CathCAD®

Interrupted Helical Hypotube

User Guide

CathCAD® Hypotube Modeling

Roth Technologies, LLC

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CathCAD®: The Software for Developing Your Next MicroCatheter

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Revision History

Revision	Date	Description
00	2026.11.16	Initial user guide for CathCAD® Interrupted Helical Hypotube modeling.

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I. Introduction

This guide explains how to set up and run CathCAD® Hypotube modeling for an uncut tube or an interrupted helical laser-cut tube. The model estimates axial, bending, and torsional stiffness and provides additional kink-radius and crush-resistance outputs where the selected analysis mode supports them.

The interface uses millimeters for geometry unless a field explicitly shows another unit. Material properties are displayed in MPa, and stiffness and force outputs show their units beside each result. Review every input and the selected material card before computing.

CathCAD® model outputs are engineering estimates. They do not replace prototype manufacture, inspection, or mechanical testing. Confirm that the model assumptions match the design and intended test conditions before relying on a result.

II. Running the Hypotube Model

Open the CathCAD® Interrupted Helical Hypotube function from CathCAD®. The screen is organized into three areas: pattern previews across the top, geometry and material inputs in the middle, and model outputs and command buttons at the bottom.

- Enter the tube geometry and, when applicable, the cut-pattern parameters.
- Select the material and review the displayed properties and analysis mode.
- Select VALIDATE to check the current setup and resolve any reported input problems.
- Select COMPUTE to run the model. Wait for the completion banner and then review the output values and summary line.
- Use EXPORT TO EXCEL to transfer results for recordkeeping or comparison. Save the workbook in Excel.

The completion banner reports elapsed solve time, a job identifier, and the governing status reported by the solver. Keep the job identifier with saved results when discussing a particular run.

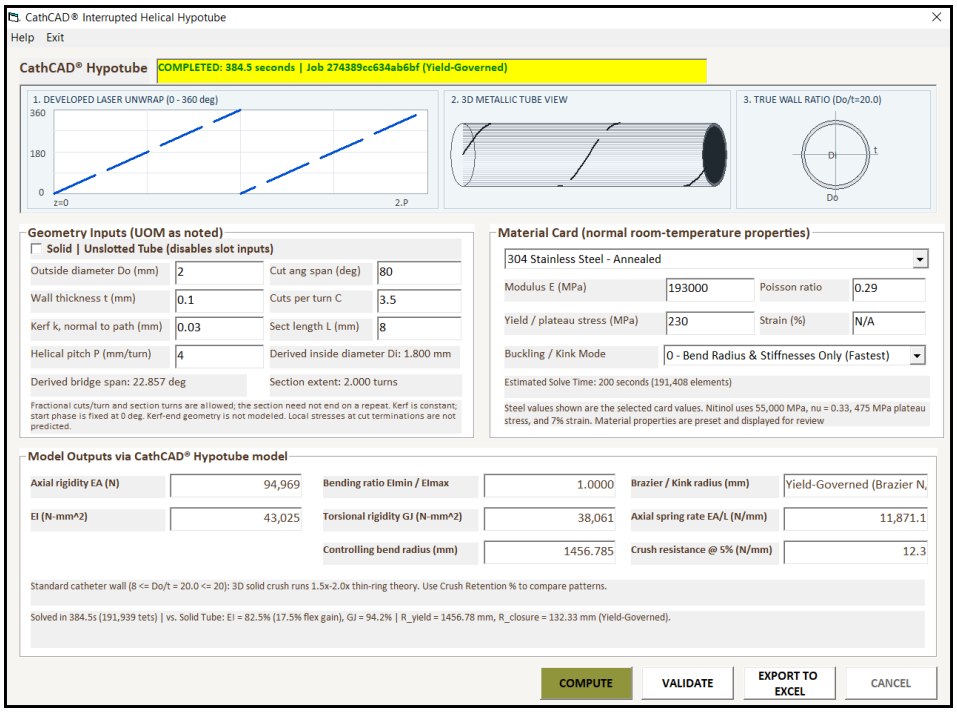
III. Geometry Inputs

Input	Meaning and use
Solid | Unslotted Tube	Select this option to model an uncut tube. Slot inputs are disabled; use the result as a baseline when comparing a cut pattern.
Outside diameter Do (mm)	Outside diameter of the starting tube.
Wall thickness t (mm)	Radial wall thickness. CathCAD® derives inside diameter as Di = Do − 2t.
Kerf k, normal to path (mm)	Width of the cut opening measured normal to the helical cut path. The screenshot example uses 0.030 mm.
Helical pitch P (mm/turn)	Axial travel of the helix for one complete 360° turn.
Cut angle span (deg)	Angular extent of the cut segment around the tube, measured in the model's helical pattern definition.
Cuts per turn C	Number of cut segments per 360° helical turn. Fractional values are allowed.
Section length L (mm)	Length of the modeled tube section. The section does not need to terminate at a complete pattern repeat.
Derived bridge span	Uncut angular span between neighboring cuts, calculated from the pattern inputs; it is not entered independently.
Section extent	Derived number of helical turns covered by the section length and pitch.

The pattern preview panels show a developed 0°–360° unwrap, a three-dimensional tube view, and the true wall ratio. Treat these as visualization and input-review aids. They are not a production cut drawing or a substitute for checking the customer's laser program.

The model fixes the start phase at 0°. Kerf is constant. Kerf-end geometry is not modeled, and local stresses at cut terminations are not predicted.

Figure 1. CathCAD® Interrupted Helical Hypotube screen showing geometry inputs, material card, previews, and example outputs.



IV. Material and Analysis Settings

Choose the material entry that best represents the tube stock and condition. The material card displays the normal room-temperature properties used for the run, including elastic modulus, Poisson ratio, yield or plateau stress, and strain where applicable. Confirm these values against the applicable supplier data or test data before interpreting results.

The interface notes preset values for stainless steels and superelastic nitinol. The shown stainless example is 304 stainless steel, annealed, with E = 193,000 MPa, v = 0.29, and yield stress = 230 MPa. The interface note lists nitinol values of 55,000 MPa, v = 0.33, plateau stress = 475 MPa, and 7% strain. These are example card values, not universal material specifications.

Select the Buckling / Kink Mode appropriate to the analysis. The displayed option “0 - Bend Radius & Stiffnesses Only (Fastest)” calculates bend-radius and stiffness outputs without the more detailed crush analysis. The selected mode can affect available outputs and estimated solve time.

V. Computing and Reviewing Results

Output	How to read it
Axial rigidity EA (N)	Effective axial rigidity reported by the model. Use it to compare axial response for designs analyzed under consistent assumptions.
EI (N·mm²)	Bending rigidity for the modeled section.
Bending ratio EImin / EImax	Ratio of the minimum to maximum modeled bending rigidity. A value nearer 1 indicates more similar bending stiffness in the two evaluated directions.
Torsional rigidity GJ (N·mm²)	Effective torsional rigidity reported by the model.
Controlling bend radius (mm)	Bend-radius value identified by the selected model criterion. Review the accompanying governing label and result summary.
Brazier / Kink radius (mm)	Predicted radius output. The interface identifies whether the result is yield-governed or controlled by the Brazier calculation.
Axial spring rate EA/L (N/mm)	Axial rigidity divided by modeled section length, as reported by the software.
Crush resistance @ 5% (N/mm)	Crush-resistance output at the stated 5% deformation criterion when supported by the selected analysis mode.

The status text below the result fields reports solve time and may compare the cut pattern with the solid-tube baseline, including relative EI and GJ and predicted radii. Read the labels and units exactly as displayed for each run. Do not compare numbers from runs that use different units, material inputs, analysis modes, or section lengths without accounting for those differences.

VI. Validating and Exporting Results

Validate the setup

Select VALIDATE after entering or changing inputs. Review any validation message and correct the identified geometry or material setup before computing. A validation pass confirms input consistency checks performed by the software; it does not confirm that the inputs match a physical part or that the model has been experimentally validated.

Compute and compare

Select COMPUTE and wait for the solver to complete. For a useful pattern comparison, keep the tube dimensions, material, section length, and analysis mode fixed while changing one design variable at a time. Include an uncut-tube baseline when assessing the effect of a cut pattern.

Export to Microsoft Excel

Select EXPORT TO EXCEL after computing a run. Review the transferred values and save the workbook from Excel. Use a clear filename and record the key geometry, material condition, selected mode, date, and job identifier alongside the workbook so the results can be reproduced.

If the export does not appear, confirm that Microsoft Excel is installed and available, then retry the export. Preserve the CathCAD® result screen or job identifier if you report an export issue.

VII. Model Assumptions and Limitations

- Results are model predictions, not guaranteed physical performance. Validate designs with representative parts and tests.
- The current pattern uses a constant helical pitch, constant kerf, and start phase fixed at 0°.
- Kerf-end geometry and local stresses at cut terminations are not modeled.
- The displayed screen note states that for standard catheter walls with $D_o/t \leq 20$, the 3D solid crush result runs approximately 1.5–2.0 times thin-ring theory. Use the reported Crush Retention % to compare patterns, and interpret absolute crush values with appropriate caution.
- The interface warns that the Brazier/kink calculation may be yield-governed. Check the governing label and material card values, especially when changing material condition.
- The mesh / element estimate and solve time shown by the software are run-specific. A long or completed solve time alone does not establish accuracy.

Use the model to compare design alternatives and understand tradeoffs. Confirm critical performance requirements through engineering review and physical testing of representative tubing.

VIII. Reporting Errors or Requesting Feature Updates

Report software errors, unexpected results, or requests for feature updates to sales@cathcad.com. Include the CathCAD® version, Windows version, job identifier, input geometry, selected material and analysis mode, the message shown on screen, and a screenshot when practical. Do not send confidential customer drawings unless you are authorized to share them.