

Flat Plate Boundary Layer - Part 2: Flat Plate Convection

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Problem Specification

1. Pre-Analysis & Start-Up
2. Geometry
3. Mesh
4. Model Setup
5. Numerical Solution
6. Post Processing
7. Verification & Validation
8. Part II: Flat Plate Convection

Frequently Asked Questions

Exercises

Comments

Part 2: Flat Plate Convection

Pre-Analysis

Model Setup and Solution

Post Processing

Nusselt Number Variation

Note 1: When you create graphs of the Nusselt number in Excel, you need to transfer the data points from the exported CSV file from ANSYS over to an Excel workbook file (.xlsx). A CSV file is just a flat text file that uses a delimiter to separate the fields (in this case, a comma). It CANNOT save any formulas or plots. A.xlsx file is the typical file format for Excel, just as.docx is for Word. In a.xlsx file, you can save the formulas, graphs, pivots, etc in the file. It was mentioned in the video, but we wanted to emphasize.

Note 2: The purpose of running one iteration here is to ONLY send the values of the heat transfer coefficient to the Post-Processor. This should be done ONLY if the solution has already converged which typically takes hundreds of iterations. Anytime a new Data File Quantity has been selected to be calculated, at least one iteration has to be performed to send the value(s) to the Post-Processor. In the video, the Professor already has a converged solution so to save time with unnecessary calculations, he sets the number of iterations to one.

Plotting Nu_x vs Pr

Here are the steps for generating a plot of Nu_x vs Pr for a chosen Re_x (say, 10,000) for selected Pr values (say, $Pr = 1, 3, 5$ and 7).

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- The screenshot displays the ANSYS Fluent 19.2.0 interface. On the left, the 'Materials' list in the 'Cell Zone Conditions' panel shows 'air' selected. The 'Create/Edit Materials' dialog box is open, showing the 'air' material type. The 'Properties' section lists the following values: Density (kg/m3) constant at 1.205, Cp (Specific Heat) (J/kg-K) constant at 1000, Thermal Conductivity (W/m-K) constant at 0.025, and Viscosity (kg/m-s) constant at 1.81e-05. The 'Run Calculation' button is highlighted in the 'Task Page' panel.

6. Plot Nu_x vs Pr in Excel and add the trend line to get a fit and the exponent m

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