input3d.dat

```
================================================================================
====
================================================================================
====
            MAIN INPUT DATA FILE : 3D HEAT-DRIVEN CAVITY FLOW PROBLEM
                   IN DIMENSIONAL UNITS
                   COUPLED WITH WALL AND GAS RADIATION
================================================================================
====
================================================================================
====

                                    _____________________ ADIABATIC ( \lambda
\nabla T \cdot \vec{n} + Q_{radiation} = 0 )
                                   /
                 _________________/_____
                /                /     /|
           /              /     / |
              /                     /  |
         /                   /   |  _______________  COLD ( Tc )
        /                   /    | /
HOT (Th)/___________________/     |/
________  |                |     /
        \ |                |    /|
         \|                |     |
      |                  |     |
      |                  |    /
      |                  |   /
      |                  |  /
      |      \           | /
      |_______\__________|/
               \
                \____________________ ADIABATIC ( \lambda \nabla T \cdot
\vec{n} + Q_{radiation} = 0 )



      K
      ^
      |   J                  |
      |  /                   | gravity ( g =9.81 m.s-2)
      | /                    |
      |/                    _|_
       ---------> I         \_/

      DESIRED CONFIGURATION :
              + CASE B from (Soucasse et al. 2012)
                  - Ra = 1.D+06
```

```
                - Pr = 0.707
                - T0 = 300 K
                - P0 = 101325 Pa
                - Uniform molar fraction of H2O = 0.02

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++
                     GENERAL LAYOUT
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++
&Version File_Version="VERSION2.0"/
================================================================================
====
                FLUID PROPERTIES
================================================================================
====
 INCOMPRESSIBLE FLUID FLOW  --> Constant Density
 HEAT DRIVEN FLOW       --> Activation of Heat Transfer
 BOUSSINESQ ASSUMPTION      --> Thermal Expansion Coefficient = 1/T0 (
here beta = 0 ==> beta = 1/T0 )

&Fluid_Properties   Variable_Density    = .false.   ,
Constant_Mass_Flow  = .true. , Heat_Transfer_Flow = .true.  ,
            Heat_Capacity_Ratio = 1.4  , Reference_Density= 1.225,
Reference_Dynamic_Viscosity= 1.852D-05,
            Reference_Temperature= 300.0  , Prandtl = 0.707,
Reference_Heat_Capacity = 1004.D0 , Thermal_Expansion_coefficient =
0.0/

================================================================================
====
   INITIALIZATION OF THE VELOCITY COMPONENTS, THE TEMPERATURE AND
SPECIES
================================================================================
====
 START FROM FLOW AT REST
 AND UNIFORM TEMPERATURE at T0 = 300 K

&Velocity_Initialization    I_Velocity_Reference_Value = 0.0  ,
J_Velocity_Reference_Value = 0.0  , K_Velocity_Reference_Value = 0.0 ,
                Initial_Field_Option_For_Velocity_I = 0,
Initial_Field_Option_For_Velocity_J = 0 ,
Initial_Field_Option_For_Velocity_K = 0/

&Temperature_Initialization     Temperature_Reference_Value = 300.0,
Initial_Field_Option_For_Temperature = 0 /

================================================================================
====
                GRAVITY
```

```
================================================================================
 FORCE GRAVITY ALONG THE VERTICAL AXIS POINTING DOWNWARD ( i.e. gravity
= -g.\vec{z} )
 CONSIDERING DIMENSIONAL PARAMETER g = 9.81 m/s^2

&Gravity  Gravity_Enabled= .true. , Gravity_Angle_IJ= 90.0  ,
Gravity_Angle_IK= 0.0 , Reference_Gravity_Constant= 9.81 /

================================================================================
                 RADIATION
================================================================================
 AS RADIATION IS CONSIDERED :
 - ACTIVATE THE RADIATIVE SOLVER [default = .false.] ( ONLY FOR 3D
CARTESIAN PROBLEMS !! )
 - SOLVE THE RADIATIVE PROBLEM EVERY 5 CONVECTIVE TIMESTEP ( LIMIT TIME
CONSUMPTION , KEEP THIS PARAMETER LOWER THAN 5~8 FOR STABILITY ... )
[default = 1]
 - IF STARTED FROM SCRATCH, FORCE THE SOLVER TO ITERATE OVER
FirstIterations=200 LOCAL ITERATIONS FOR INCIDENT FLUXES CONVERGENCES
   AT WALLS AND VOLUMIC RADIATIVE SOURCE TERM [default = 20]
 - FOR EACH RADIATIVE PROBLEM SOLVING STEPS, ITERATE OVER
RadiativeLocalIterations=20 SUB-ITERATIONS OR UNTIL
RadiativeConvergenceTolerance=5.E-05 RESIDUAL
   ERROR IS REACHED [default = 1.E-15]
 - WallRadCoeff AND VolRadCoeff ARE FOR DEVELOPPEMENT ONLY ... [default
= 1]
 - CONSIDER THE "LATHROP" SCHEME TO INTERPOLATE THE CELL-FACES
RADIATIVE INTENSITY [default = STEP]
 - CONSIDER THE ANGULAR DISCRETISATION WITH S10 LEVEL SYMMETRIC
QUADRATURES SQuad = 10 ( 120 DIRECTIONS IN VOLUMES, 60 DIRECTIONS ON
WALLS) [default = 8]
 - CONSIDER BLACK WALLS ON DIRICHLET WALLS AND REFLECTIVE WALLS ON THE
OTHERS [default = 0.1]
 - CONSIDER THE MEDIUM AS A REAL GAS MIXTURE :
   + ACTIVATE THE SLW MODEL ActivateGas=.true. [default = .false.]
   + SPLIT THE ABSOPTION COEFFICIENT DOMAIN IN 8 WEIGHTED SUM OF GRAY-
GASES NbGas = 8 [default = 1]
   + ka_min AND ka_max REPRESENTS THE MININUM AND MAXIMUM RANGE OF THE
ABSORPTION COEFFICIENT DOMAIN in m^{-1} [default = 0]
   + CONSIDERS THE MEDIUM AS AN AIR-H2O GAS MIXTURE WITH UNIFORM MOLAR
FRACTION x = 0.02 [default = 0.07]

&Radiative_Heat_Transfer_DOM    activateRadiation=.true. ,
RadiativePeriod = 5, FirstIterations=200,
                RadiativeLocalIterations=20,
RadiativeConvergenceTolerance = 5.E-05,
                WallRadcoeff = 1.0 , VolRadCoeff = 1.0, RadiativeScheme
= "LATHROP",
```

```
                ActivateGas=.true., NbGas = 8, ka_max=570.,
ka_min=6.3e-07,
                Pref=101325.0, Href = 1.0, speca='H2O',xaref=0.02,
xaUniform=0.02,
                SQuad = 10, WallEmissivity = 1.0 1.0 0.0 0.0 0.0 0.0 /

================================================================================
                   DOMAIN FEATURES
================================================================================
 - CONSIDER HERE A CUBICAL CAVITY WITH WALL REFINED CELLS GIVEN IN
SEPARATE MESH FILES
 - WE CONSIDERS AN MPI DOMAIN DECOMPOSITION PROBLEM ON 2x2x3 MPI
PROCESSES

&Domain_Features Start_Coordinate_I_Direction= 0.00 ,
End_Coordinate_I_Direction= 1.00,
                Start_Coordinate_J_Direction= 0.00 ,
End_Coordinate_J_Direction= 1.00,
                Start_Coordinate_K_Direction= 0.00 ,
End_Coordinate_K_Direction= 1.00,
                Cells_Number_I_Direction= 40
,Cells_Number_J_Direction= 40 ,Cells_Number_K_Direction= 30,
                Number_OMP_Threads= 1,
                MPI_Cartesian_Topology= .true. ,
                Total_Number_MPI_Processes= 12,
                Max_Number_MPI_Proc_I_Direction= 2 ,
Max_Number_MPI_Proc_J_Direction= 2, Max_Number_MPI_Proc_K_Direction= 3,
                Regular_Mesh= .false. /

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+++++++
             DEFINITION OF BOUNDARY CONDITIONS
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++
================================================================================
======
                WALL BOUNDARY CONDITION SETUP
================================================================================
======
 - WE CONSIDER DIRICHLET TEMPERATURE CONDITION ON HOT AND COLD WALLS
(Heat_BC_Option = 0)
 - AND WALL CONVECTION-RADIATION COUPLING AT THE OTHER WALLS
(Heat_BC_Option = 5)

&Heat_Wall_Boundary_Condition_Setup
      Wall_BC_DataSetName ="Set1",
      West_Heat_BC_Option = 0 , East_Heat_BC_Option = 0 ,
Back_Heat_BC_Option = 5 ,  Front_Heat_BC_Option = 5 ,
```

```
South_Heat_BC_Option = 5 , North_Heat_BC_Option = 5,
      West_Wall_BC_Value= 300.005 , East_Wall_BC_Value= 299.995 ,
Back_Wall_BC_Value= 0.0 , Front_Wall_BC_Value= 0.0 ,
South_Wall_BC_Value= 0.0 , North_Wall_BC_Value= 0.0 /

================================================================================
               BORDER BOUNDARY CONDITIONS
================================================================================
 !--- No new boundary conditions are defined at the ends of the domain
: walls by default are preserved, the inlet and outlet previously are
defined above)
!--- As "None" is the default setting for this namelist, it can be
removed

&Border_Domain_Boundary_Conditions West_BC_Name= "None" , East_BC_Name=
"None" , Back_BC_Name= "None" , Front_BC_Name= "None" , North_BC_Name=
"None" , South_BC_Name= "None" /
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++
                    NUMERICAL METHODS
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++
 PARTIAL DIAGONALISATION TECHNIQUE IS EMPLOYED FOR THE POISSON PROBLEM
==>  Numerical_Method_Poisson_Equation   = 3

&Numerical_Methods  NS_NumericalMethod= "BDF2-SchemeO2"
,       !--- BDF2 + 2nd order centered scheme
                    MomentumConvection_Scheme="Centered-O2-
Conservative"   ,       !--- conservative form for solving the velocity
(momentum) equation
                    TemperatureAdvection_Scheme="Centered-O2-
Conservative",       !--- conservative form for solving the temperature
(enthalpy) equation
                    Poisson_NumericalMethod="Home-
PartialDiagonalization"  /       !--- Partial Diagonalization for
Poisson's equation
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++
                    SIMULATION MANAGEMENT
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++
 - START FROM SCRATCH IF Restart_Parameter= 0 OR FROM EXISTING FILES IF
Restart_Parameter= 3
 - WE CONSIDERS THAT THE PROBLEM WILL REACH A STEADY STATE AND WILL
EVOLVE IN TIME WITH FIXED CFL PARAMETER

&Simulation_Management    Restart_Parameter= 3 ,
                          Steady_Flow_Stopping_Criterion_Enabled =
.true. , Steady_Flow_Stopping_Criterion = 1.D-14,
```

```
                            Temporal_Iterations_Number = 100 , Final_Time
= 3.D+04  ,
                            TimeStep_Type = 1 ,
                            CFL_Min      = 0.3 , CFL_Max      = 0.3 ,
                            Timestep_Min = 1.D-03   , Timestep_Max =
1.D+01 ,
                            Iterations_For_Timestep_Linear_Progress= 1,
                            Probe_Recording_Rate                   = 1000
,
                            Simulation_Backup_Rate                 = 5000
, Simulation_Checking_Rate = 20 /

================================================================================
                    PROBES MANAGEMENT
================================================================================
================================================================================
           FIELDS RECORDING SETUP
================================================================================
&Field_Recording_Setup     Check_Special_Features=
"NOHeat_Driven_Cavity_Flow" /

&Simulation_Management
    InstantaneousFields_RecordingReset=.false.     ,
    InstantaneousFields_TimeRecordingRate= 5.0E+01 ,
    InstantaneousFields_RecordingStartTime= 0.D-00  /
&Instantaneous_Fields_Listing  Name_of_Field = "U     " /      First
velocity component
&Instantaneous_Fields_Listing  Name_of_Field = "V     " /      Second
velocity component
&Instantaneous_Fields_Listing  Name_of_Field = "W     " /      Third
velocity component
&Instantaneous_Fields_Listing  Name_of_Field = "T     " /
Temperature
&Instantaneous_Fields_Listing  Name_of_Field = "P     " /      Pressure
&Instantaneous_Fields_Listing  Name_of_Field = "divU  " /      Momentum
divergence


END OF FILE
```

From:
https://sunfluidh.lisn.upsaclay.fr/ - **Documentation du code de simulation numérique SUNFLUIDH**

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https://sunfluidh.lisn.upsaclay.fr/doku.php?id=sunfluidh:3d_heat_driven_cavity_incomp_flow_gasrad

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