```
===========================================================================
===========================================================================
            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
```

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===========================================================================
 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,
```

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                 Regular_Mesh= .false. /

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++
              DEFINITION OF BOUNDARY CONDITIONS
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============================================================================
=
                 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
      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 ,
      End_of_Data_Block= .true.   /
============================================================================
=
               BORDER BOUNDARY CONDITIONS
============================================================================
=
 THE BORDER BOUNDARY CONDITIONS HAVE ALREADY BEEN DEFINED ==> Border = 0

&Border_Domain_Boundary_Conditions West_Border= 0 , East_Border= 0 ,
Back_Border= 0 , Front_Border= 0 , North_Border = 0 , South_Border = 0 /
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++
                   NUMERICAL METHODS
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++
 PARTIAL DIAGONALISATION TECHNIQUE IS EMPLOYED FOR THE POISSON PROBLEM ==>
Numerical_Method_Poisson_Equation   = 3

&Numerical_Methods  Numerical_Scheme= 1 ,
                    Convective_Flux_Discretization_Type = 1  ,
Temperature_Advective_Flux_Discretization_Type = 1 ,
Species_Advective_Flux_Discretization_Type= 1 ,
                    Explicit_Solving_of_Density         = 0  ,
Velocity_Correction_Enabled        = .true.,
                    Numerical_Method_Poisson_Equation   = 3  ,
Iterative_Method_Selection         = 1    ,
```

```
                    Number_max_Grid= 4                       ,
Number_max_Cycle= 10         , Number_Iteration= 15,
                    Relaxation_Coefficient           = 1.80 ,
Convergence_Criterion = 1.D-08 /
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++
                   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 DECLARATION
============================================================================
=
&Field_Recording_Setup     Check_Special_Features=
"NOHeat_Driven_Cavity_Flow" /
&Simulation_Management     Fields_Recording_Rate = 5.D+02 /
&Instantaneous_Fields_Listing  Name_of_Field = "U     " , Recording_Enabled
= .true.  /      First velocity component
&Instantaneous_Fields_Listing  Name_of_Field = "V     " , Recording_Enabled
= .true.  /      Second velocity component
&Instantaneous_Fields_Listing  Name_of_Field = "W     " , Recording_Enabled
= .true.  /      Third velocity component
&Instantaneous_Fields_Listing  Name_of_Field = "T     " , Recording_Enabled
= .true. /      Temperature
&Instantaneous_Fields_Listing  Name_of_Field = "P     " , Recording_Enabled
= .true. /      Pressure
```

```
&Instantaneous_Fields_Listing  Name_of_Field = "divU  " , Recording_Enabled
= .true. , End_of_Data_Block= .true. /      momentum divergence
```

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

Permanent link:
https://sunfluidh.lisn.upsaclay.fr/doku.php?id=sunfluidh:3d_heat_driven_cavity_incomp_flow_gasrad&rev=1481641799

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