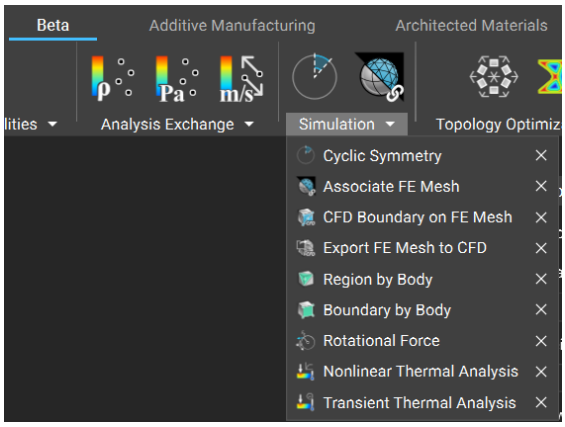
Follow Along: Advanced Thermal Analyses

Now, let's walk through a **Transient Thermal Analysis** and **Nonlinear Thermal Analysis** of the brake disc discussed in previous lessons.

Download the starter file in the lesson to get started.

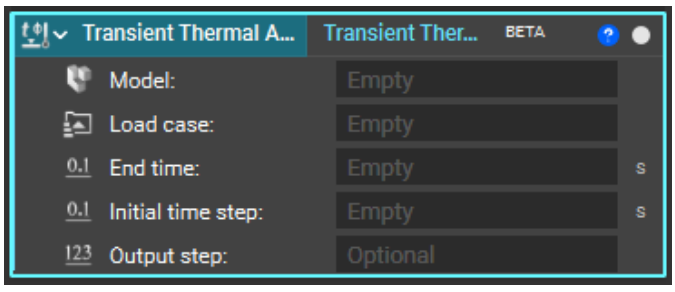
Step 1: Let's begin with a **Transient Thermal Analysis** of the brake disc. We will use the same Boundary Conditions as in the **Thermal Analysis** Follow-Along Lesson.

Add a Transient Thermal Analysis block to the Notebook. This block is found in the Simulation dropdown list of the Beta tab.

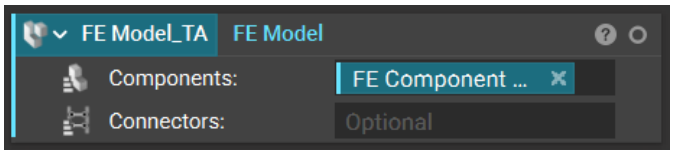


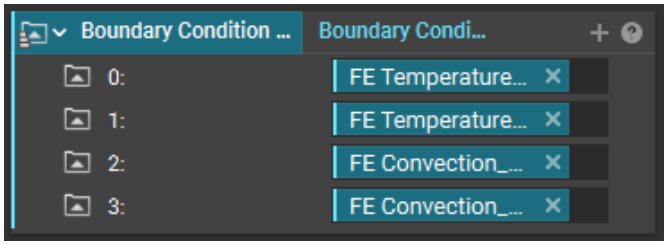
Notice that, like a Thermal Analysis, we have a Model and Load case input. However, because this type of analysis is time-dependent, we also have the inputs for End time, Initial time step, and an optional Output step (to specify N to output results at every Nth step).

Make this block into a variable called *Transient Thermal Analysis*.

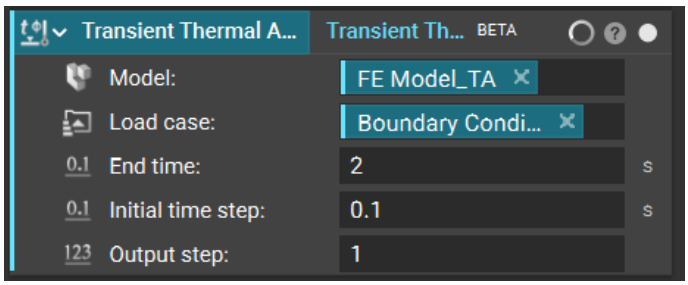


Add the same **FE Model** and **Boundary Conditions** that we used in the initial Thermal Analysis of the disk.

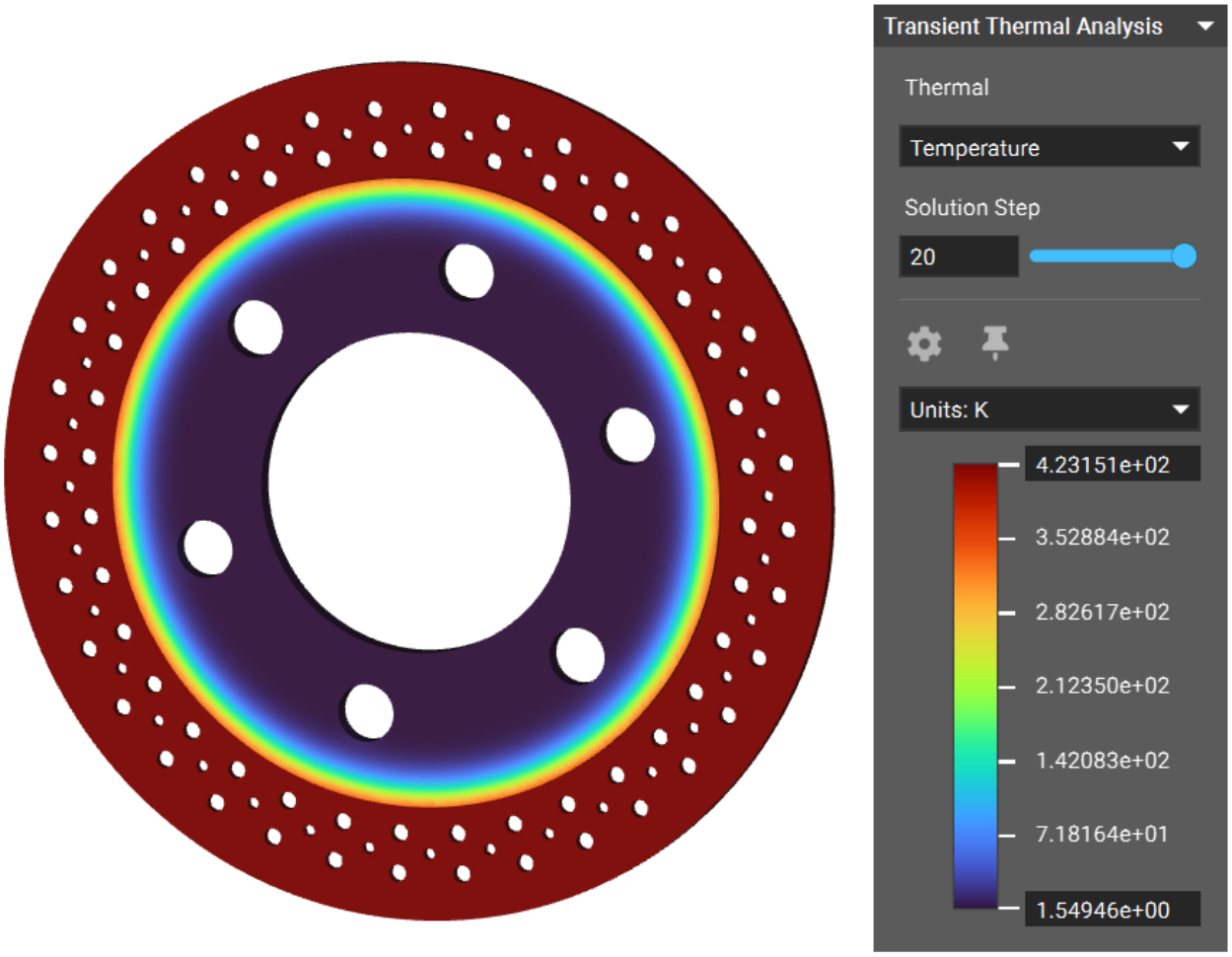




Add these to the **Transient Thermal Analysis** block. Then, specify an End time (2 s), Initial time step (0.1 s), and Output step (1). The block will automatically run.

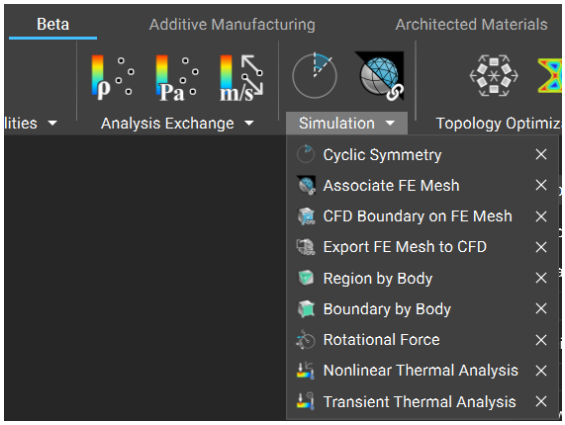


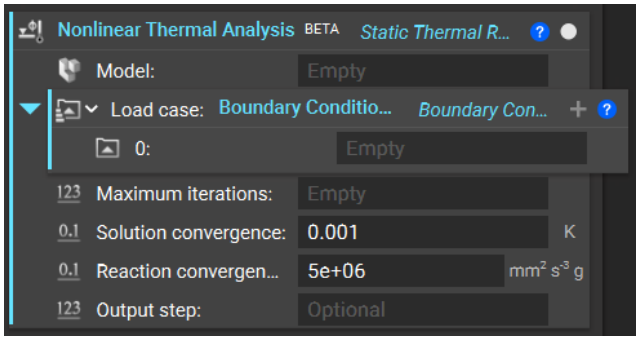
After the **Transient Thermal Analysis** runs, use the dropdown menu in the results window to specify the result type. Use the slider to choose a Solution Step to view.



Now, we have completed our **Transient Thermal Analysis**.

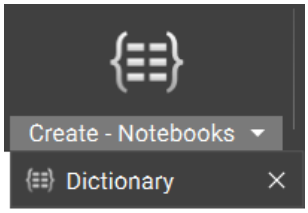
Step 2: Now, let's set up and run a **Nonlinear Thermal Analysis**. Begin by adding this block to the Notebook. It is found in the Simulation dropdown list under the Beta tab.

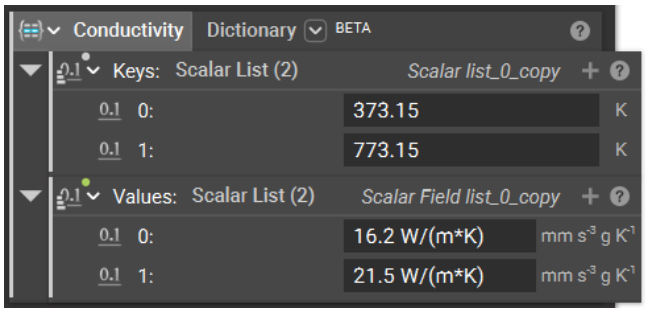


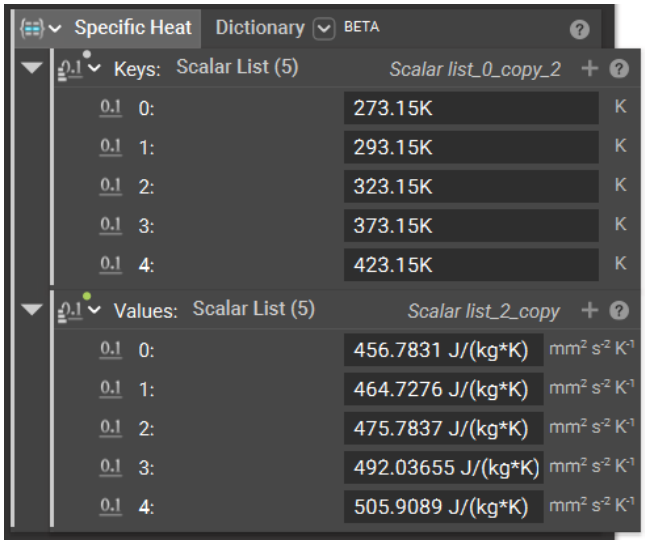


For this analysis, we'll need two additional material properties: Conductivity and Specific Heat of the stainless steel. Therefore, we will need to create an entirely new **FE Model**.

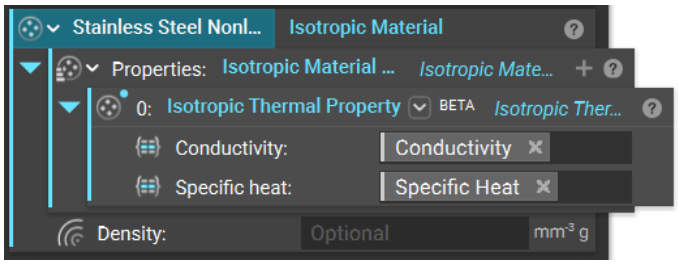
Use **Dictionary** blocks (from the Create - Notebooks dropdown list under the Beta tab) to specify Conductivity and Specific Heat at key temperatures for the nonlinear analysis in **Scalar Lists**.



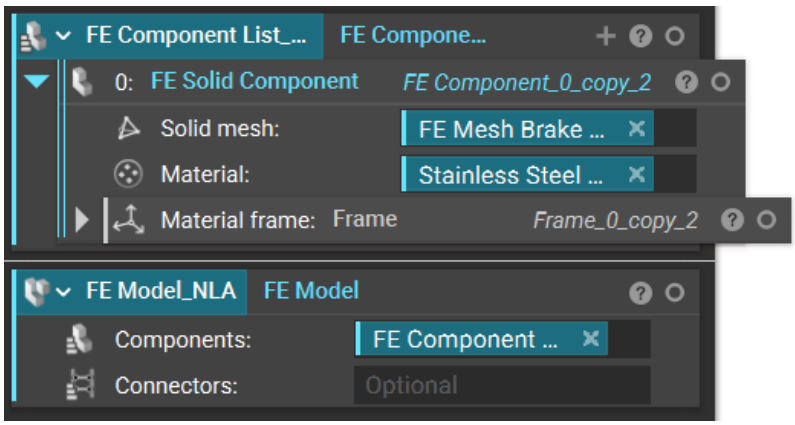




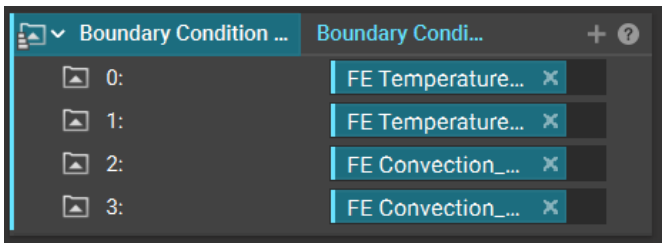
Add an **Isotropic Material** to the Notebook, followed by an **Isotropic Thermal Property** in the **Isotropic Material Properties** list. Drag the **Dictionary** blocks for Conductivity and Specific Heat into the list. Make this block a variable called *Stainless Steel Nonlinear*.



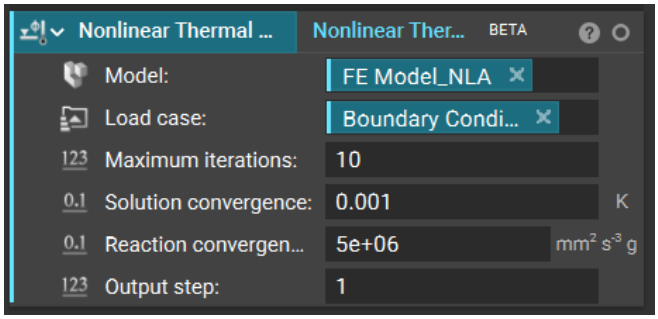
Next, add an **FE Model** block to the Notebook and make it a variable called *FE Model_NLA*. In the **Components List**, add an **FE Solid Component** and use the **FE Mesh** of the brake disc as the Solid mesh. Add the new SS material, and use the same Boundary Conditions as we used in the **Transient Thermal Analysis**.



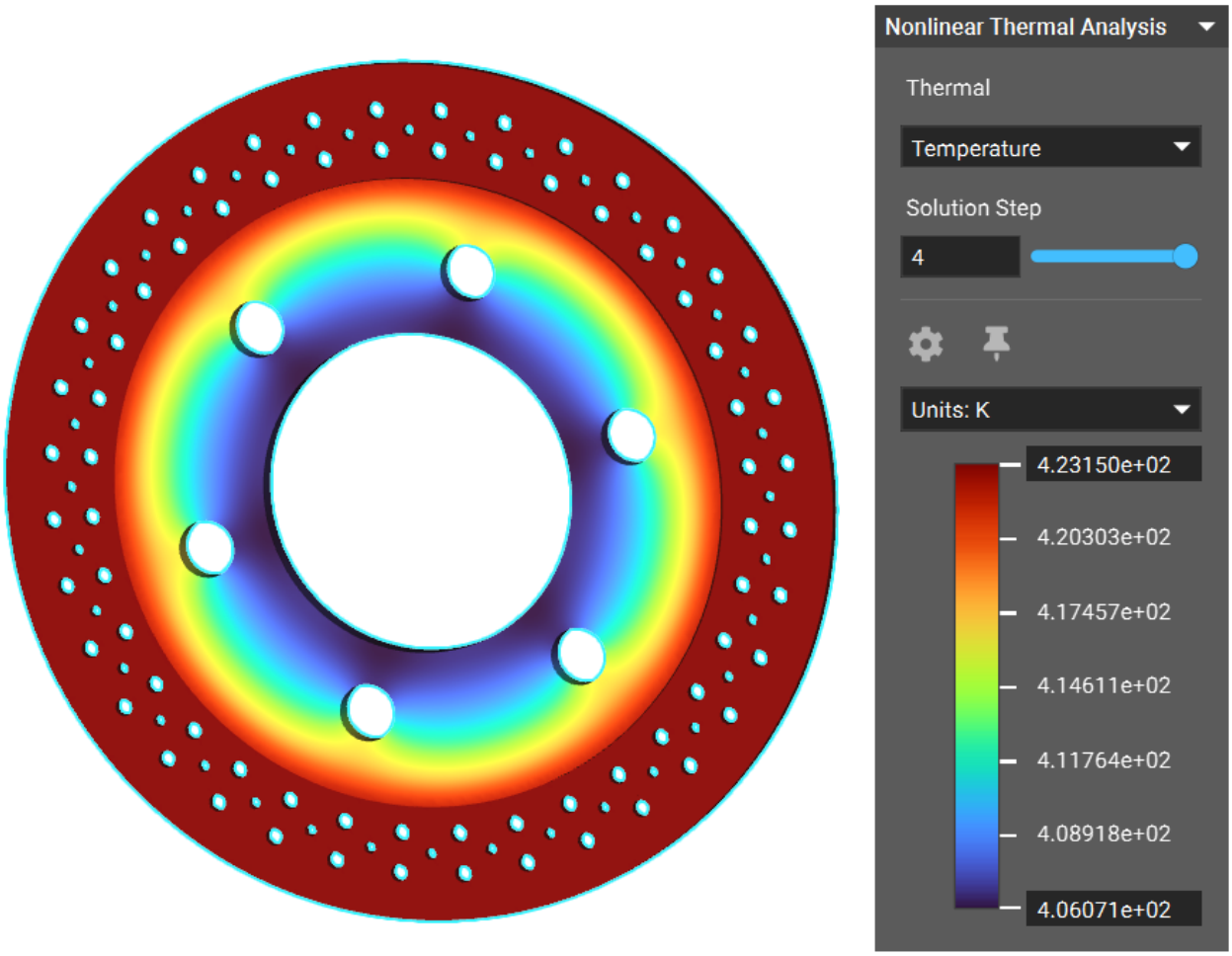
We will use the same Boundary Conditions as we used in the **Transient Thermal Analysis**. For visibility, copy and paste the variable into the new section and rename the variable *Boundary Conditions_NLA*.



Add these Boundary Conditions and **FE Model** to the **Nonlinear Thermal Analysis**, set a Maximum of 10 iterations, and choose output step of 1. Make this a variable called *Nonlinear Thermal Analysis*. The block will run automatically.



After the analysis runs, you can choose the result type and use the solution steps slider to view the results at different stept



Now, we have completed our **Nonlinear Thermal Analysis**.