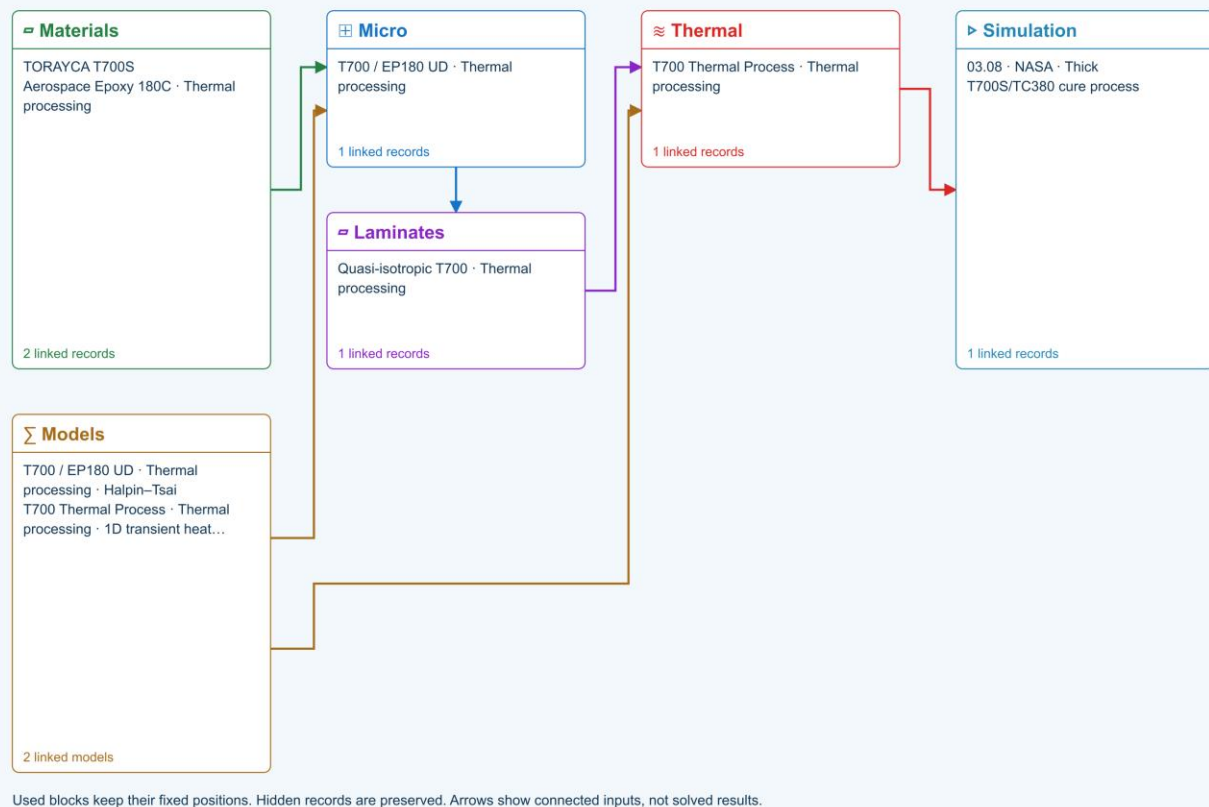


Figure 6. Cure, crystallization & material transport · Used records in the universal fixed layout · not solved results

Inputs Calibrated kinetics, modulus or transport laws and material assignment Results / handoff
Material laws consumed by compatible Micro or transport calculations

- Kamal–Sourour autocatalytic
- Kamal–Sourour with diffusion control
- Nth-order Arrhenius
- CHILE (degree of cure)
- UV intensity-dependent cure
- Nakamura–Avrami
- Temperature-dependent tabular
- 1D Fickian diffusion

Independent model records can be linked together through material inputs. A saved model must be assigned to a material before it contributes to a simulation.

Thermal transport · 3

Models browser → Thermal transport · source: CASES / Thermal

Representative exercise workflow · supplied records remain in place; only used connections have arrows.

Exercise workflow · [Open full-size map](#)

Only blocks on the exercise path are shown. This changes the view only, not the exercise records.

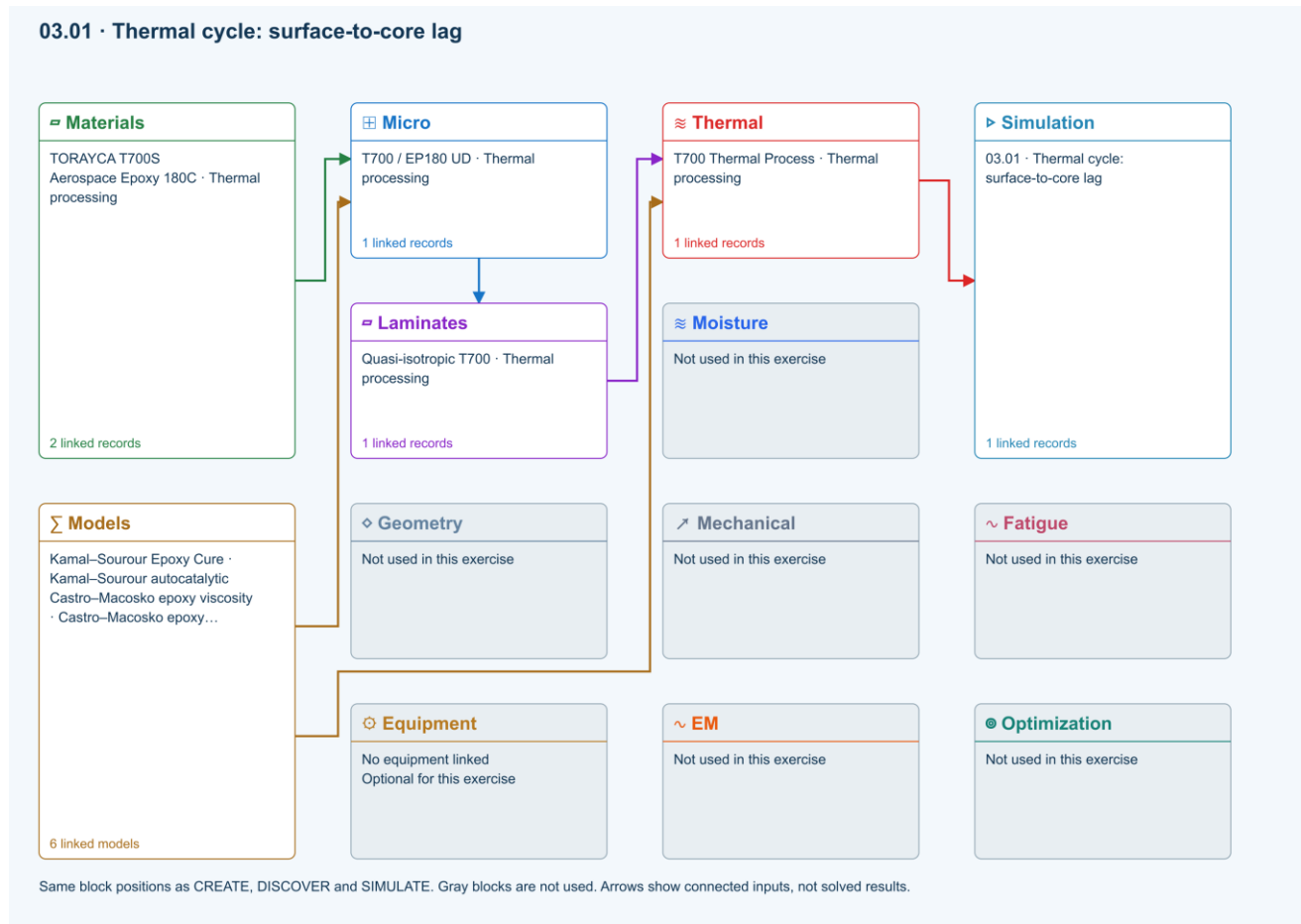


Figure 7. Thermal transport · Fixed layout with all supplied blocks · not solved results

03.01 · Thermal cycle: surface-to-core lag

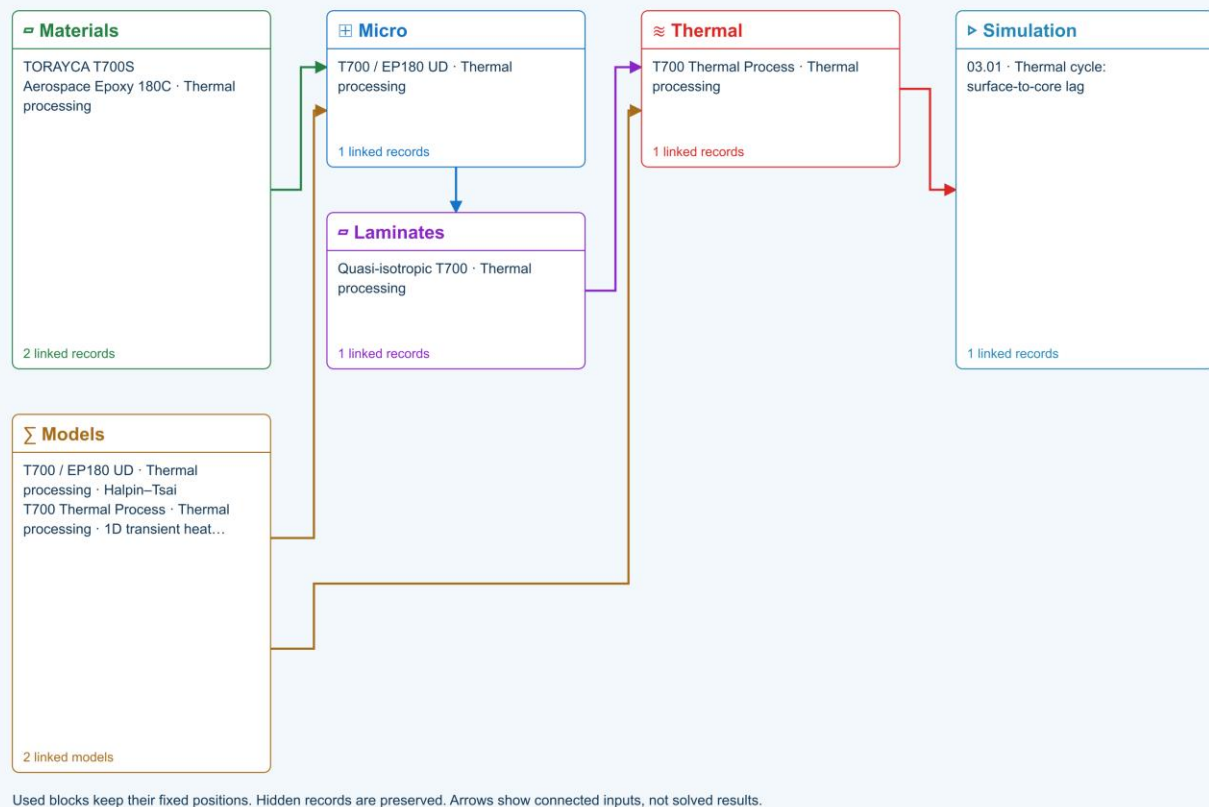


Figure 8. Thermal transport · Used records in the universal fixed layout · not solved results

Inputs Laminate transport properties, initial state and the thermal case's own surface cycle Results / handoff Temperature and supported polymer-state histories; mapped fields only when coupling is enabled

- 1D transient heat transfer
- 1D steady-state heat transfer
- 1D pultrusion thermal cure

One transport formulation per thermal case. Select its laminate and configure its own initial conditions and surface cycle; pultrusion additionally requires a distance-based die schedule and pulling velocity.

Moisture transport · 2

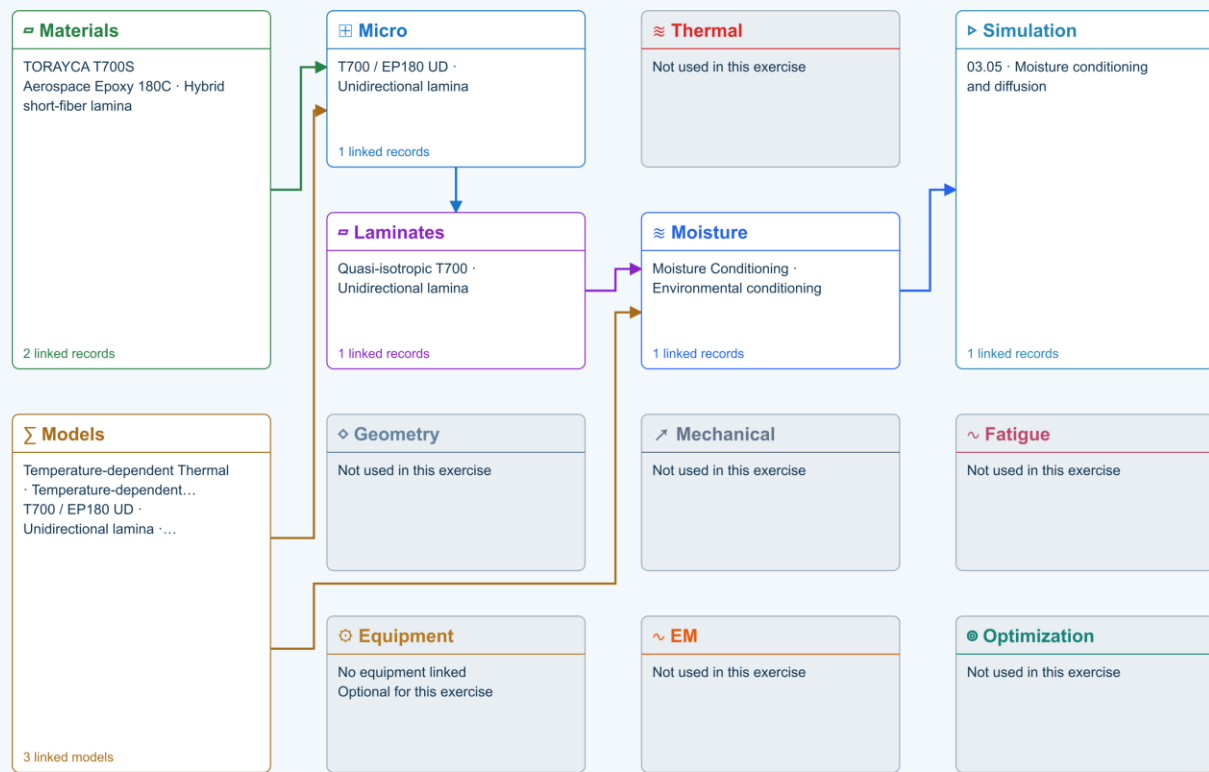
Models browser → Moisture transport · source: CASES / Moisture

Representative exercise workflow · supplied records remain in place; only used connections have arrows.

Exercise workflow · [Open full-size map](#)

Only blocks on the exercise path are shown. This changes the view only, not the exercise records.

03.05 · Moisture conditioning and diffusion



Same block positions as CREATE, DISCOVER and SIMULATE. Gray blocks are not used. Arrows show connected inputs, not solved results.

Figure 9. Moisture transport · Fixed layout with all supplied blocks · not solved results

03.05 · Moisture conditioning and diffusion

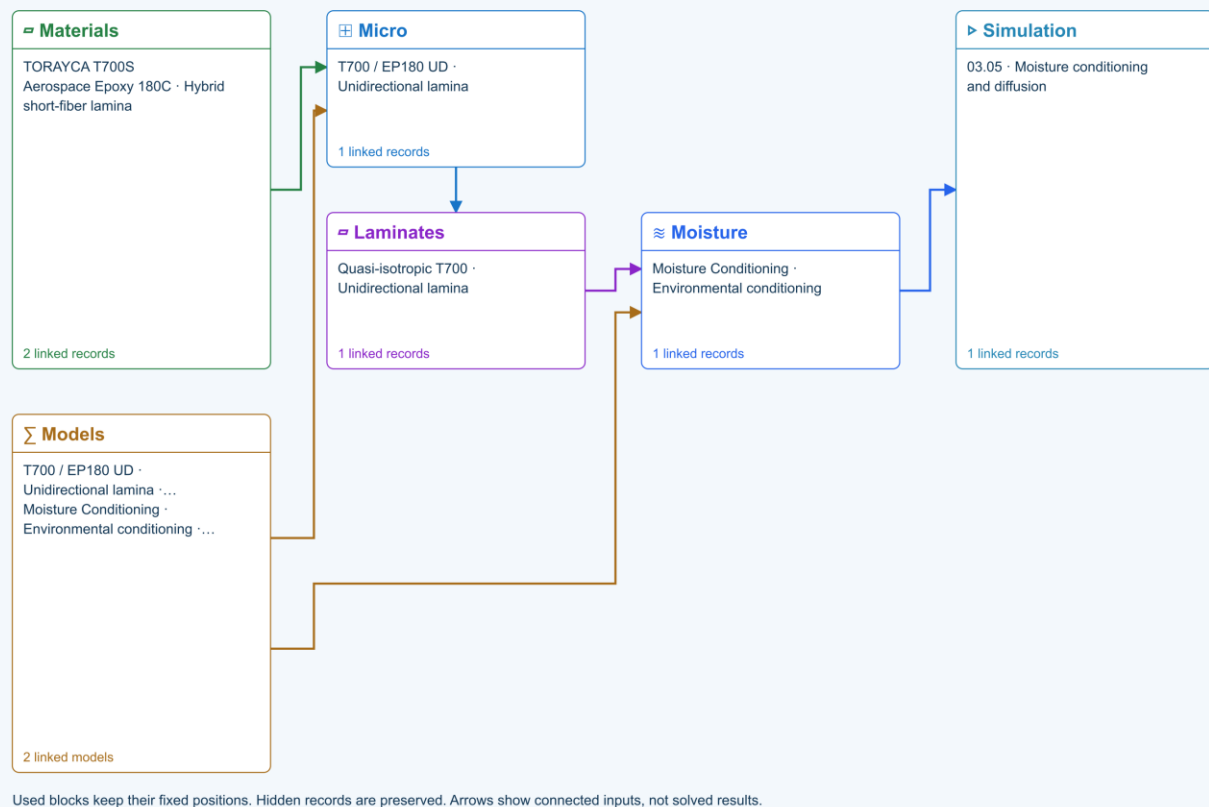


Figure 10. Moisture transport · Used records in the universal fixed layout · not solved results

Inputs Laminate diffusion properties, initial moisture and its own boundary schedule Results / handoff Moisture history and enabled swelling contribution

- 1D transient moisture diffusion
- 1D steady-state moisture diffusion

One formulation per moisture analysis. Thermal and moisture analyses can both be linked in Simulation; each needs its own boundary conditions.

Rubber-covered roller contact · 1

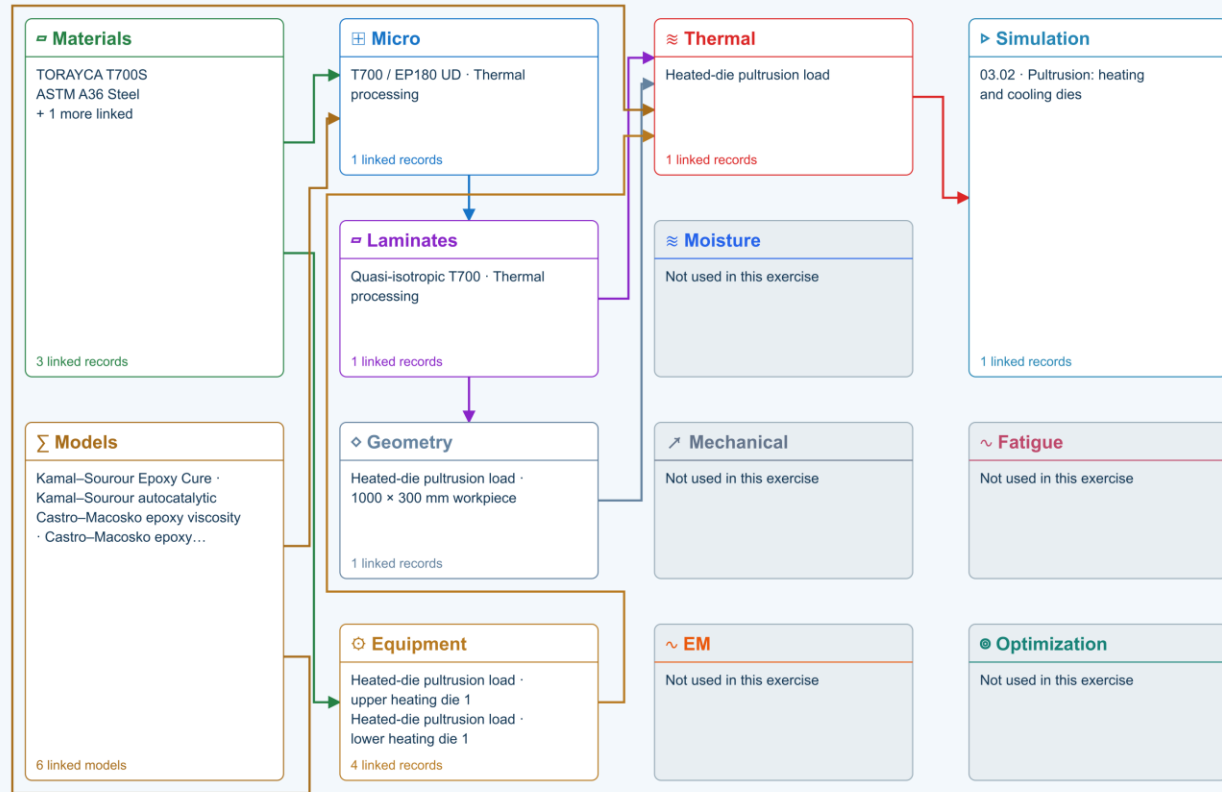
Geometry → Rollers; Models → Roller contact

Thermal starting point: add roller Geometry and a roller boundary; the supplied die exercise does not contain a roller.

Exercise workflow · [Open full-size map](#)

Only blocks on the exercise path are shown. This changes the view only, not the exercise records.

03.02 · Pultrusion: heating and cooling dies



Same block positions as CREATE, DISCOVER and SIMULATE. Gray blocks are not used. Arrows show connected inputs, not solved results.

Figure 11. Rubber-covered roller contact · Fixed layout with all supplied blocks · not solved results

03.02 · Pultrusion: heating and cooling dies

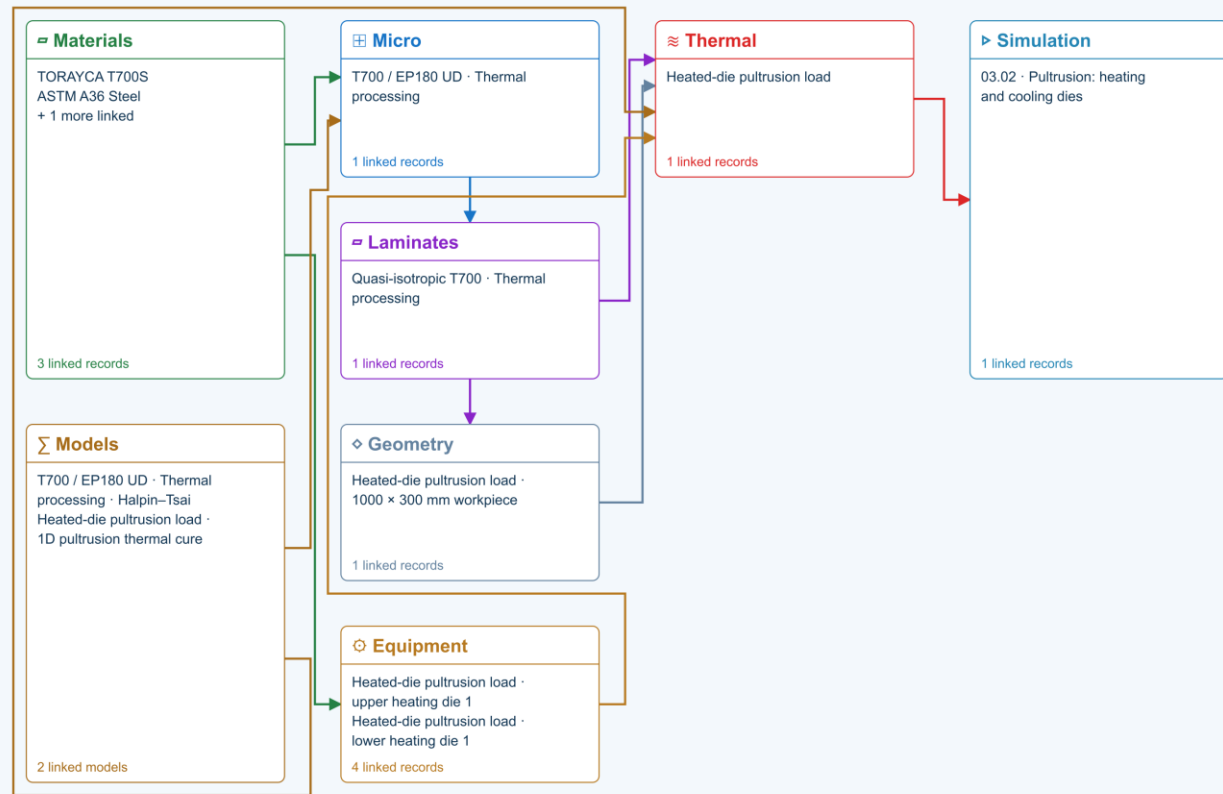


Figure 12. Rubber-covered roller contact · Used records in the universal fixed layout · not solved results

Inputs Roller radius, width, coating or metal properties, applied force and supported contact assumptions Results / handoff Contact footprint and pressure feeding applicable moving-process thermal and quality histories

- Bonded-layer roller contact

Bonded coating on a rigid core against a rigid flat. Geometry selects Infinite width (analytical plane strain) or Finite width (3D elastic contact with axial end spreading). Small deformation and optional prescribed sliding friction; no hyperelasticity or rolling resistance.

Tool-release shape · 1

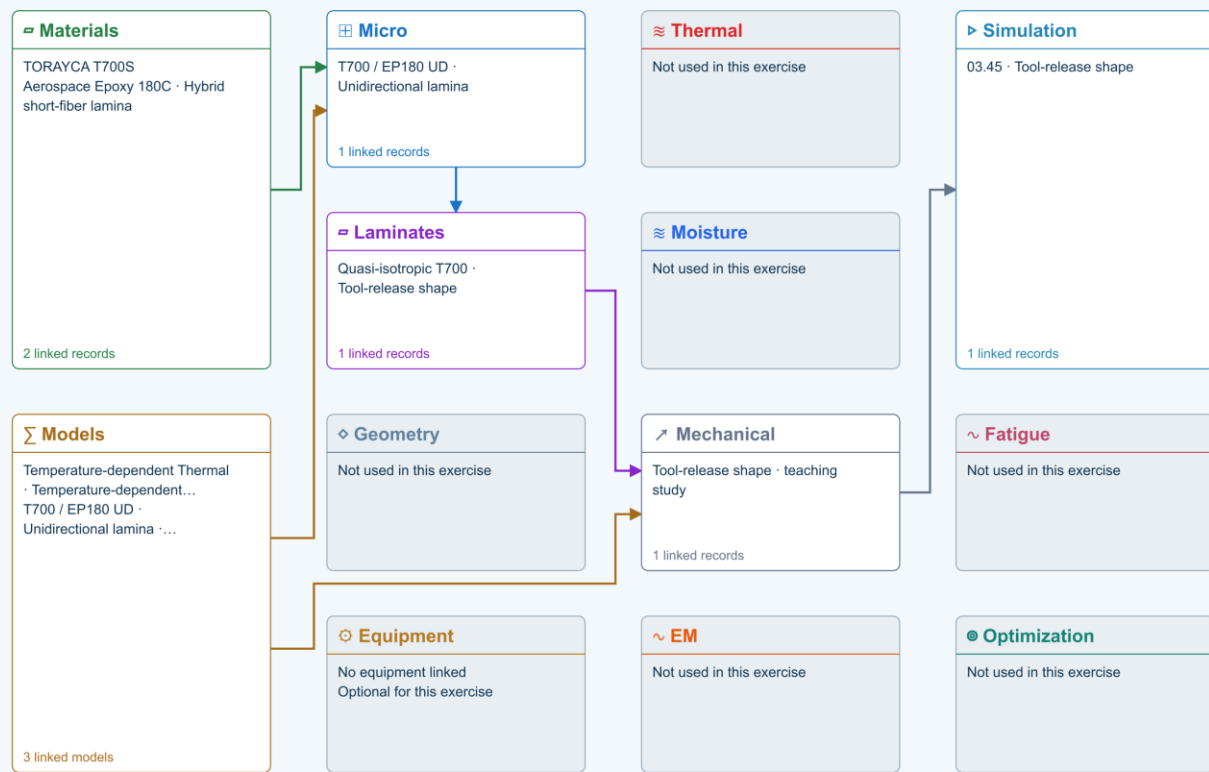
Structural models → Tool-release shape

Representative exercise workflow · supplied records remain in place; only used connections have arrows.

Exercise workflow · [Open full-size map](#)

Only blocks on the exercise path are shown. This changes the view only, not the exercise records.

03.45 · Tool-release shape



Same block positions as CREATE, DISCOVER and SIMULATE. Gray blocks are not used. Arrows show connected inputs, not solved results.

Figure 13. Tool-release shape · Fixed layout with all supplied blocks · not solved results

03.45 · Tool-release shape

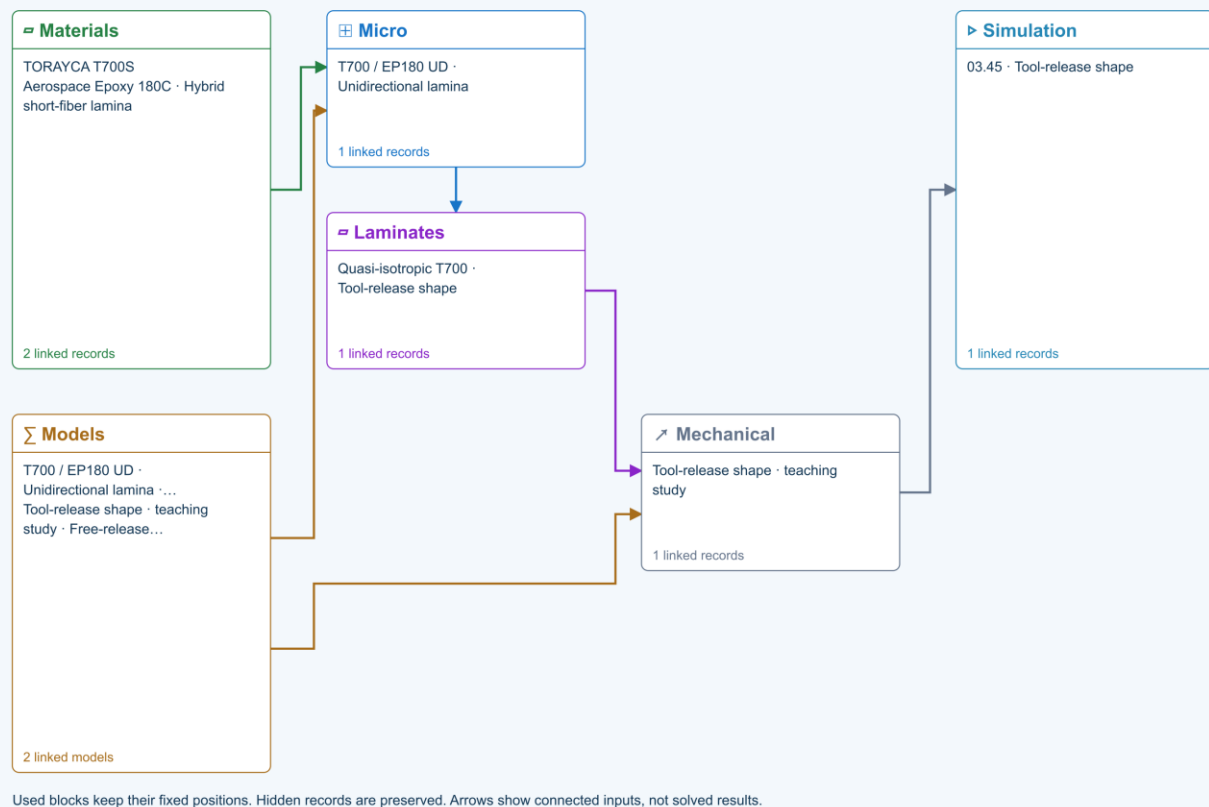


Figure 14. Tool-release shape · Used records in the universal fixed layout · not solved results

Inputs Laminate and prescribed temperatures, CTE and effective post-gel shrinkage Results / handoff Free-release CLT curvature and separate corner spring-in estimate; not an automatic process-history handoff

- Free-release eigenstrain & spring-in

Free CLT release from prescribed ply-local shrinkage/thermal eigenstrains. Corner spring-in is a separate uniform-strain estimate. Stress-free temperature and effective post-gel shrinkage need calibration. No tool friction, cure kinetics or viscoelastic restraint history.

Structural mechanics

Size plates, beams, shells, sandwich panels and joints

Explore 7 families · 17 model choices

Plate · CLT & FSDT · 6

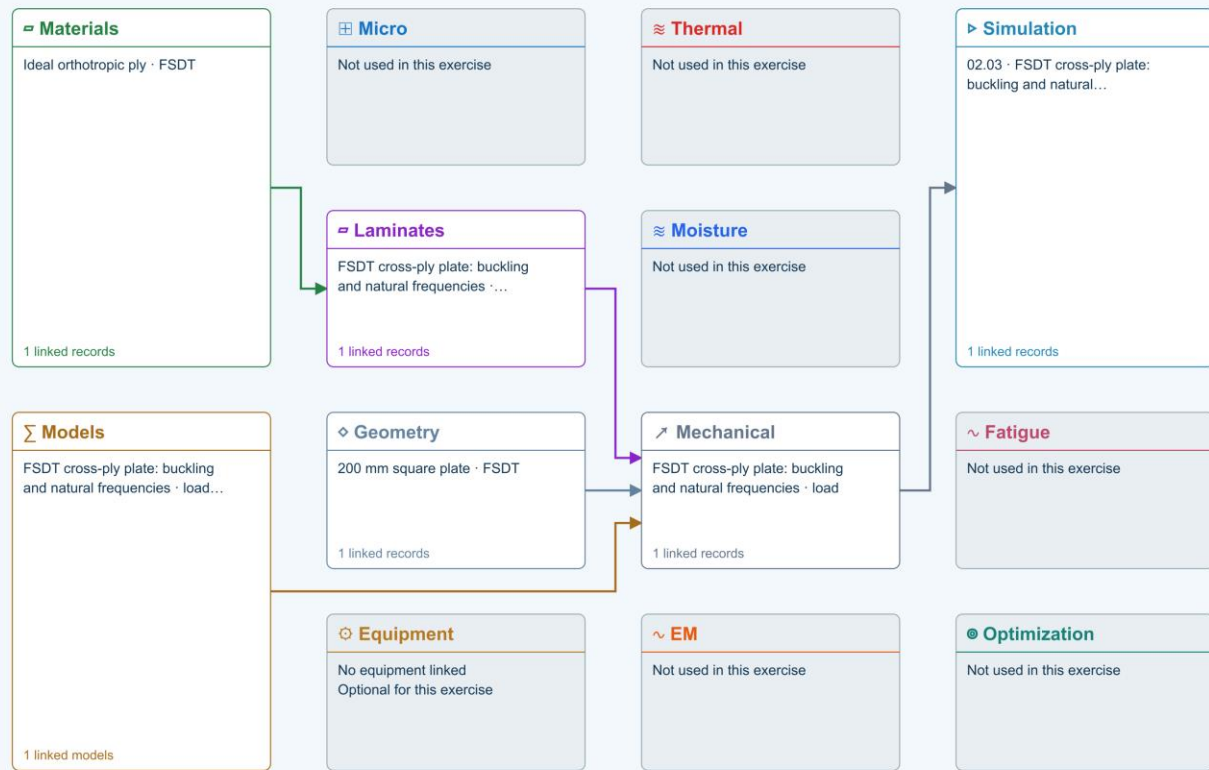
Structural models → Laminate mechanics · CLT / FSDT

Representative exercise workflow · supplied records remain in place; only used connections have arrows.

Exercise workflow · [Open full-size map](#)

Only blocks on the exercise path are shown. This changes the view only, not the exercise records.

02.03 · FSDT cross-ply plate: buckling and natural frequencies



Same block positions as CREATE, DISCOVER and SIMULATE. Gray blocks are not used. Arrows show connected inputs, not solved results.

Figure 15. Plate · CLT & FSDT · Fixed layout with all supplied blocks · not solved results

02.03 · FSDT cross-ply plate: buckling and natural frequencies

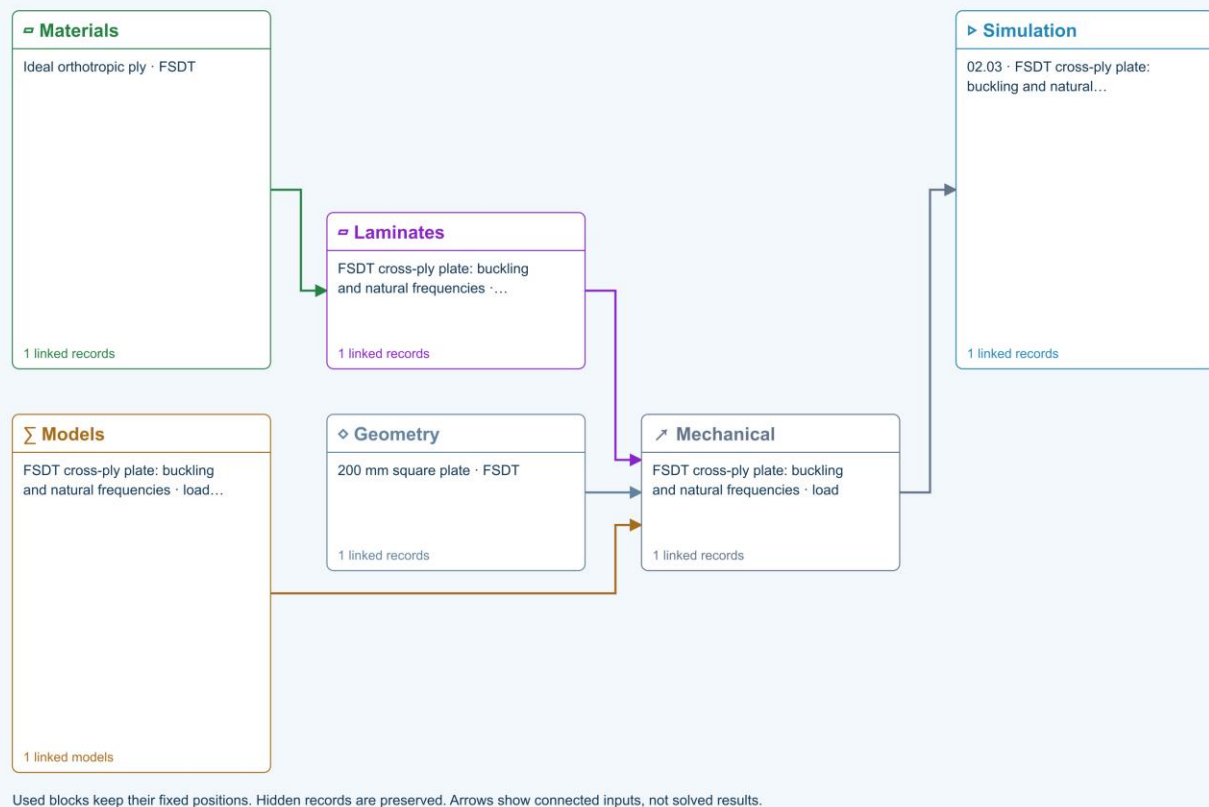


Figure 16. Plate · CLT & FSDT · Used records in the universal fixed layout · not solved results

Inputs Laminate stiffness, finite plate dimensions, supported edges and study choice Results / handoff FSDT static bending or selected buckling / modal results; not progressive damage

- CLT
- FSDT
- Static bending
- Modal
- Buckling
- Buckling and modal

Choose a formulation and study. Buckling and modal can be requested together; static bending requires FSDT. These are reference-elastic studies, separate from coupled process or progressive failure.

Cylinder · 2

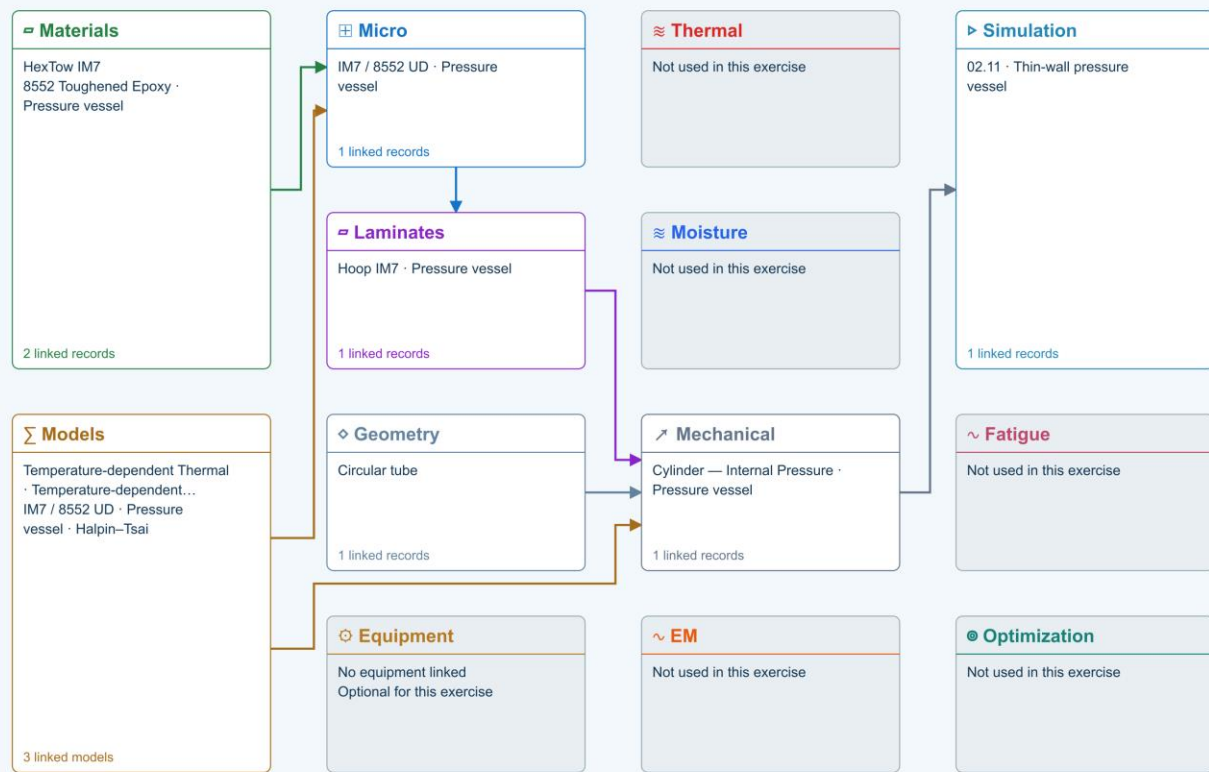
Structural models → Cylinder models

Representative exercise workflow · supplied records remain in place; only used connections have arrows.

Exercise workflow · [Open full-size map](#)

Only blocks on the exercise path are shown. This changes the view only, not the exercise records.

02.11 · Thin-wall pressure vessel



Same block positions as CREATE, DISCOVER and SIMULATE. Gray blocks are not used. Arrows show connected inputs, not solved results.

Figure 17. Cylinder · Fixed layout with all supplied blocks · not solved results