

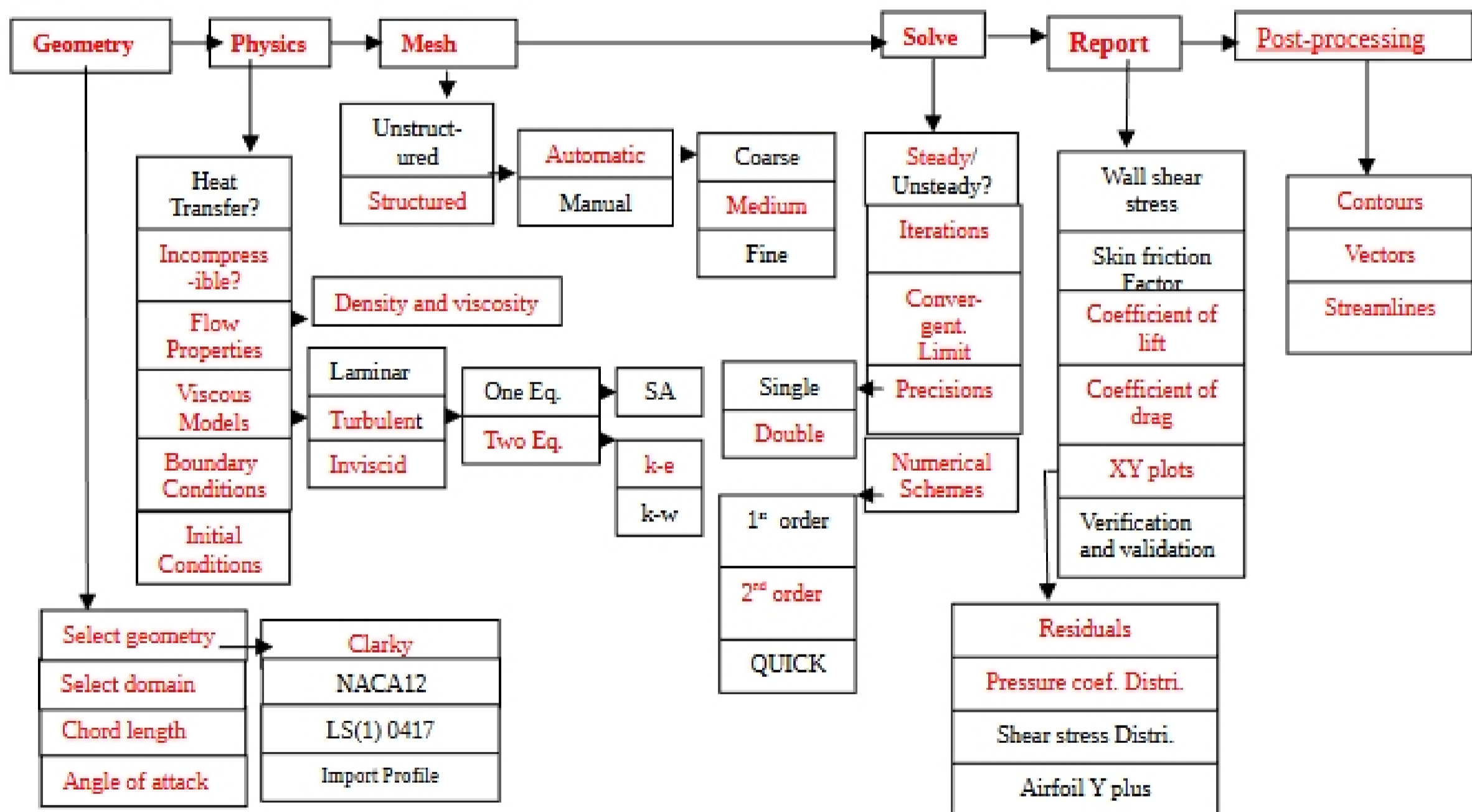
Simulation of Turbulent Flow around an Airfoil

57:020 Mechanics of Fluids and Transfer Processes CFD PRELAB 2

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1. Purpose

The Purpose of CFD PreLab 2 is to simulate **turbulent** flow around Clarky airfoil following “CFD process” by an interactive step-by-step approach. Students will have “hands-on” experiences using FlowLab to compute pressure, lift and drag coefficients using both **viscous and inviscid** models. Students will **validate** simulation results with EFD data measured at EFD Lab 3, analyze the differences and possible numerical errors, and present results in Lab report.

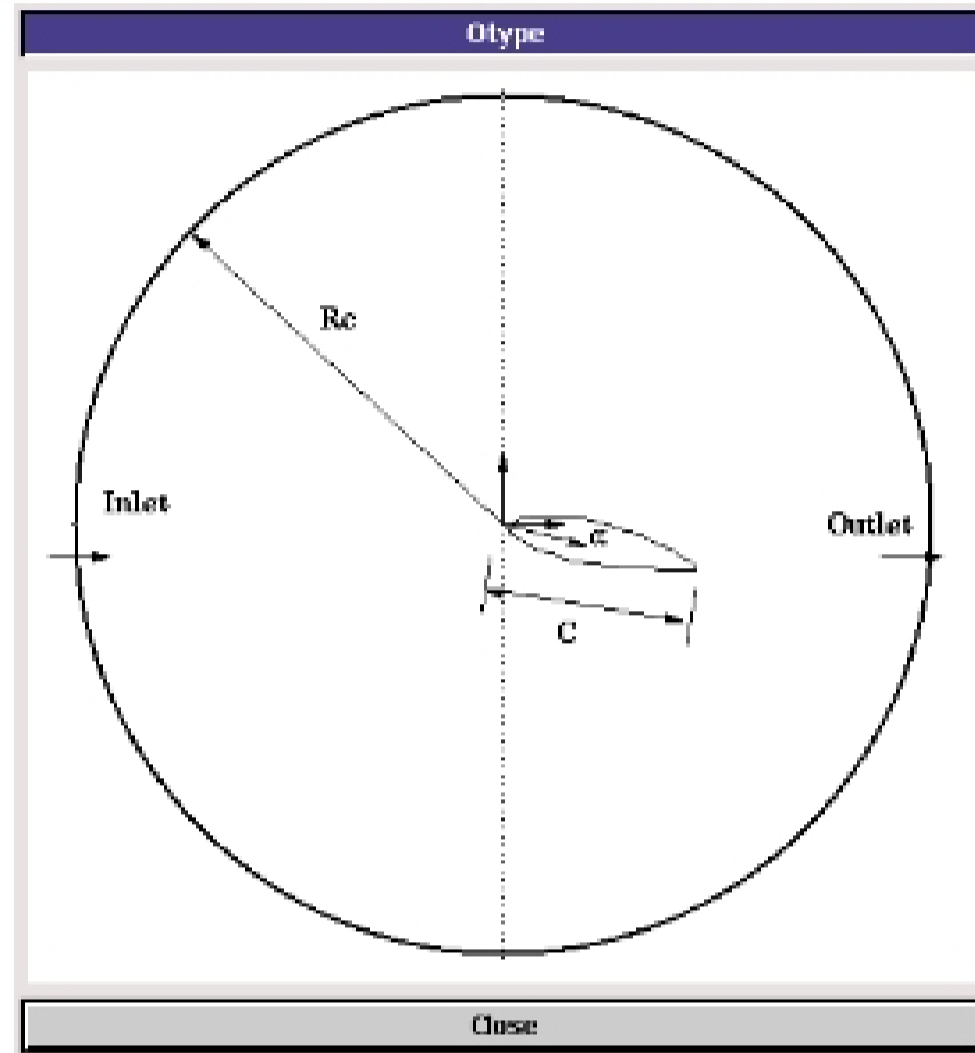


Flow chart for ISTUE teaching module for airfoil flow (red color illustrates the options you will use in this CFD PreLab 2)

2. Simulation Design

In EFD Lab 3, you have conducted experimental study for turbulent flow around a ClarkY airfoil ($Re=300,000$) for two angles of attack 0 and 16 degrees. The pressure on the foil surface you have measured will be used for CFD PreLab 2. In CFD PreLab 2, simulation will be conducted under the same conditions of EFD Lab 3 (geometry, Reynolds number, fluid properties) at angle of attack 0 degree using both viscous and inviscid models. Simulation results will be validated by your own EFD data.

The problem to be solved is turbulent flow around the ClarkY airfoil with angle of attack (0)



In the figure above, C is the chord length of the airfoil, α is the angle of attack, and Rc is the radius of the “O” domain.

3. CFD Process

Step 1: (Geometry)

Geometry	
Select Geometry	ClarkY
Select Domain	O type
Chord Length (C)	0.3048 m
Angle of attack	0
Mesh Type	Map
Circle Radius	0.3048 m
Reset	Create
Next >	

Choose “ClarkY” airfoil and “O type” domain, input the chord length of the foil and angle of attack 0 degree.

1. **Select Geometry** (Clarky)

2. **Select domain** (O type)
3. **Chord length** (0.3048 m)
4. **Angle of attack** (0)
5. **Mesh type** (Map)
6. **Circle Radius Rc** (6m)

Click <<Create>>→<<Next>>.

Step 2: (Physics)

(1). With or without Heat Transfer?

Since we are not dealing with the thermal aspects of the flow, like heat transfer, etc., switch the <<**Heat Transfer**>> button OFF, which is the default setup.

(2). Incompressible

Use “Incompressible”. “Compressible” option is not available for current template.

(3). Flow Properties

Use the air properties at the **room temperature** when you conducted EFD Lab3 and click <<OK>>. You can use the following website to calculate air properties from the temperature:

<http://www.mhtl.uwaterloo.ca/old/onlinetools/airprop/airprop.html>

The values in the figure above are for 24° temperature.