RESULTS VISUALIZATION

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1.1 Case study 1 - Laplace problem

Case study 1 involves solving a linear Laplace equation in a cubic domain as shown in figure 1. Following case have been simulated.

In ***case 1*** at left face of the cube a temperature of 0 units and on the right face a temperature of 0.5 unit is prescribed.
In ***case 2*** a temperature of 0 unit and 1 unit is prescribed on top and bottom face respectively.
In ***case 3*** Boundary condition of 1 unit is prescribed on the Front face.

1.2 Results

Case 1. It can be seen that the temperature field linearly changes from left to the right face.

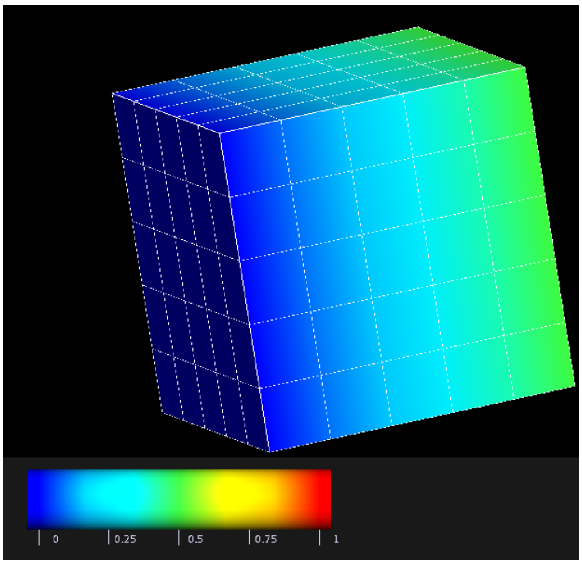


Fig 1.1 Temperature field for case 1

Case 2. Temperature linearly increases from top to bottom face.

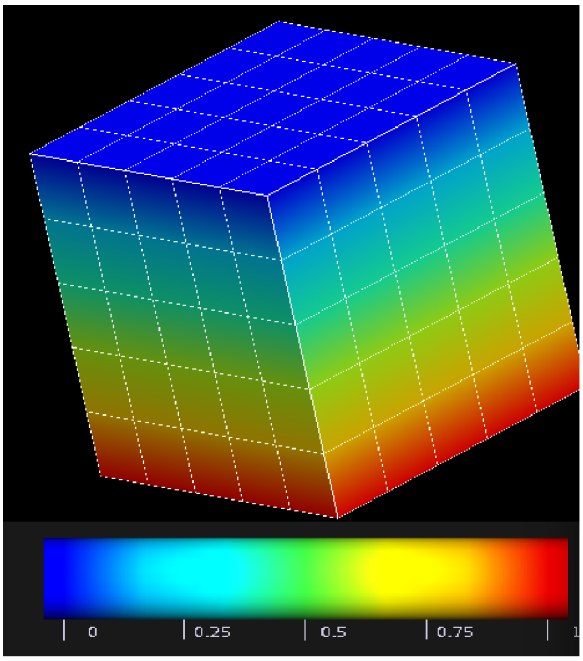


Fig 1.2 Temperature field for case 2

Case 3. The whole domain attains a uniform temperature of 1 unit.

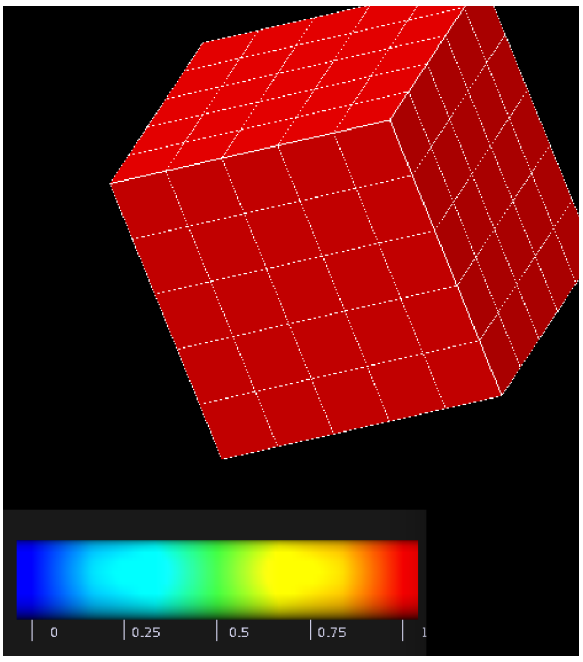


Fig1.3 Temperature field for case 3

2.1 Case study 2 - Two Dimensional Flow problem

Case study 2 involves a 2 dimensional flow problem involves flow of fluid in 2D rectangular pipe. Following are some feature of this simulation, although all these features can be tweaked from the input file. *Note that before changing feature , please make sure the feature is included in the KeywordLibrary.f90.*

1. 1) The pipe is 10 meters in length and 2 meters in width.
2. A rectangular mesh is used with 5x5 elements.
3. He fluid has unit density and viscosity.
4. The analysis has been preformed in 100 time steps.
5. Implicit theta time integration scheme is used.
6. Boundary Conditions: No slip condition is applied on top and bottom edge of the rectangular. A horizontal velocity of 1 unit is prescribed in left edge of the domain (figure 2.1) and pressure of 0 units us applied on the right edge.

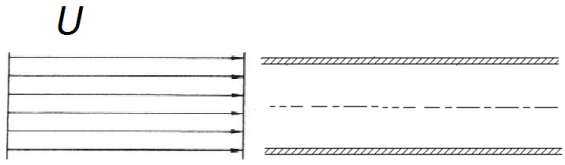


Fig 2.1 Schematic of the case2

2.2 Results

2.2.1 Velocity field

The horizontal component of velocity is illustrated in figure 2.2. It can be seen that value of velocity is zero on top and bottom edge due to no stick condition. The horizontal velocity v_x attains a steady parabolic profile after some time interval. Moreover after the flow is fully developed, It becomes independent of the x axis, that is:

$$v(x, y) = v(y) \tag{1}$$

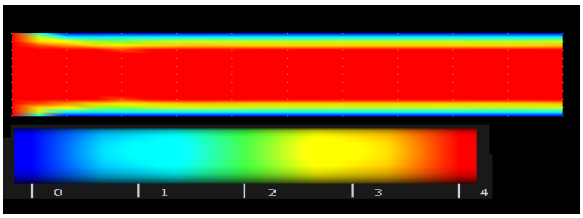
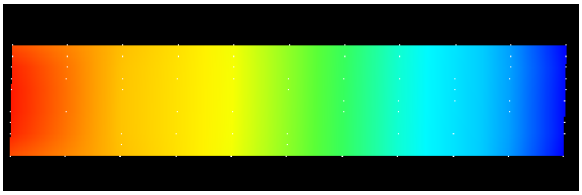


Fig 2.2 Velocity field of case study 2

2.2.2 Pressure field

It can be seen in the figure 4.3, the pressure field decreases linearly from left to right edge. As a consequence the gradient of the pressure is uniform across the domain. The trend is not linear in initial section of the flow , which is due to the fact that the pressure is not fully developed in this region.



2.3 Verification with Poiseuille flow

The study carried out here corresponds to Poiseuille flow. As per the Poiseuille flow the velocity field is only a function of the y dimension and independent of x dimension for a constant pressure gradient. The following equation shows that in fully develop state the velocity field is parabolic.

$$u_x = \frac{\Delta p h^2}{8\mu L}(1 - \frac{4y^2}{h^2}) \tag{2}$$

3 Case study 3 - A cube subjected to uniaxial displacement

In this study a cube of dimension 1x1x1 is subjected to uniaxial displacement of 1.2 units and gravitational field. A transverse isotropic model is assigned to the cube. The quasi static analysis has been carried out in 50 load increments.

3.1 Results

The displacement field is illustrated in figure 3.1.

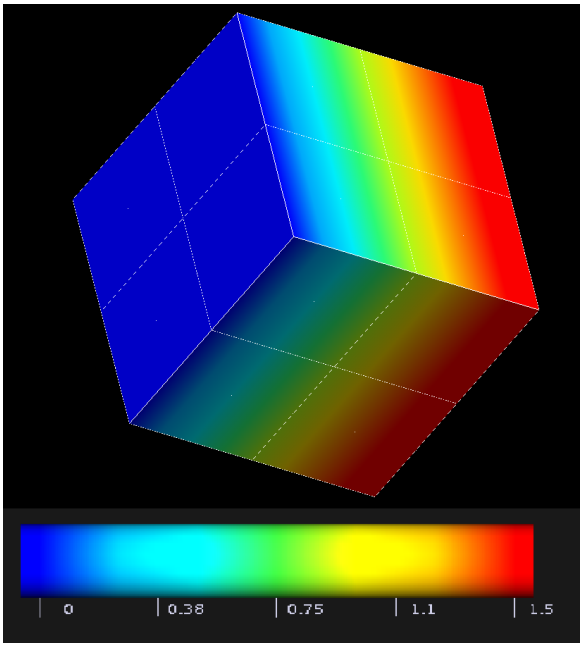


Fig 3.1 A Cube subjected to uniaxial displacement