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UNIVERSITY OF WINDSOR

Faculty of Engineering

Heat Transfer – MECH 3228

Heat Transfer COMSOL Assignment 2

Due date: July 2nd, 2021

Q 1. A metal alloy structure (k = 17 W/m·K) has a length of 5.3 cm, a perimeter of 11 cm, and a cross-sectional area of 5.13 cm2. The structure is exposed to hot gas from the combustion chamber at 973°C with a convection heat transfer coefficient of 538 W/m2·K. The base of the structure maintains a constant temperature of 450°C. Determine the heat transfer rate to the metal structure and temperature at the tip by performing two COMSOL simulations:

Simulation 1: rectangular shape, 1.19x4.31 cm

Simulation 2: circular shape with diameter given by the hydraulic diameter (i.e. D = 4A/p)

Tasks and deliverables:

1. Compare your answer with the answer obtained in the tutorial. Are the results different? If yes, discuss what could be the reason.
2. Provide a screenshot of your mesh and mesh information (i.e. Quads; Edge elements; Vertex elements; and Domain element statistics)
3. Provide a screenshot of your results in COMSOL
   1. Temperature distribution within the structure
   2. Results: Normal conductive heat flux; Heat Transfer rate; Inner surface temperature
4. Provide a screenshot of your entire COMSOL window containing your results with the Study being visible

Analysis:

Question 1:

My values compared to the tutorial solutions were different. For my rectangular fin tip, I got 5.71E5 W/m^2 for normal conductive heat flux, 293.02 W for heat transfer rate, and 1200 K (926degC) for the inner surface temperature. For the cylinder fin the normal conductive heat flux is 4.198E5 W/m^2, the heat transfer rate is 215.36W and the inner surface temperature was 918.79degC. The tutorial results were 370.1W for heat transfer and 960degC for the inner surface temperature. The reason for this big of a difference could possible be due to different shapes however the surface area of the heat transfer technically should be the same. A more plausible reason is because there was no actual material provided except for the thermal properties of the metal and gas applied, so I had chosen High strength alloy steel for my rectangular fin simulation and structural steel for my cylinder fin simulation. This is most likely the reason for the discrepancies between all 3 solutions.

Question 2:

Graphical user interface, chart, surface chart

Description automatically generated

Chart

Description automatically generated

Graphical user interface

Description automatically generated with medium confidence

Diagram

Description automatically generated

Question 3:

PART A:

Chart

Description automatically generated

Chart

Description automatically generated

PARTB:

Rectangular Fin:

Application, table

Description automatically generated with medium confidence

Cylinder:

Table

Description automatically generated with medium confidence

Question 4:

Graphical user interface, application

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Graphical user interface, application

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