CL455-CFD-Assignment-5

Date: 31/10/2022
Total Marks:7
Duration: 2:15 pm to 5:00 pm

2-D Natuaral convection inside a closed cavity.

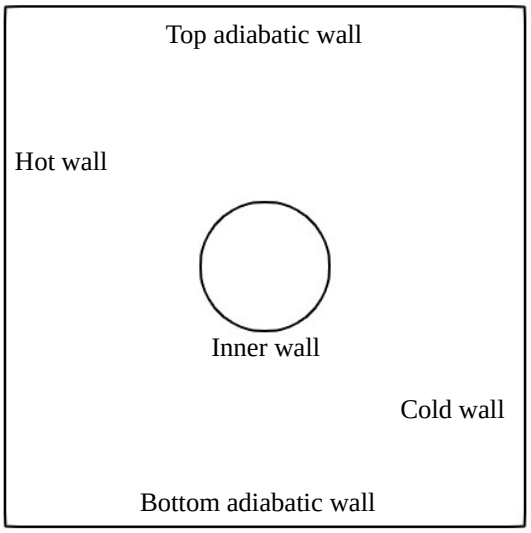
Consider a square cavity as shown below enclosing a circle within it; (Note that, circle is hollow, hence no need to mesh that part). Left wall is at higher temperature, right at low temperature, and top and bottom walls are adiabatic. Based on your roll number, maintain the temperature difference between hot and cold wall as ΔT= last two digits of your roll number + 10, and temperature of inner circle as ΔT/2. (Define values of temperature in Kelvin.)

Dimensions of the cavity are as: Square side = 200mm; Inner circle radius = 25mm.

Keep size of mesh in each block as 50*50*1 (x*y*z). Run your simulation for total time-steps of 10000.

Reference tutorial: $FOAM_Tutorial/heatTransfer/buoyantSimpleFoam/buoyantCavity.

[Do not change the fluid properties; use the default values already there in the script.]

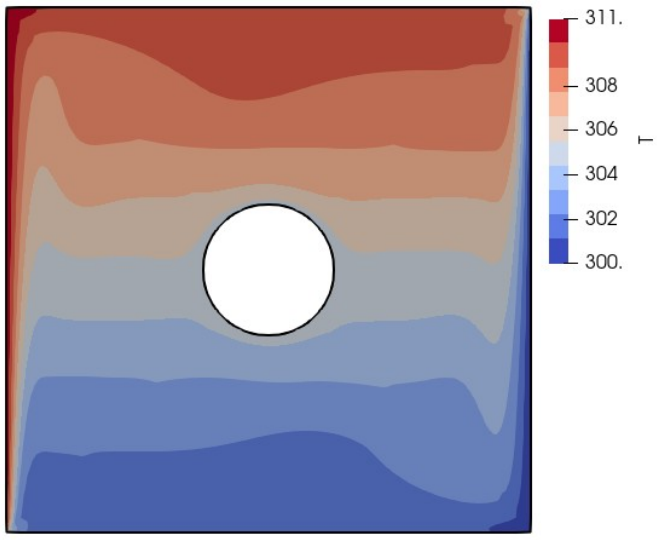


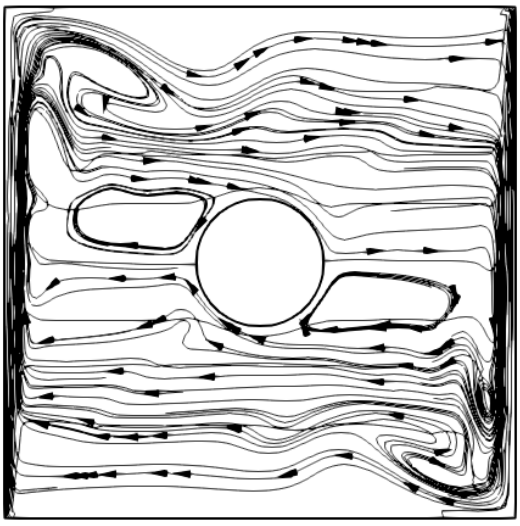
Obtain the following results and upload them as a single file.

1. Upload 0 / T file.
2. Show mesh, average velocity contours, and stream lines as shown below.

   Note: Till now,

   1. We presented results without boundary of the domain, notice boundary of the domain here.
   2. We plotted smooth contours, which is not the case here.
   3. The stream-lines were without arrows, they are present here.
3. What difference you observe in the 0 / P file compared to the previous cases. Provide specific reasons for the observations.
4. Calculate the Grashof number, and Rayleigh number based on cavity dimension, ΔT, and ρ=1.24; (required fluid properties can be found at location constant/thermophysicalProperties.)



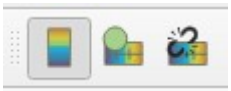


Guide

The tutorial for plotting arrows over the stream-line is provided here or use this link: https://www.youtube.com/watch?v=5M6VgXyHB60

Follow the steps below to obtain boundary of domain and isotherms (as shown in left figure):

1. On your case, apply ‘slice’ filter perpendicular to z direction.
2. Uncheck ‘Show Plane’ in properties bar.
3. Select ‘slice1’ in pipeline browser and apply ‘FeatureEdges’ filter.
4. In properties bar, under coloring section, change p (or U) to ‘solid Color’ and below that click on ‘Edit’ and select “Black colour”.
5. Below ‘Coloring’ select within a ‘styling’ title give ‘Line Width’ as 2.
6. Select ‘Slice1’ in pipeline browser.
7. From the option shown below, click on middle option. New window named ‘color Map Editor’ will open.



8. In this new window, under ‘Color Discretization’ title, change ‘Number Of Table Values’ to 10.

This way, you should be able to get the temperature contours as shown in the figure.