FACULTY OF MECHANICAL ENGINEERING

BMM4783 COMPUTATIONAL FLUID DYNAMICS

PROJEC TITLE:

Effect of Air Velocity on the Thermal-Hydraulic Behaviour of Arrays of Flat Tube Banks using CFD

DURATION	Six weeks (from week 8-13)
DEADLINE	Week 13
NAME AND MATRIC NO.	1.
	2.
MARK DISTRIBUTION	100 marks for presentation , 100 marks of report

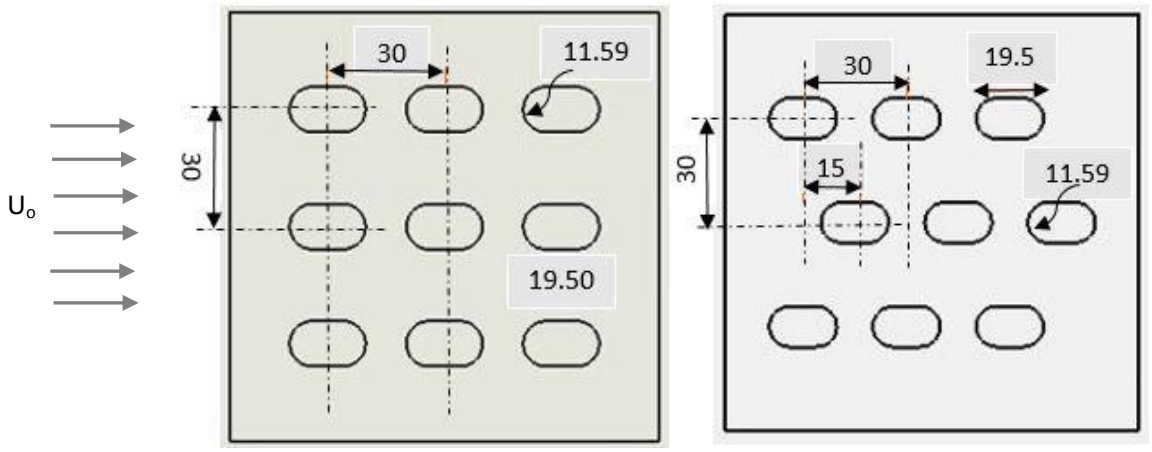
1. Objective

The Purpose of this CFD project is to simulate effect of air inlet velocity on steady flow of air over arrays of tube banks arranged in inline and staggered manner following the “CFD process” you studied during the lab classes and to conduct validation of friction factor and Nusselt number simulation results with experimental data. You will use post-processing tools (streamlines, velocity vectors, and contours) to visualize the flow fields. Moreover, you are required to analyze the differences between CFD and experimental data and present results in a CFD Lab report.

2. Problem Description

The problem to be analyzed is **effect of air inlet velocity** on the steady flow of air over the tube banks shown in Fig. 1. Throughout the simulation, the tube banks’ remain parallel to the flow direction, i.e., $\alpha = 0^{o}$. For the analysis, the tube surfaces are considered to have fixed surface temperature of 100 ^{o}C and only the air flows over the tube surfaces at various velocities ranging from

1.8 m/s – 3.8 m/s. Take note that you need to used either symmetry or periodic boundary conditions to reduce computational time and space. Other useful dimensions are presented in Table 1.



(a) (b)

Fig.1. Schematic diagrams for cross-section of fin-and-tube heat exchanger with (a) in-line and (b) staggered arrangements (all dimensions are in mm)

Table 1. Computational domain geometric details

Name	Value (mm)	Symbol
Tube transverse pitch	30	P_t
Tube longitudinal pitch	30	P_l
Tube diameter	11.59	D
Tube hydraulic diameter	15.1	D_h
Tube and fin material	-	Aluminum (al)

3. Expected Results

Your analysis should include at least the following:

- Mesh independency test
- Comparison of experimental and simulation data for friction factor and/or Nusselt number including percentage errors.
- Residual plots and contour of stream functions.
- Variation of friction factor and Nusselt number with inlet velocity (Reynolds number) in xy plot

- Variation of temperature distribution along the flow direction in xy plot
- Contours, velocity vectors, etc.
- Other data

Note:- All results included in the report should be discussed in detail.

4. Report

Strictly follow the provided guideline for report preparation.