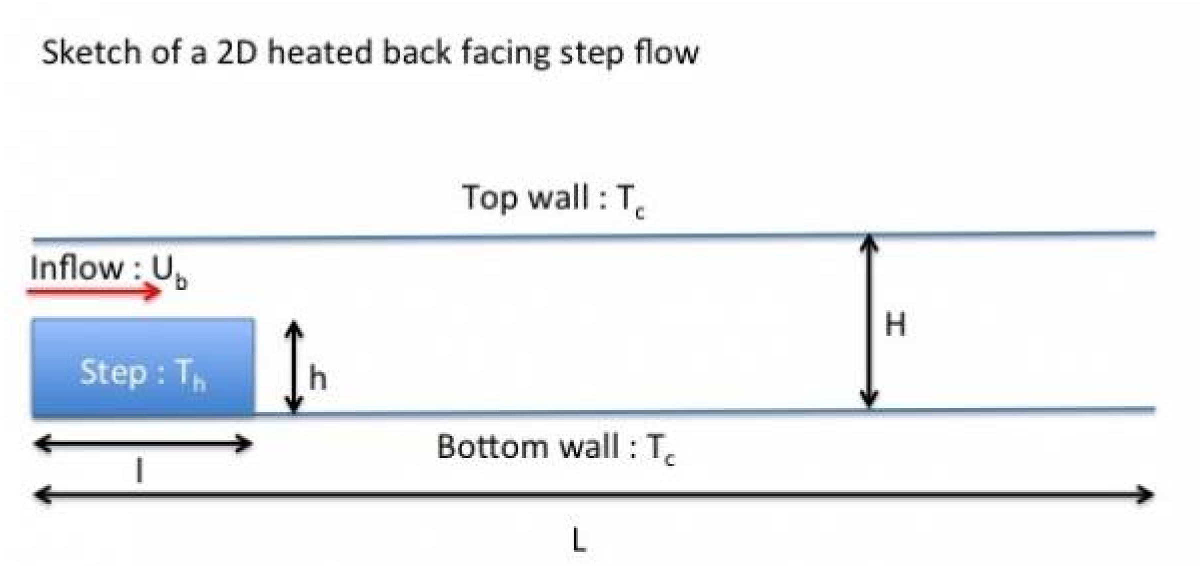
Tutorial : How to build the input data file ?

This tutorial shows how to create an input data file for a 2D heated back-facing step flow. After providing the main features of the problem, explanations on how to build step by step the corresponding data file is shown. Each relevant namelist is commented and referred to other pages for more details.
The user can create its own data file by resorting to any highlighted data set.

Flow characteristics

Description

The computation is on a 2D heated back-facing step flow. The temperature of the bottom and top walls is imposed to T_c and the temperature of the step walls is T_h. The inflow is fixed with an uniform velocity profile U_b at temperature Tc. We consider an incompressible flow under the Boussinesq hypothesis : the physical properties are constant and the thermal buoyancy effect is modelised by the Boussinesq hypothesis : $F_b= -\rho_0.\beta.g_0.(T - T_0)$ (see the page Gravity for more details). We suppose the fluid is air that behaves as a perfect gas. As a consequence, $\beta= \frac{1}{T_0}$



The governing equations for incompressible flows are shown here.

Dimensionless data

Reference scales for the dimensionless problem :

- the fluid density ρ_0
- the bulk velocity U_b
- the kinematic viscosity μ_0
- the step height
- the temperature T_c

From the previous reference scales, we define the Reynolds number : $Re_h= \frac{\rho_0 \dot U_b \dot h}{\mu_0}$ and the dimensionless temperature $T*= \frac{T}{T_c}$.
We therefore deduce the following dimensionless data :

- Fluid density $\rho_0*=1$
- Inflow bulk velocity $U_b*= 1$
- Bottom and top wall temperature $T_c*=1$
- Thermal expansion coefficient $\beta*=1$
- Step height $h*= 1$

Any other data of the problem are set to :

- Domain length : $L*=12$
- Domain height : $H*= 2$
- Step length : $l*= 2$
- Reynolds number $Re_h= 100$
- Step wall temperature $T_h*= 2$
- Gravity constant $g*= \frac{g_0 \dot h}{U_b^2}= 1$
- Prandtl number $Pr= 0.71$

Data setup

We now build the data file by selecting the relevant namelists in the lookup list. We only keep the relevant variables (that must be explicitly set). The others ones are removed. We need to set :

- Data set on the fluid properties
- Data set on the computational domain
- Data set on physical quantity initialization over the domain
- Data set on forces on the fluid
- Data set on the boundary conditions
- Data set on the numerical methods
- Data set on the simulation control
- Data set on the output data

Boundary conditions can be difficult to understand. Some help can be find through some examples illustrated here.