2D CFD-Simulation Example with Fluent

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CES
March 2007

Turbulent Flow in Manifold

(By considering only input velocities)

1. Data

Fluid : water
Density = 998.2 kg/m3
Dynamic viscosity = 0.001003 kg/m.s
The flow is turbulent
Re ≈ $1x10^6$

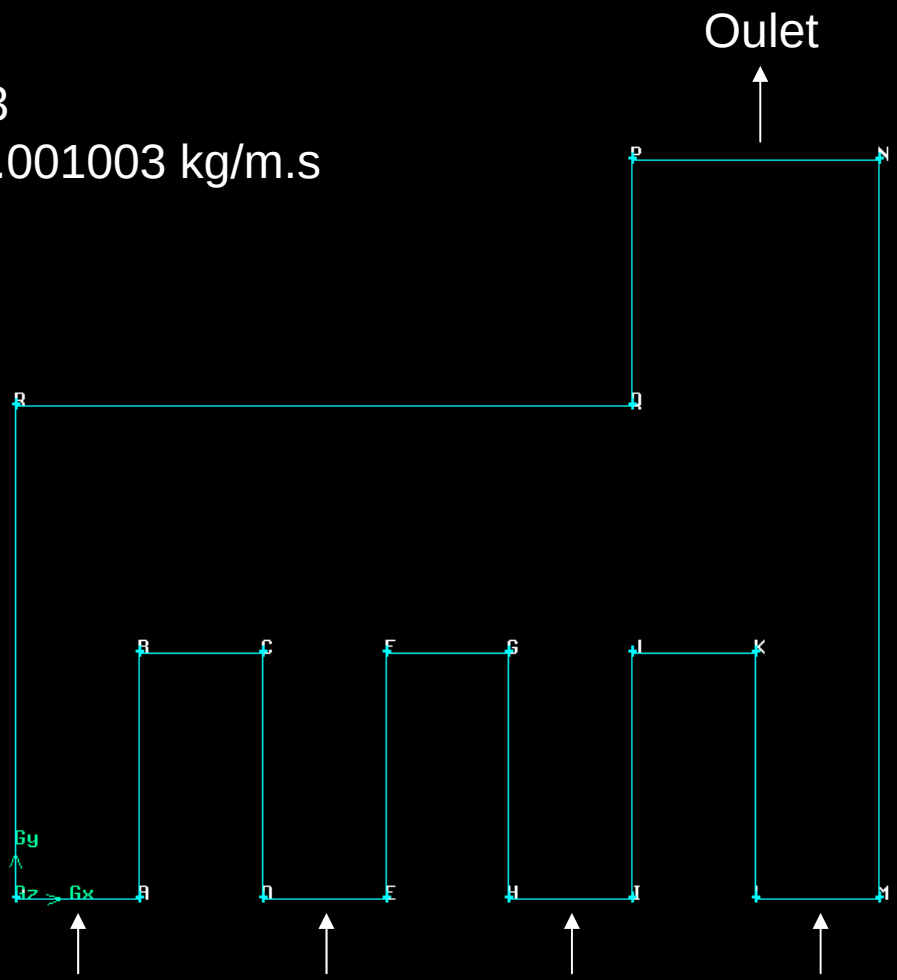
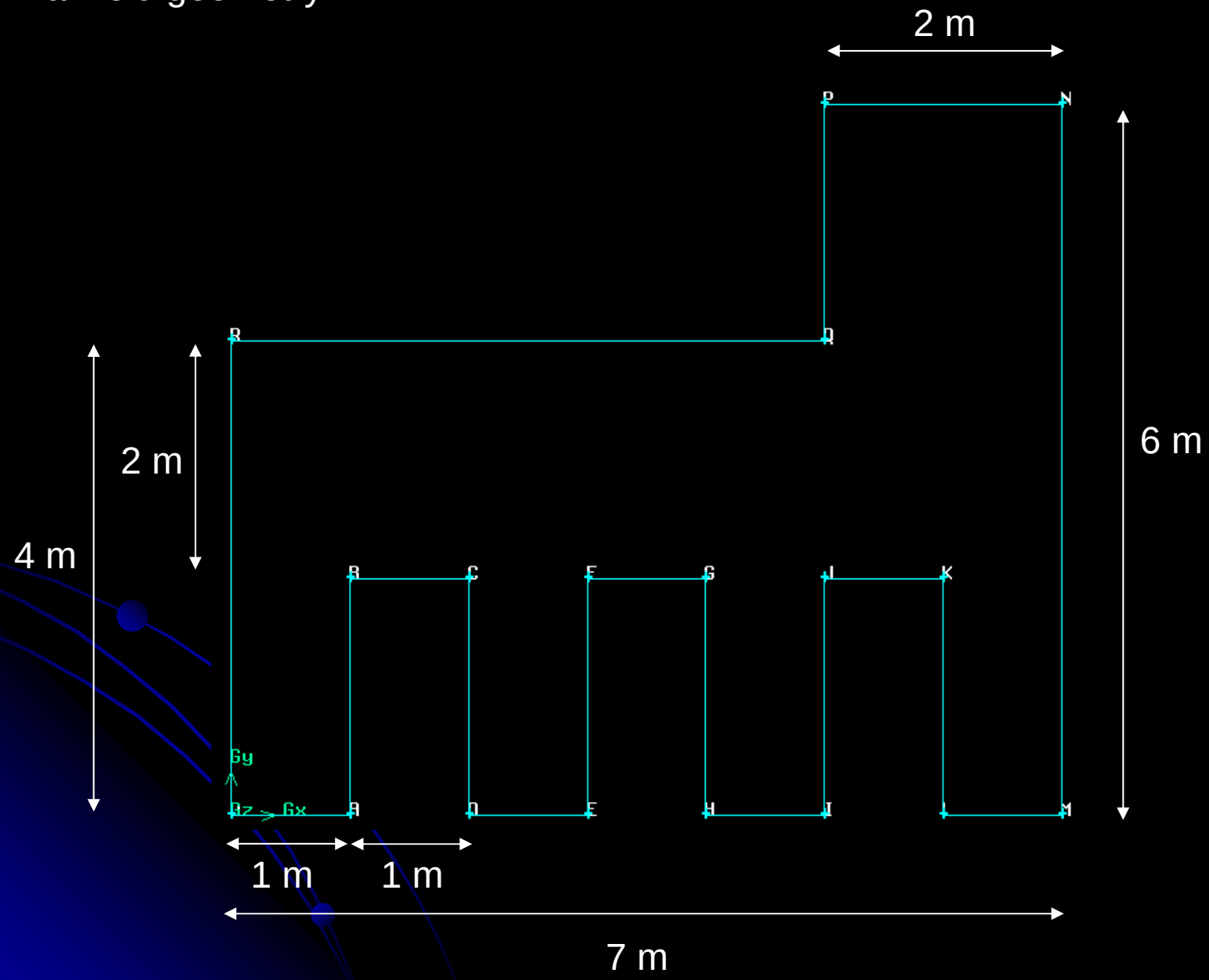


Fig. Manifold with 4 inlet pipes and 1 outlet pipe

Manifold geometry



Mesh generation with Gambit

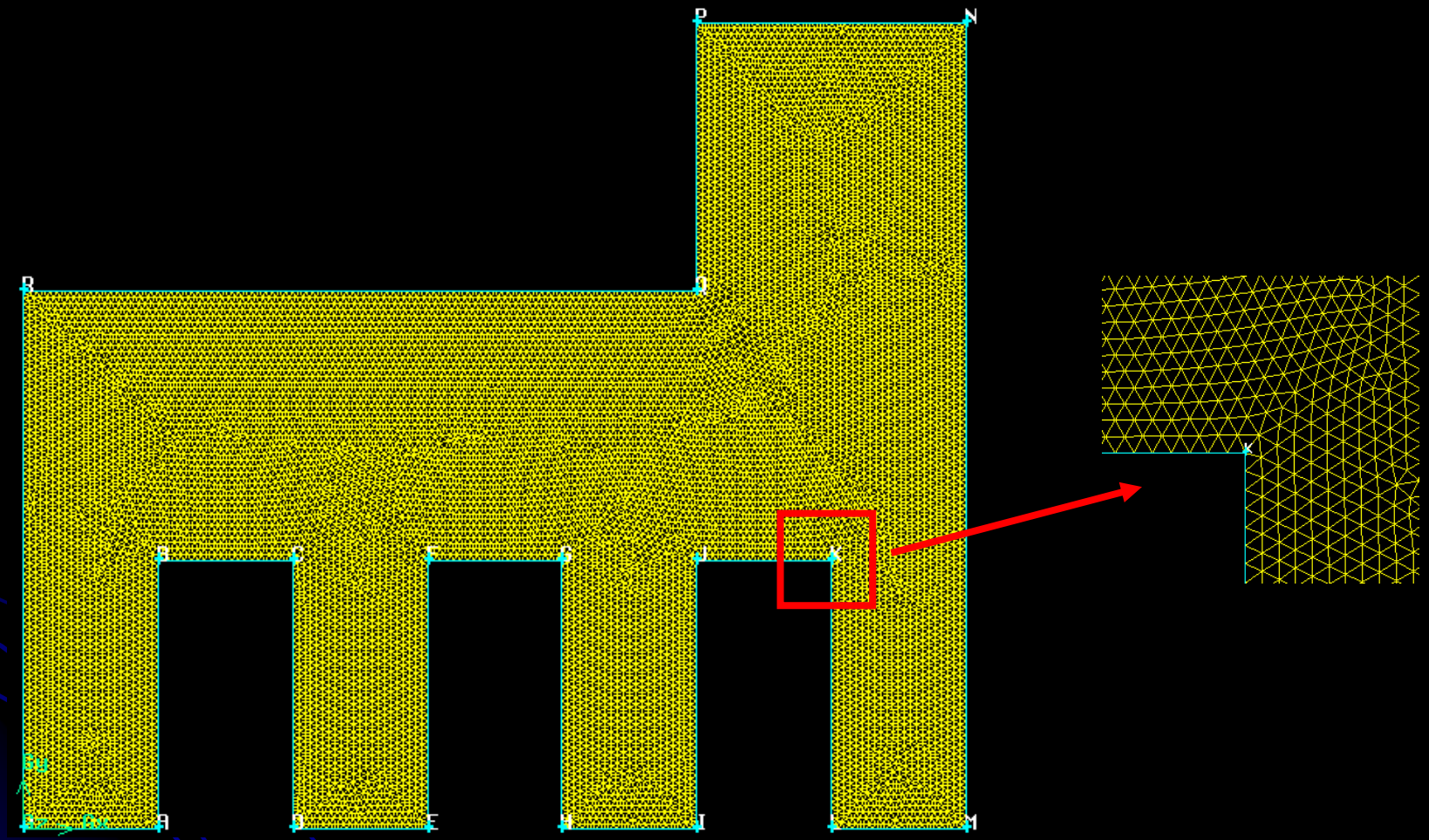
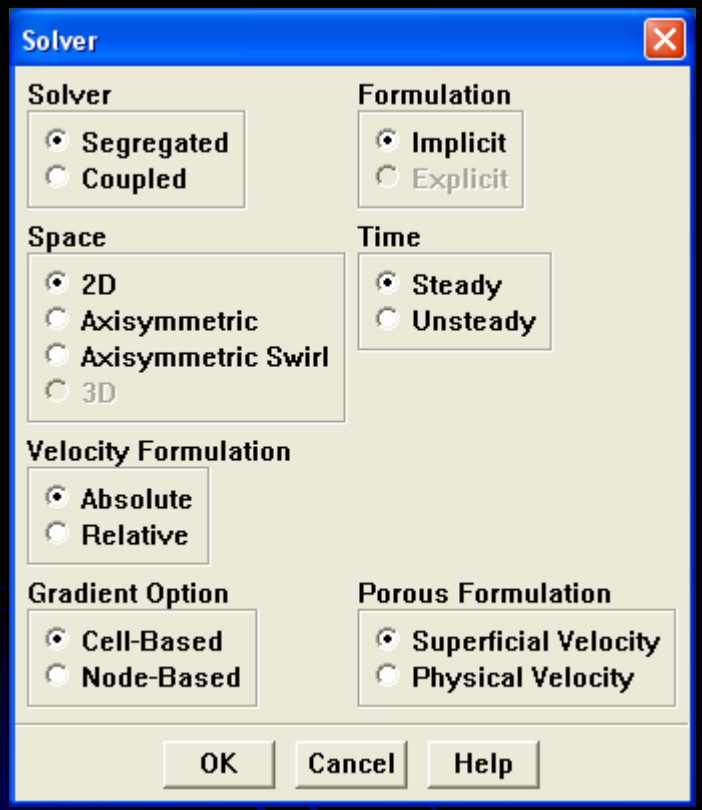
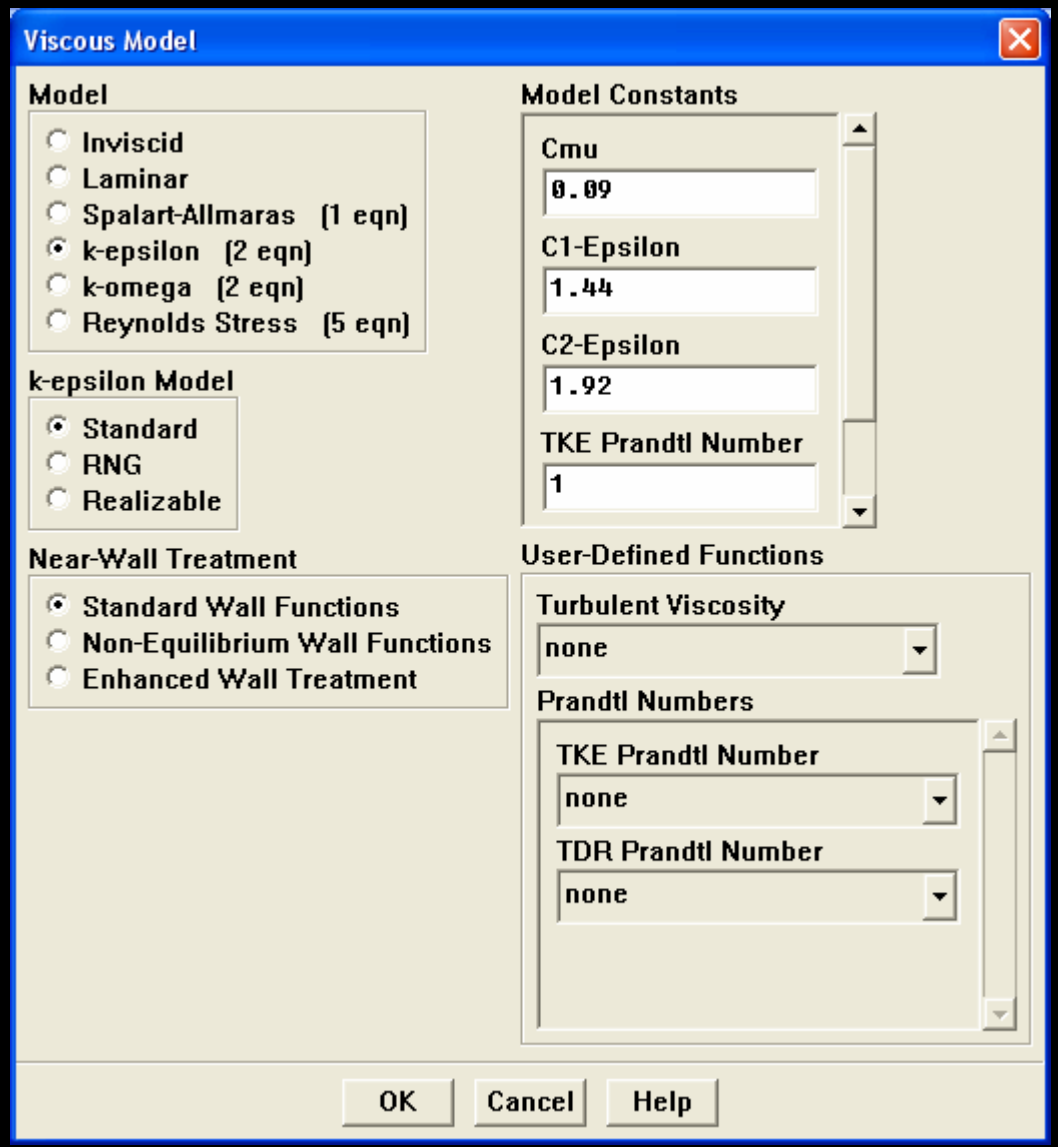


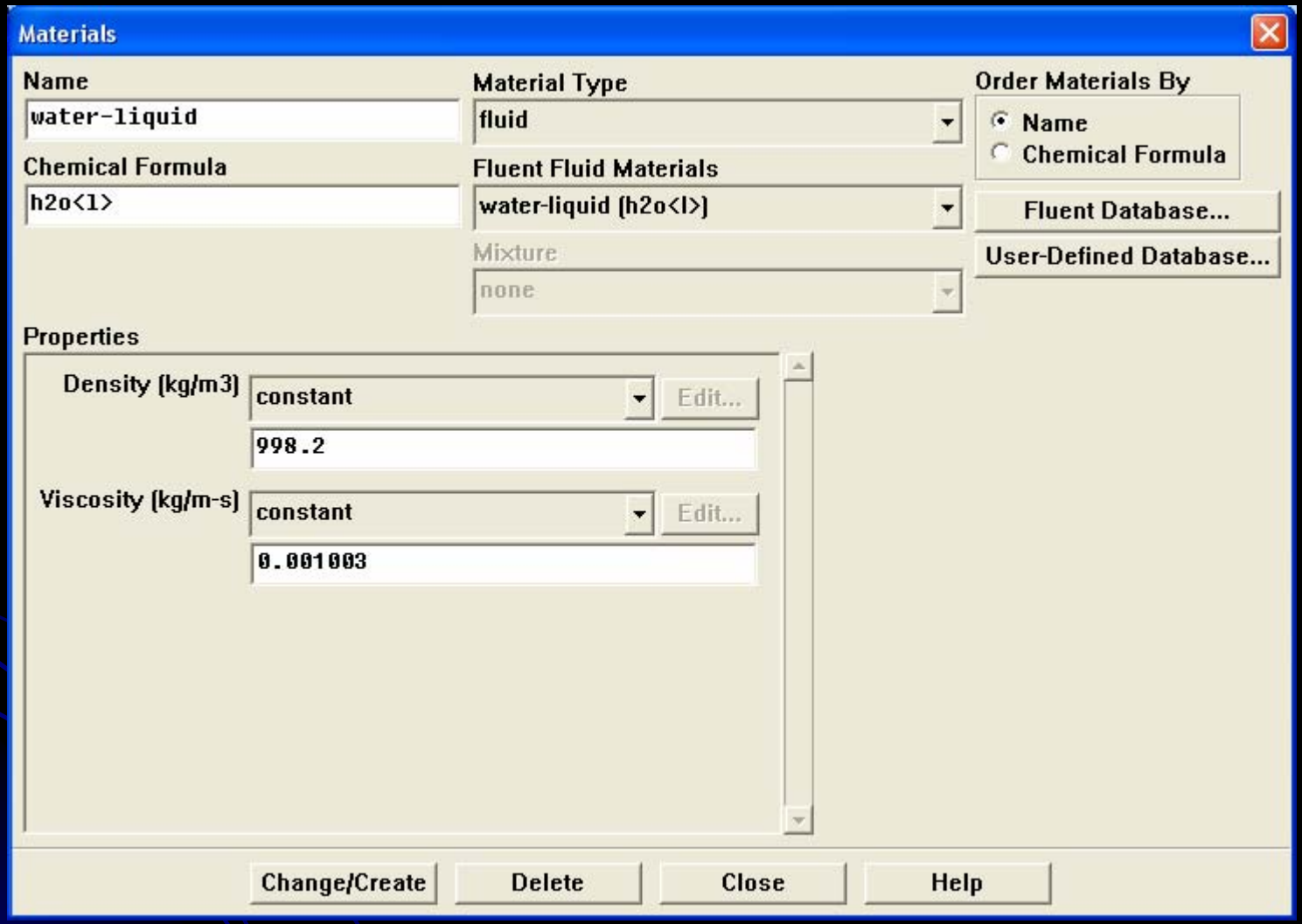
Fig. Triangular mesh created with Gambit

Define Solver and Viscous Model

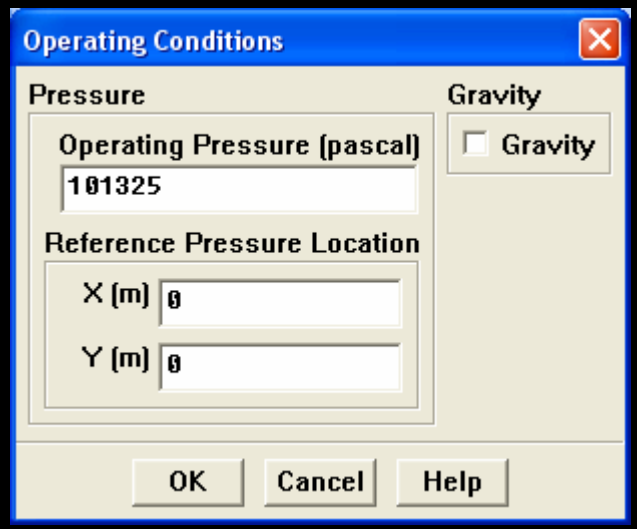




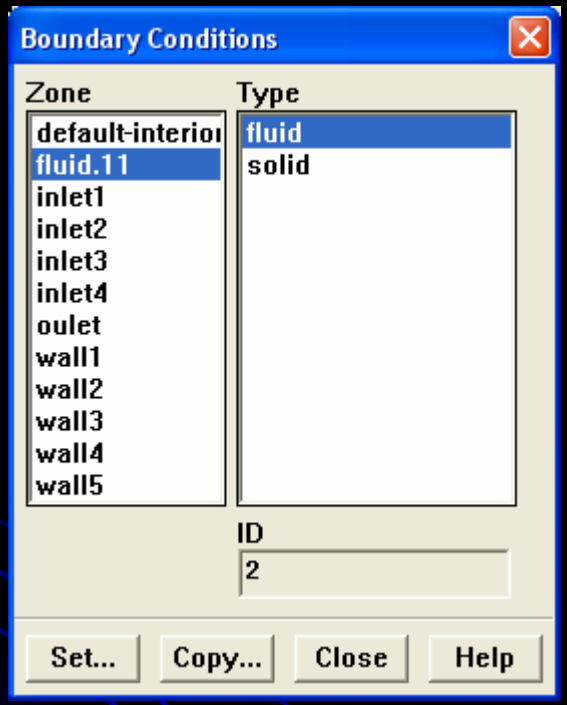
Define Fluid

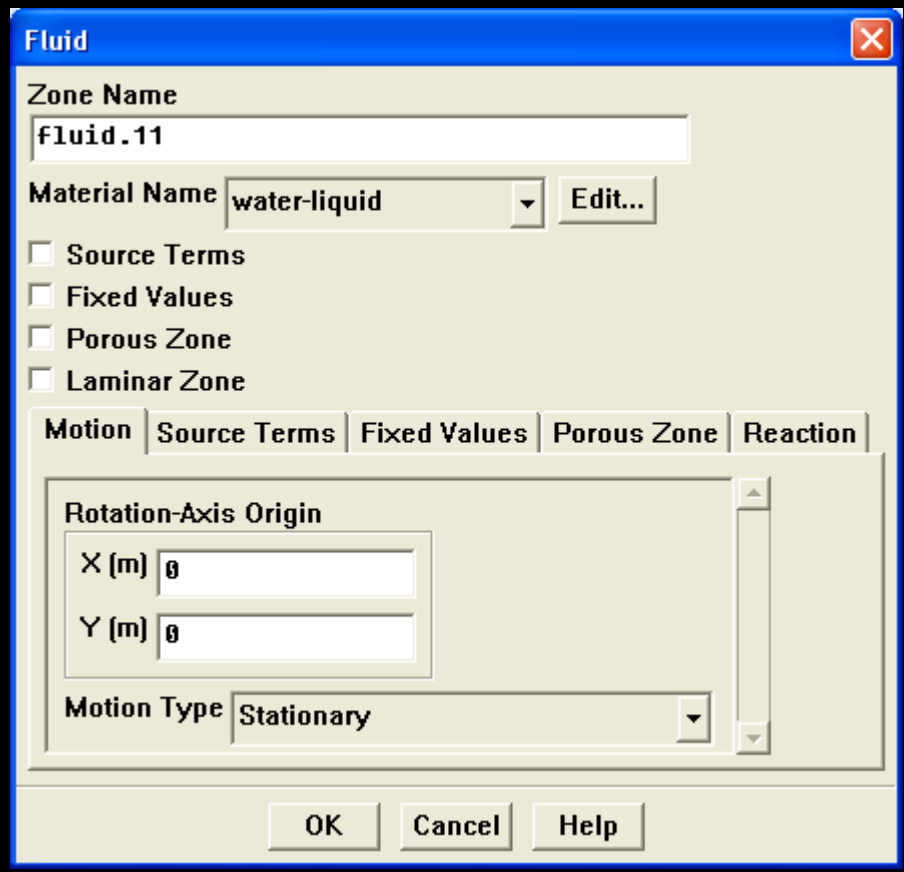


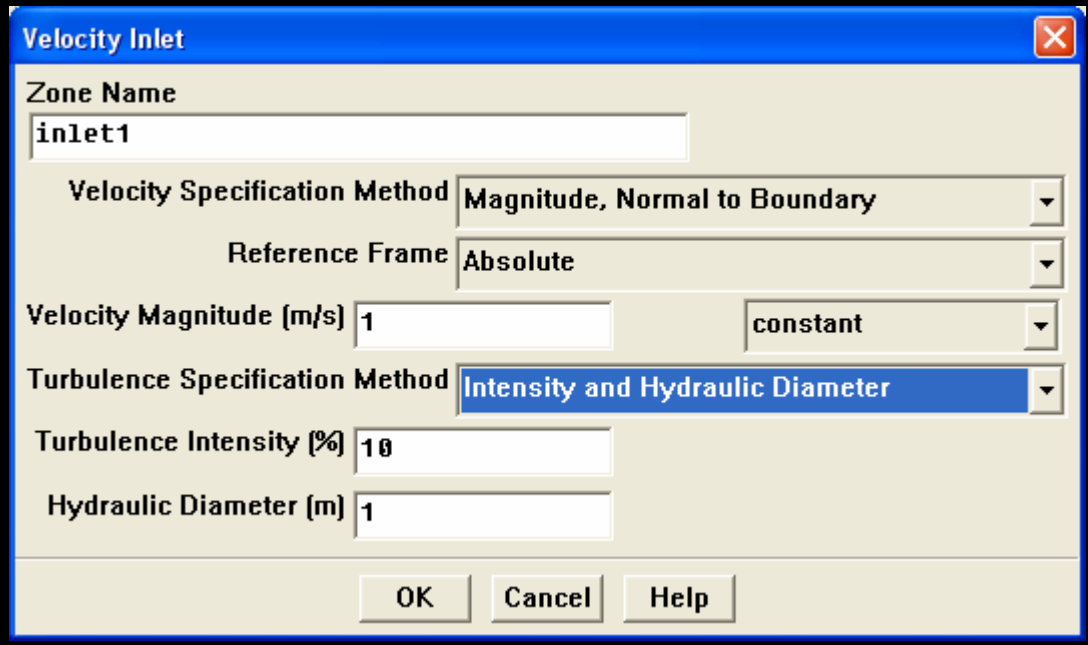
Define Operating Conditions



Define Boundary Conditions



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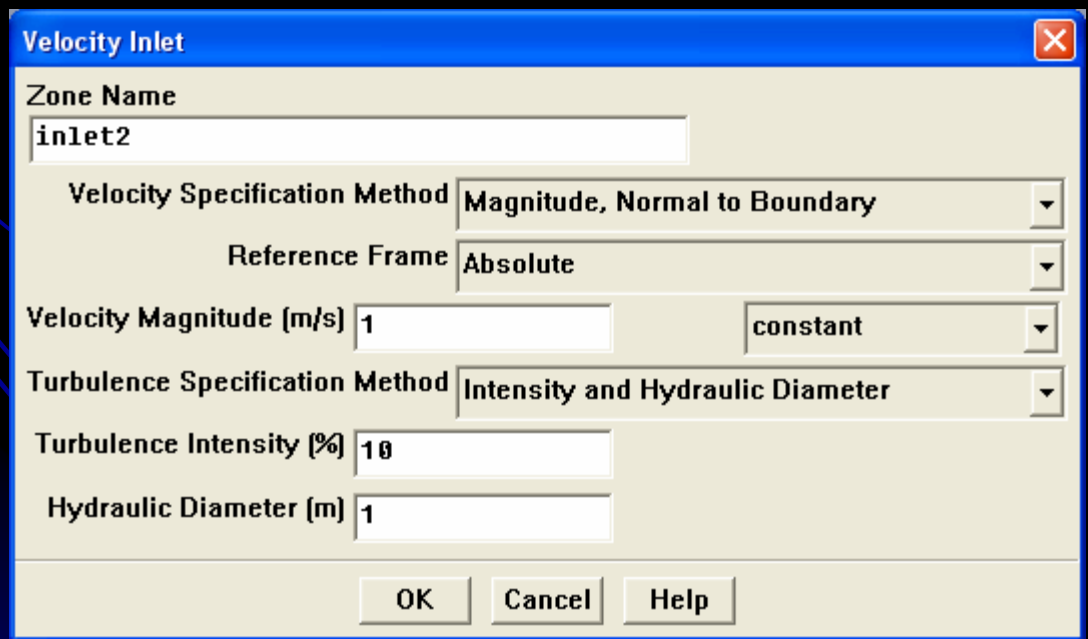
Zone Name
inlet1
Velocity Specification Method
Magnitude, Normal to Boundary
Reference Frame
Absolute
Velocity Magnitude (m/s)
1
constant
Turbulence Specification Method
Intensity and Hydraulic Diameter
Turbulence Intensity (%)
10
Hydraulic Diameter (m)
1
OK
Cancel
Help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Zone Name
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Velocity Specification Method
Magnitude, Normal to Boundary
Reference Frame
Absolute
Velocity Magnitude (m/s)
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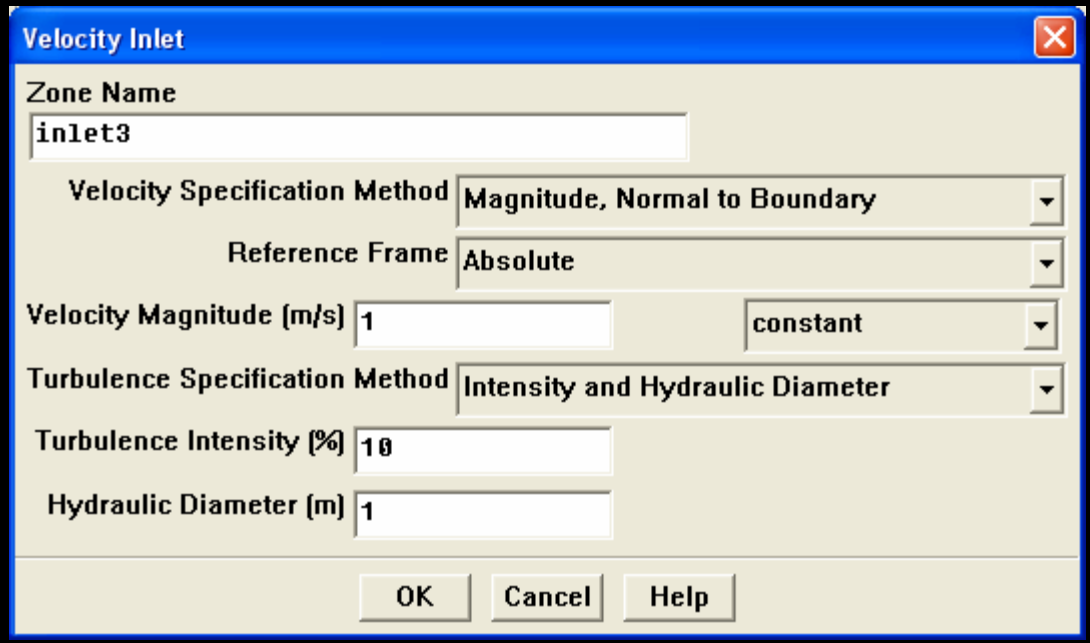
constant
Turbulence Specification Method
Intensity and Hydraulic Diameter
Turbulence Intensity (%)
10
Hydraulic Diameter (m)
1
OK
Cancel
Help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Zone Name
inlet3
Velocity Specification Method
Magnitude, Normal to Boundary
Reference Frame
Absolute
Velocity Magnitude (m/s)
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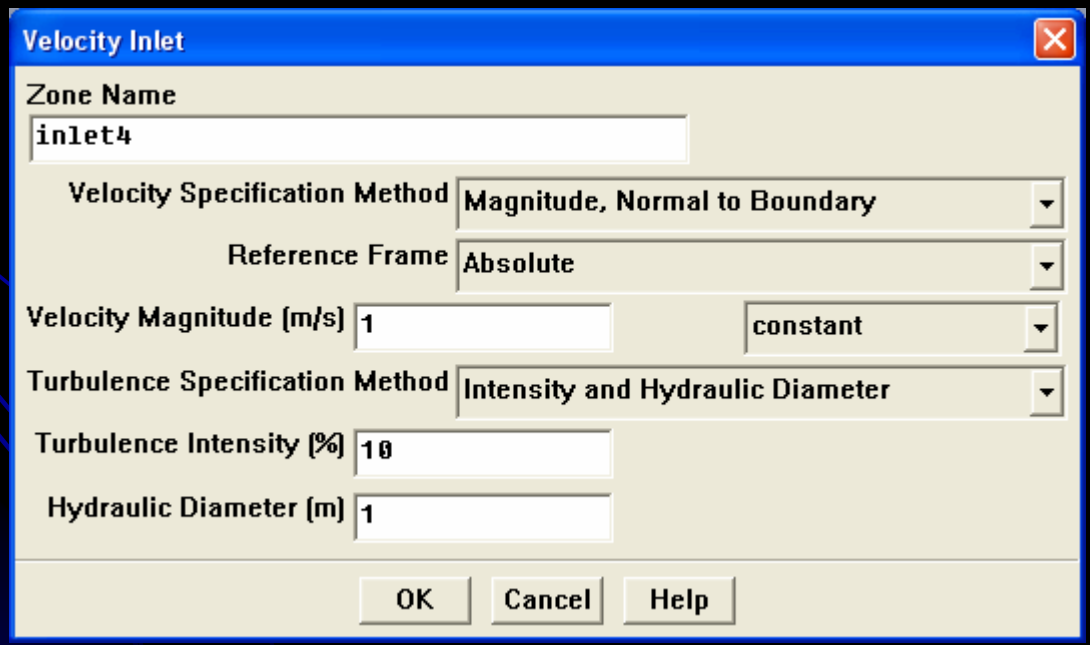
constant
Turbulence Specification Method
Intensity and Hydraulic Diameter
Turbulence Intensity (%)
10
Hydraulic Diameter (m)
1
OK
Cancel
Help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Zone Name
inlet4
Velocity Specification Method
Magnitude, Normal to Boundary
Reference Frame
Absolute
Velocity Magnitude (m/s)
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constant
Turbulence Specification Method
Intensity and Hydraulic Diameter
Turbulence Intensity (%)
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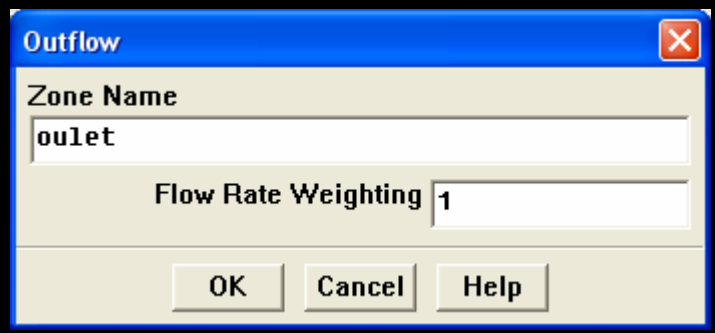
Hydraulic Diameter (m)
1
OK
Cancel
Help


Outflow
Zone Name
oulet
Flow Rate Weighting
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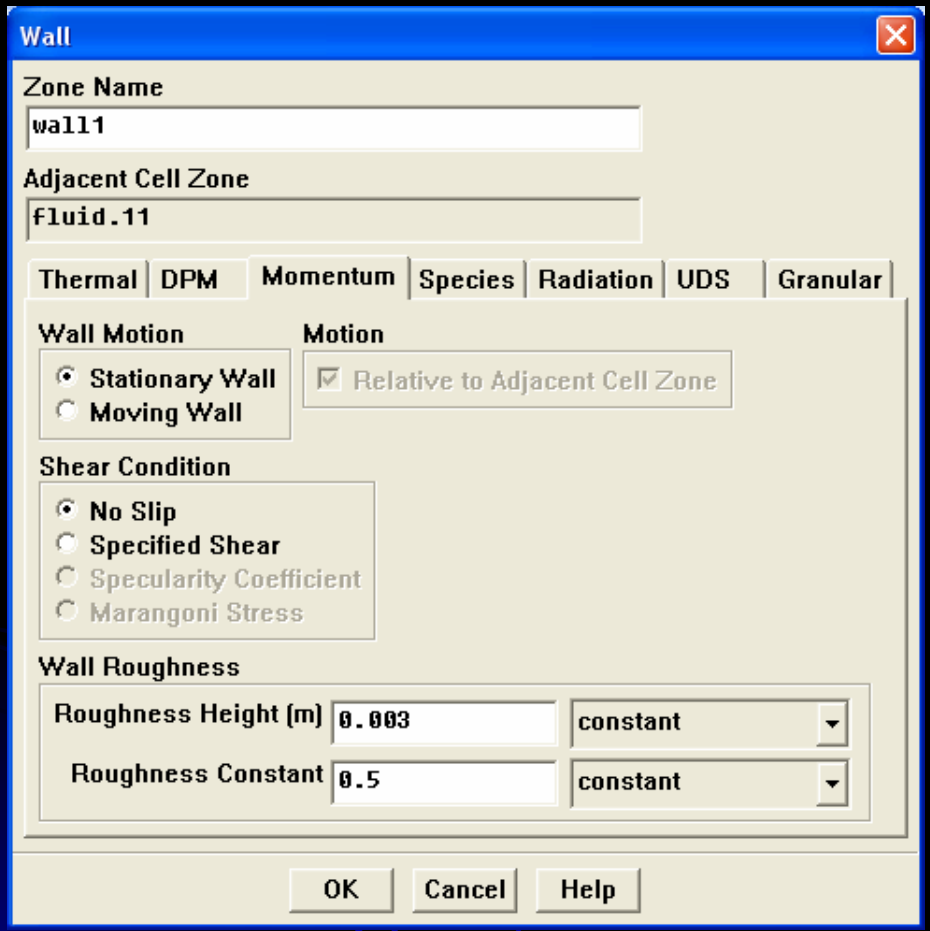
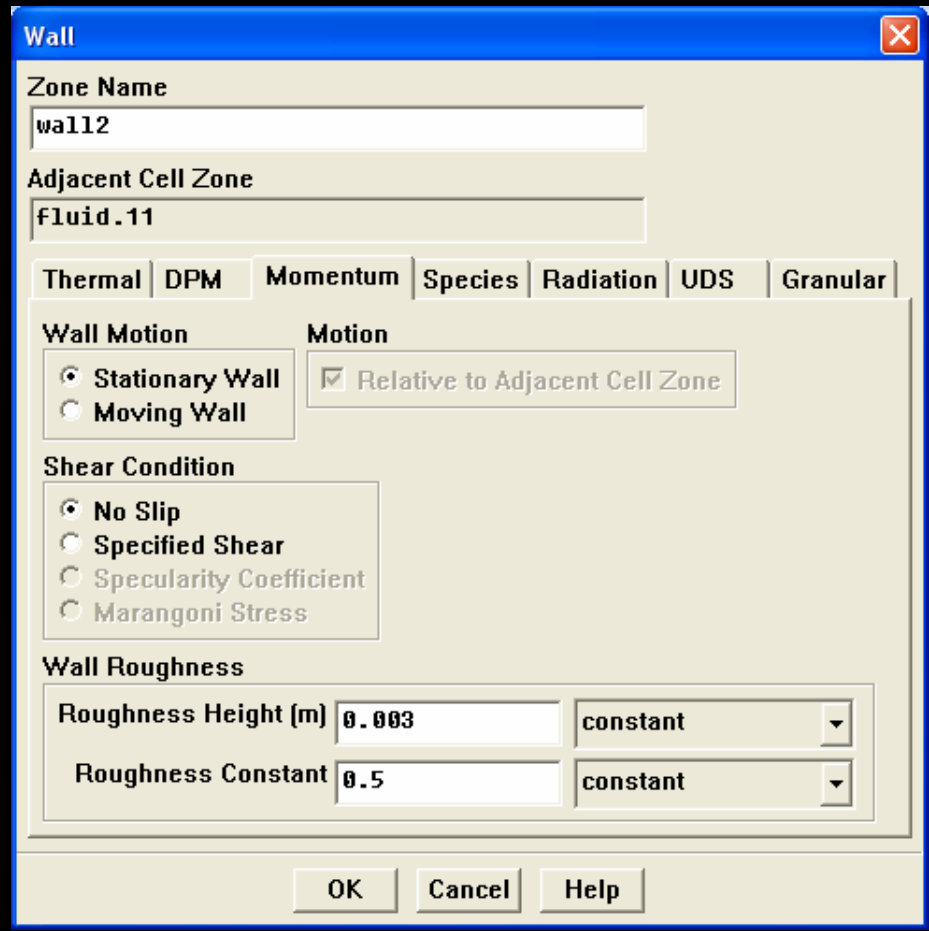
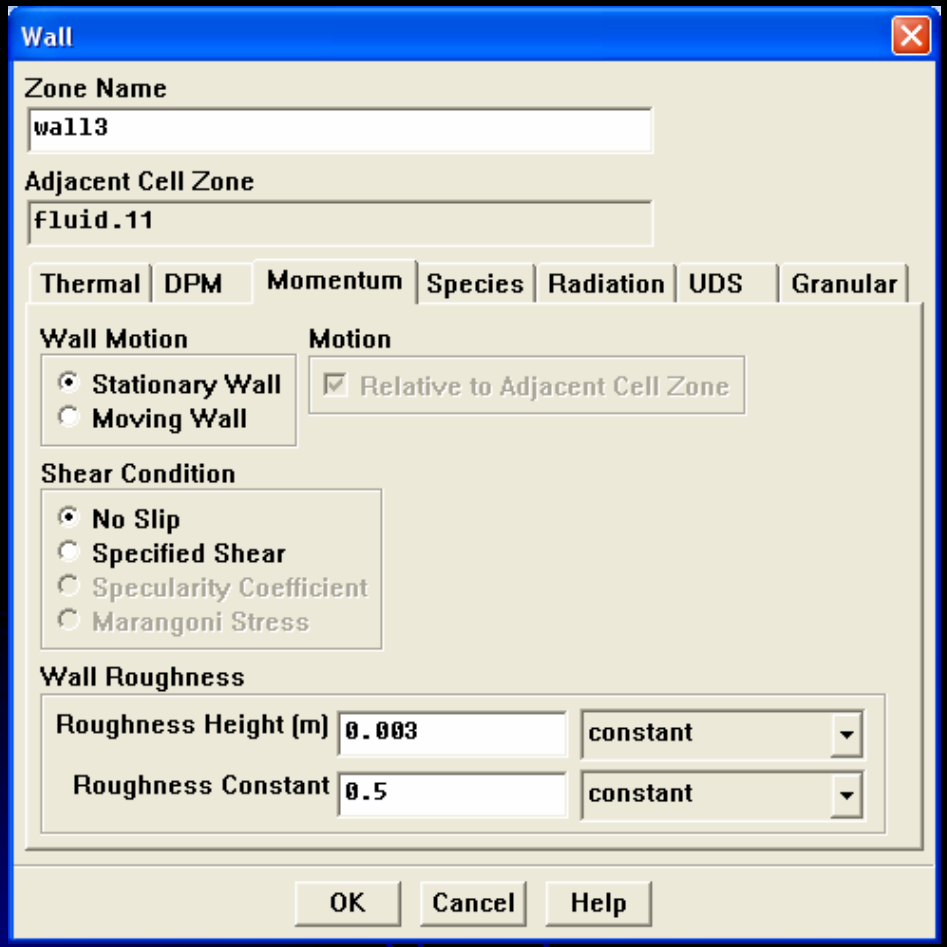
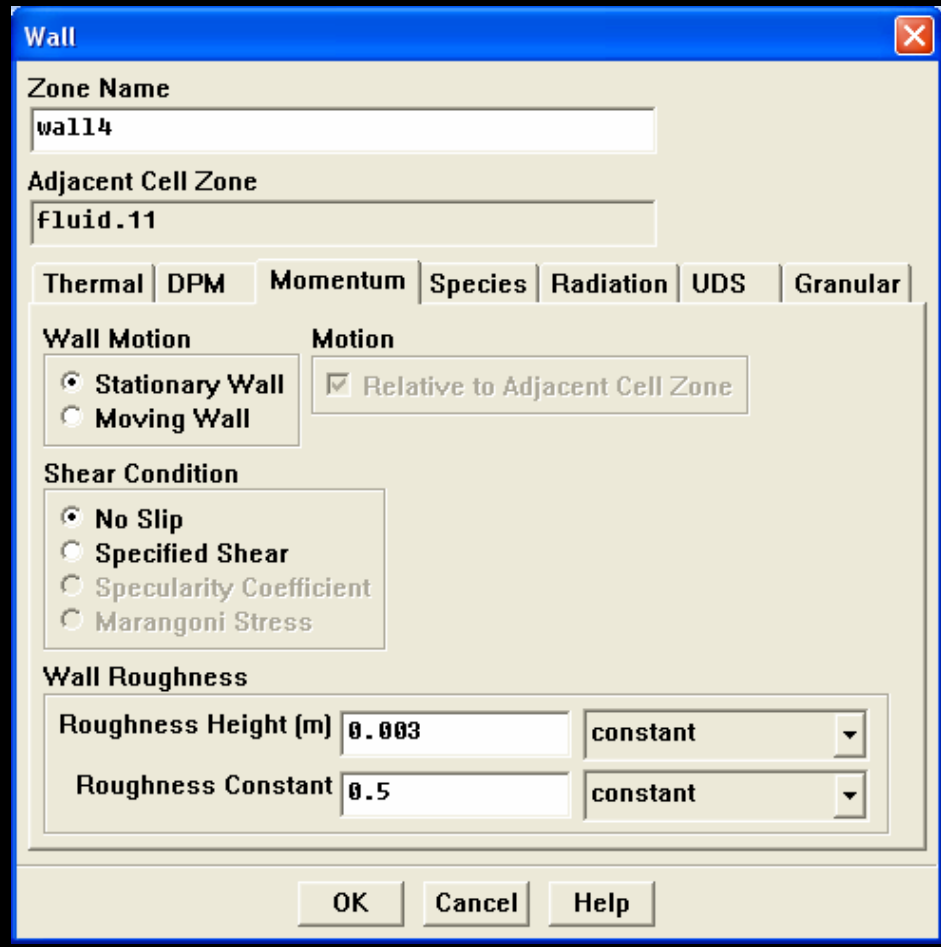
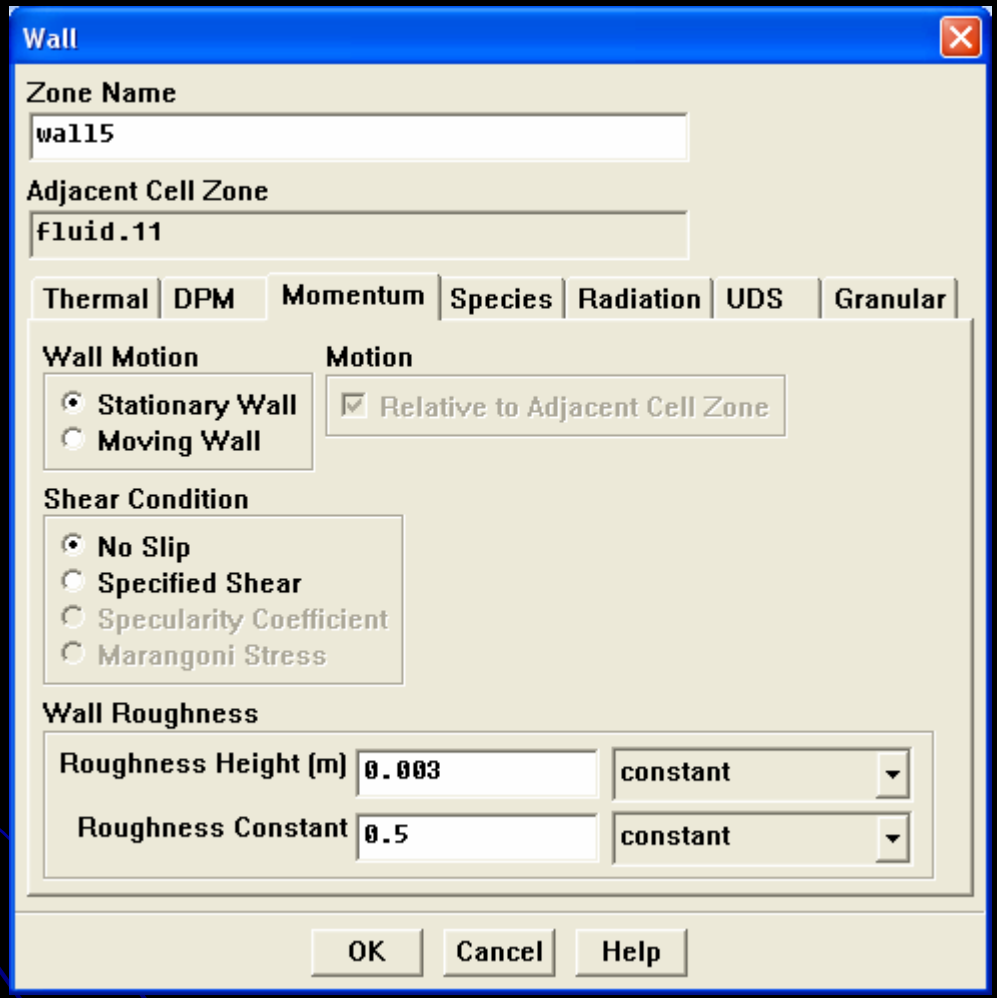
OK
Cancel
Help


Wall
Zone Name
wall1
Adjacent Cell Zone
fluid.11
Thermal
DPM
Momentum
Species
Radiation
UDS
Granular
Wall Motion
Stationary Wall
Moving Wall
Motion
Relative to Adjacent Cell Zone
Shear Condition
No Slip
Specified Shear
Specularity Coefficient
Marangoni Stress
Wall Roughness
Roughness Height (m)
0.003
constant
Roughness Constant
0.5
constant
OK
Cancel
Help

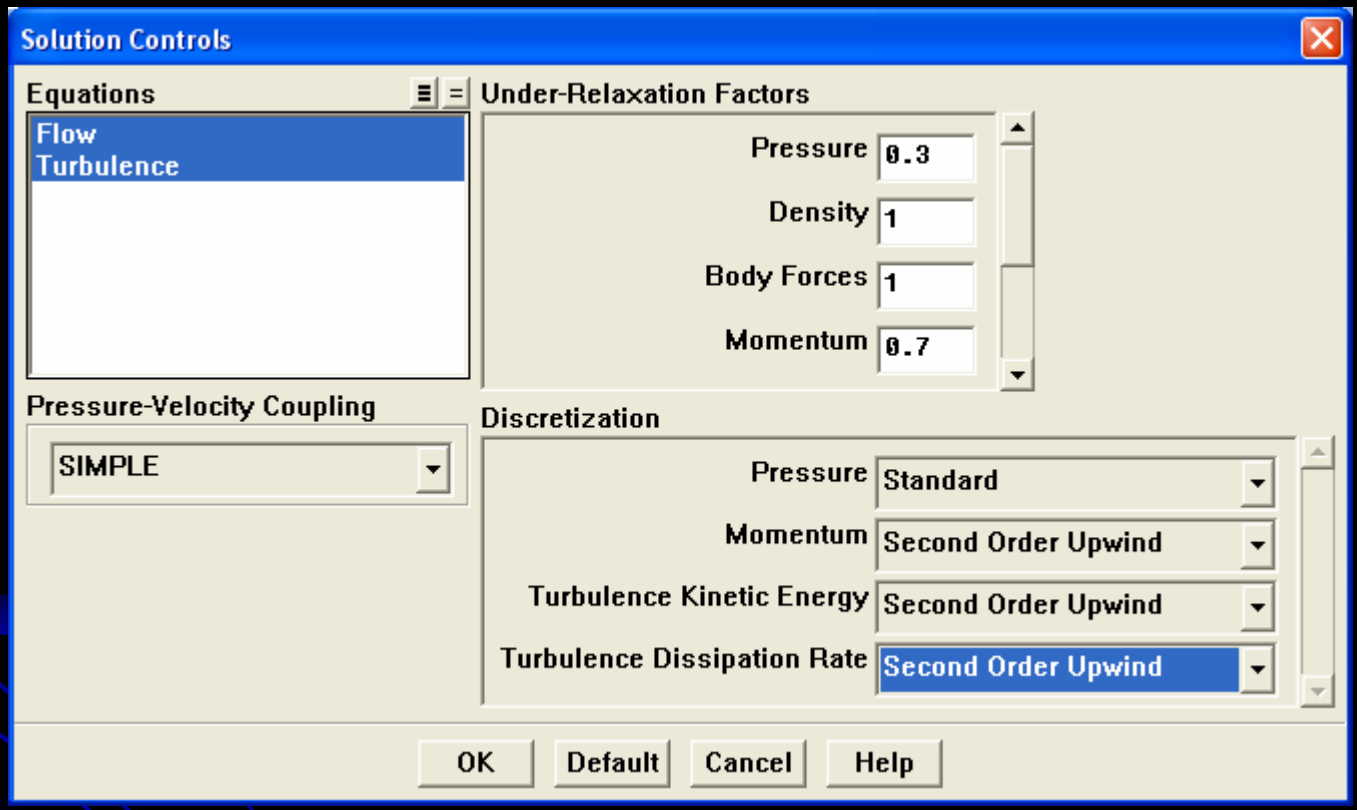

Wall
Zone Name
wall2
Adjacent Cell Zone
fluid.11
Thermal
DPM
Momentum
Species
Radiation
UDS
Granular
Wall Motion
Stationary Wall
Moving Wall
Motion
Relative to Adjacent Cell Zone
Shear Condition
No Slip
Specified Shear
Specularity Coefficient
Marangoni Stress
Wall Roughness
Roughness Height (m)
0.003
constant
Roughness Constant
0.5
constant
OK
Cancel
Help


Wall
Zone Name
wall3
Adjacent Cell Zone
fluid.11
Thermal
DPM
Momentum
Species
Radiation
UDS
Granular
Wall Motion
Stationary Wall
Moving Wall
Motion
Relative to Adjacent Cell Zone
Shear Condition
No Slip
Specified Shear
Specularity Coefficient
Marangoni Stress
Wall Roughness
Roughness Height (m)
0.003
constant
Roughness Constant
0.5
constant
OK
Cancel
Help

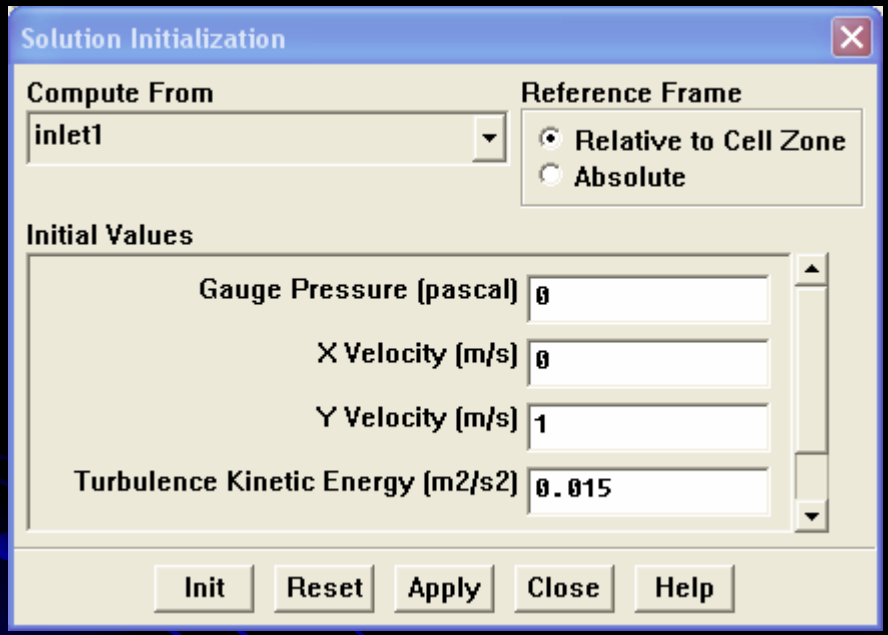

Wall
Zone Name
wall4
Adjacent Cell Zone
fluid.11
Thermal
DPM
Momentum
Species
Radiation
UDS
Granular
Wall Motion
Stationary Wall
Moving Wall
Motion
Relative to Adjacent Cell Zone
Shear Condition
No Slip
Specified Shear
Specularity Coefficient
Marangoni Stress
Wall Roughness
Roughness Height (m)
0.003
constant
Roughness Constant
0.5
constant
OK
Cancel
Help

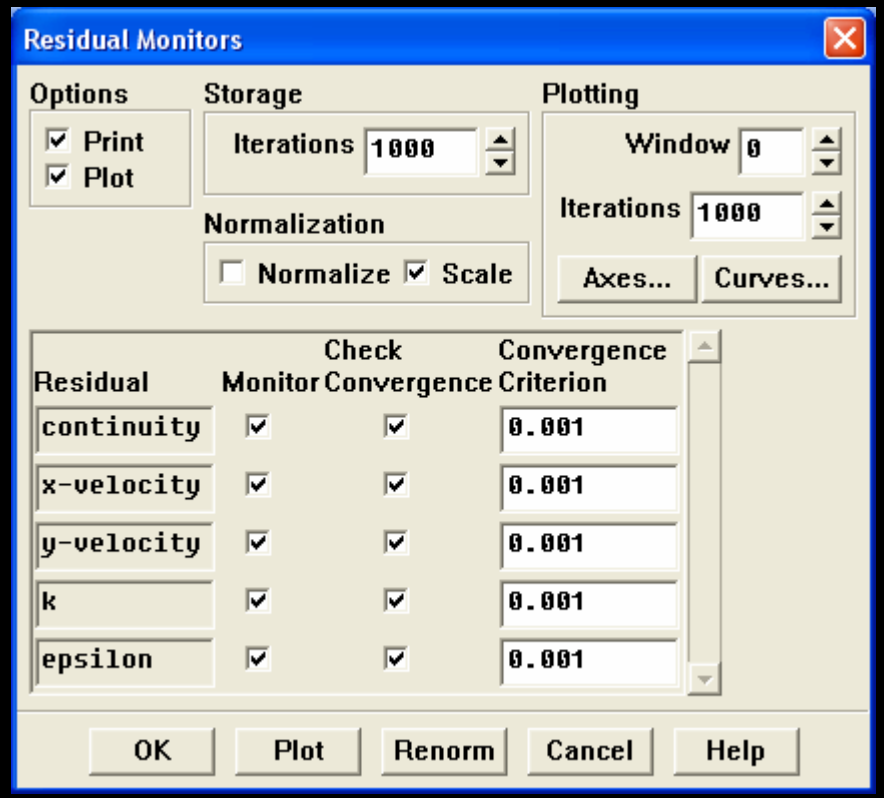

Wall
Zone Name
wall5
Adjacent Cell Zone
fluid.11
Thermal
DPM
Momentum
Species
Radiation
UDS
Granular
Wall Motion
Stationary Wall
Moving Wall
Motion
Relative to Adjacent Cell Zone
Shear Condition
No Slip
Specified Shear
Specularity Coefficient
Marangoni Stress
Wall Roughness
Roughness Height (m)
0.003
constant
Roughness Constant
0.5
constant
OK
Cancel
Help

Solve control solutions

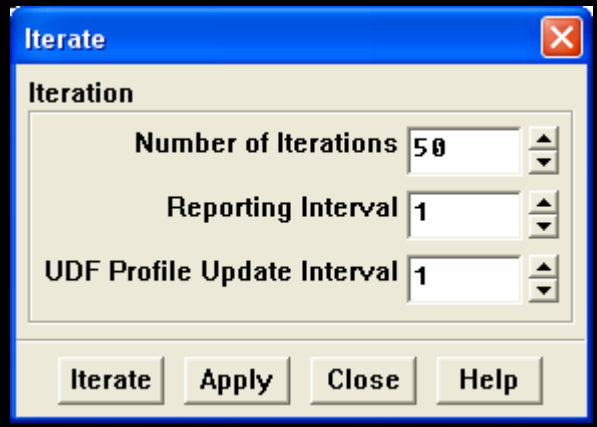


Solve Solution Initialization and Residual Monitors

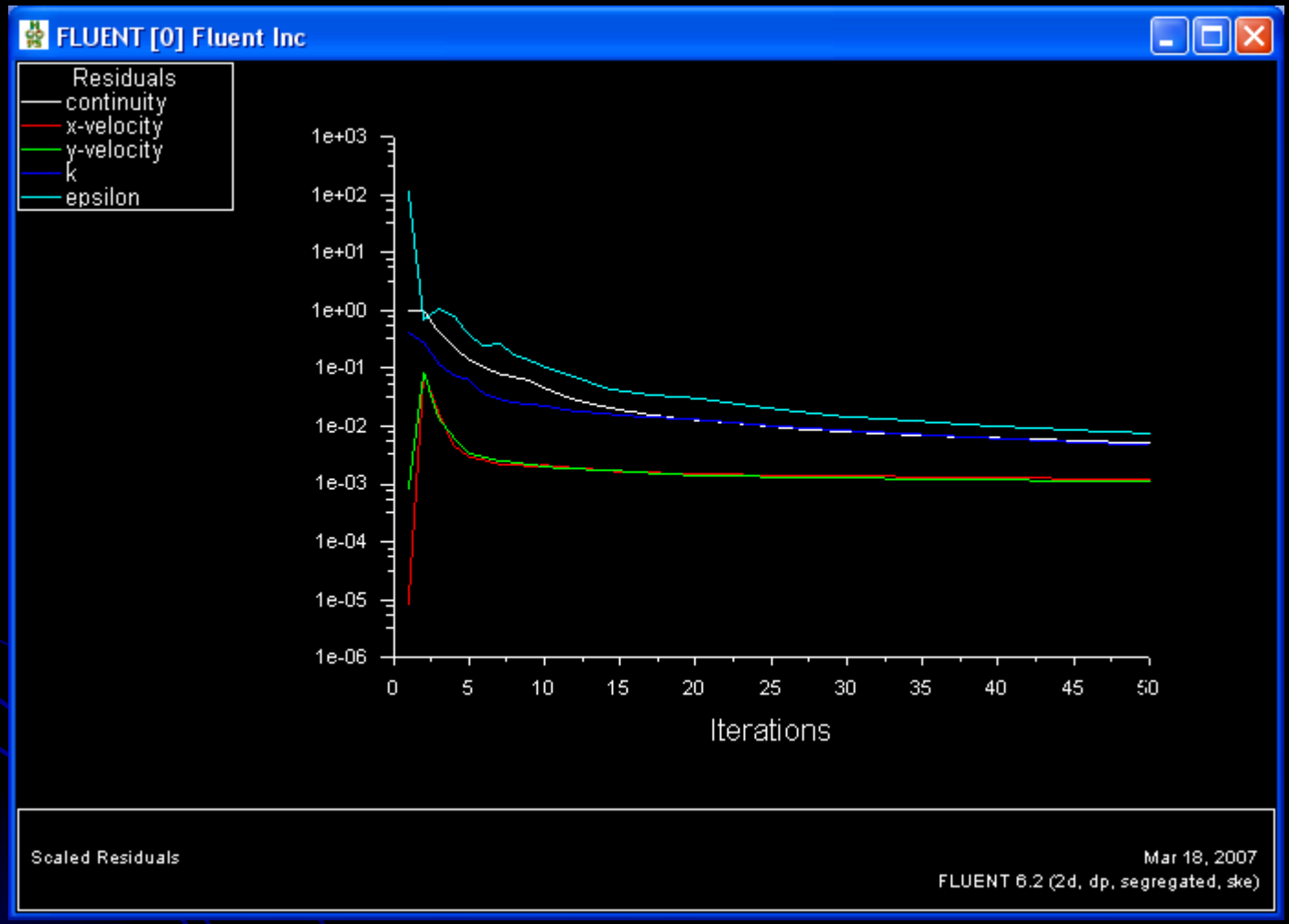




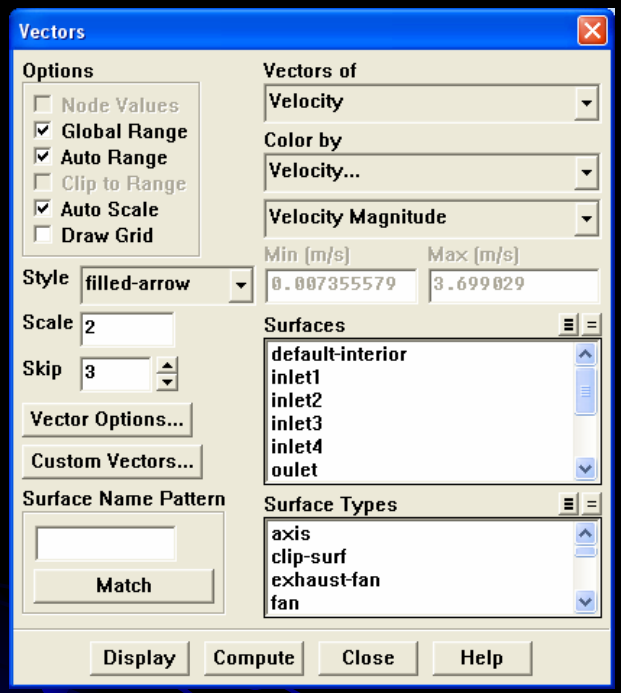
Solve Iteration

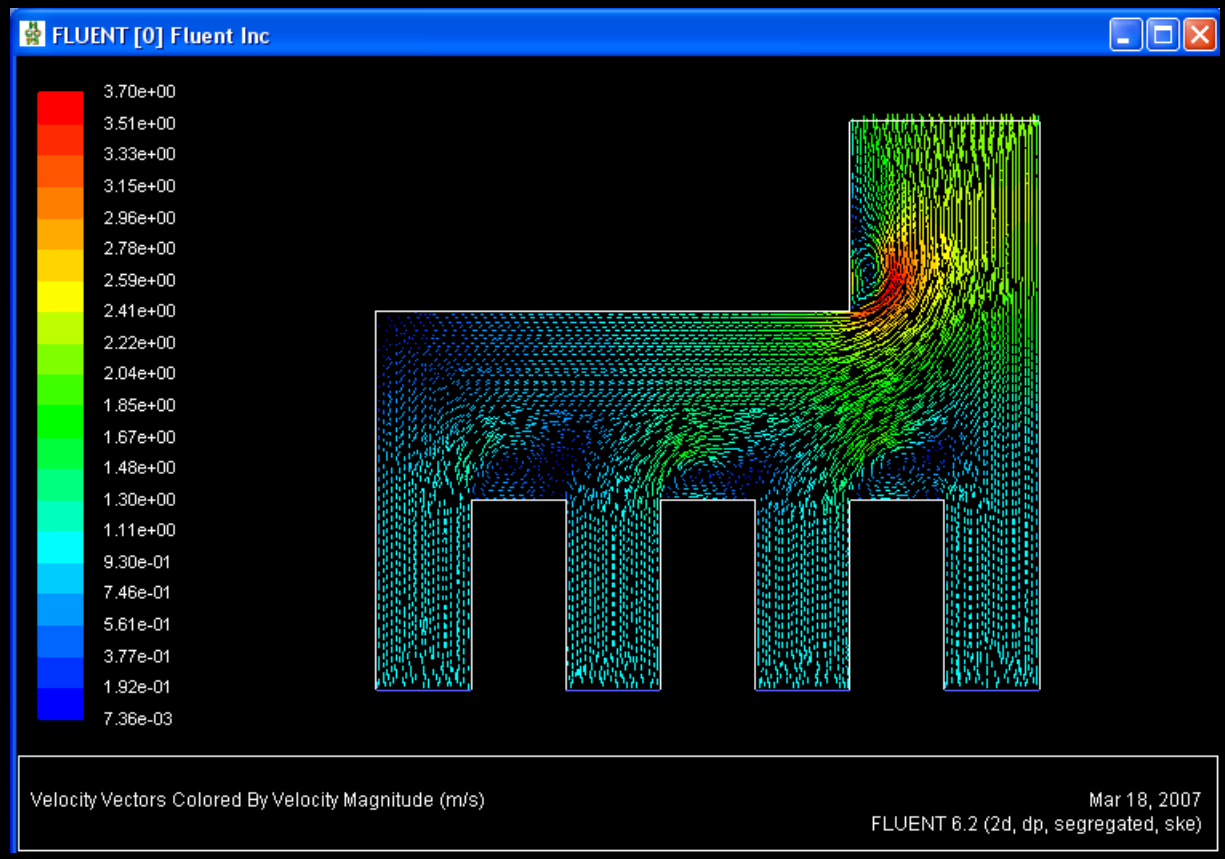


Convergence of solution

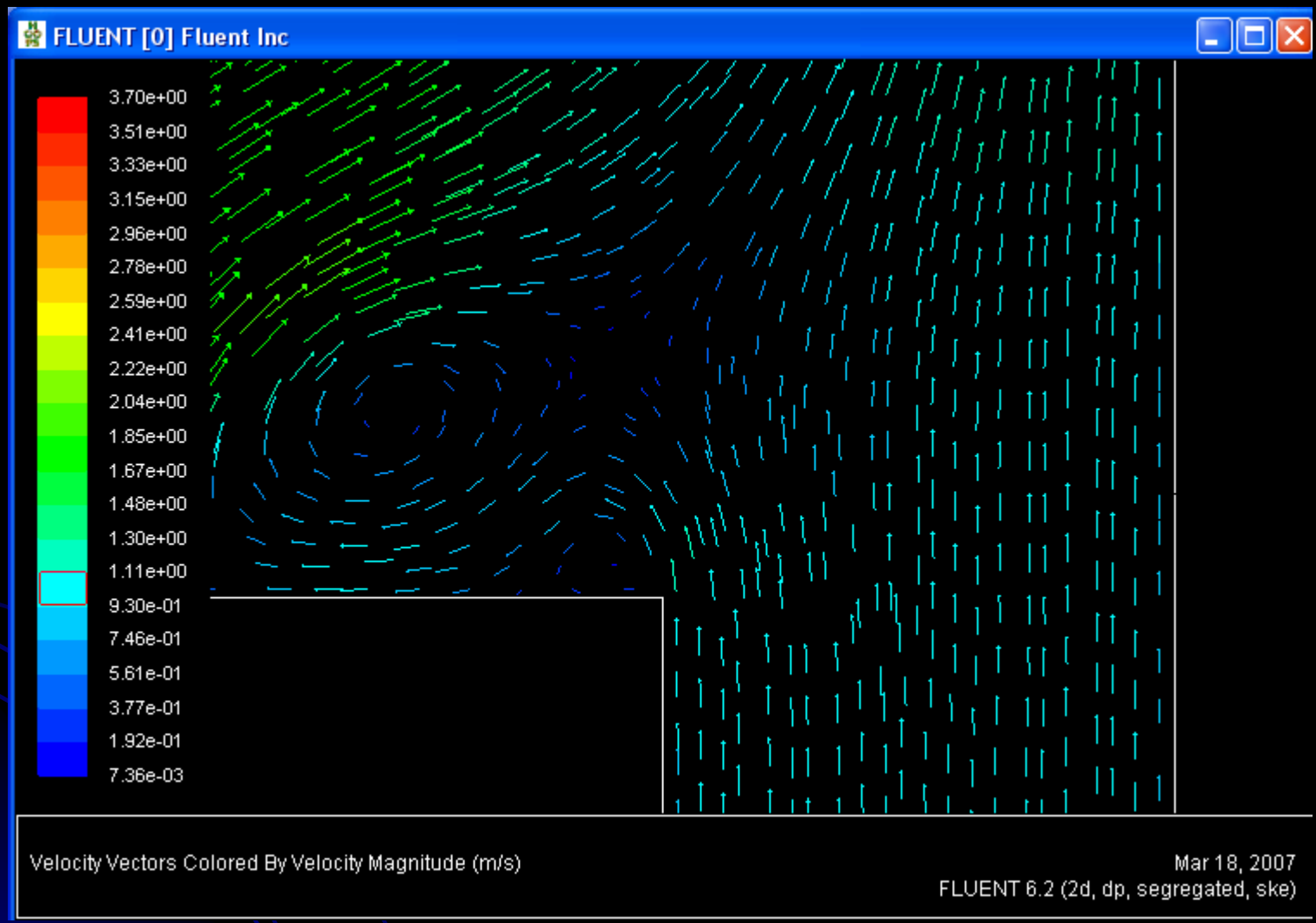


Display of Vectors – Velocity Magnitude

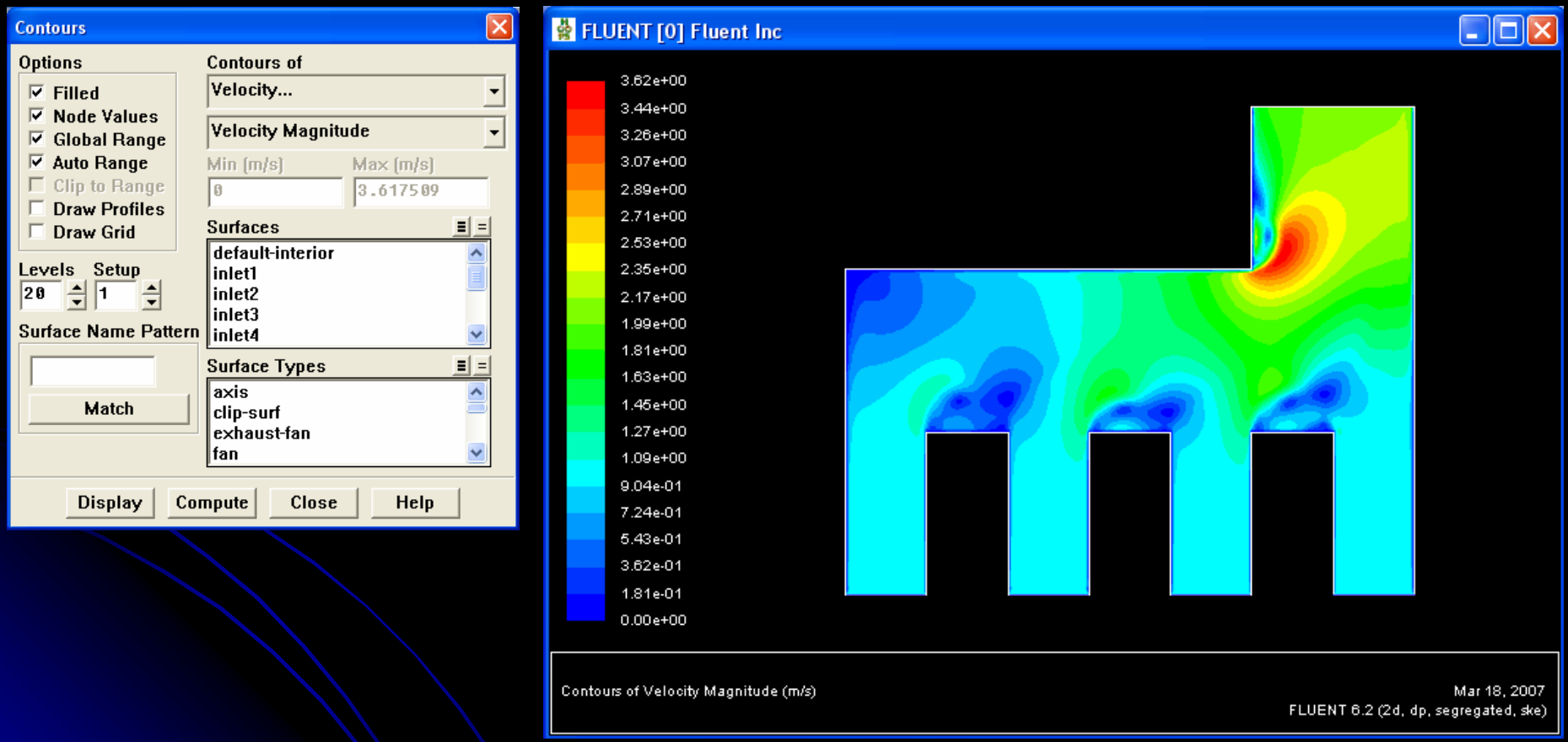




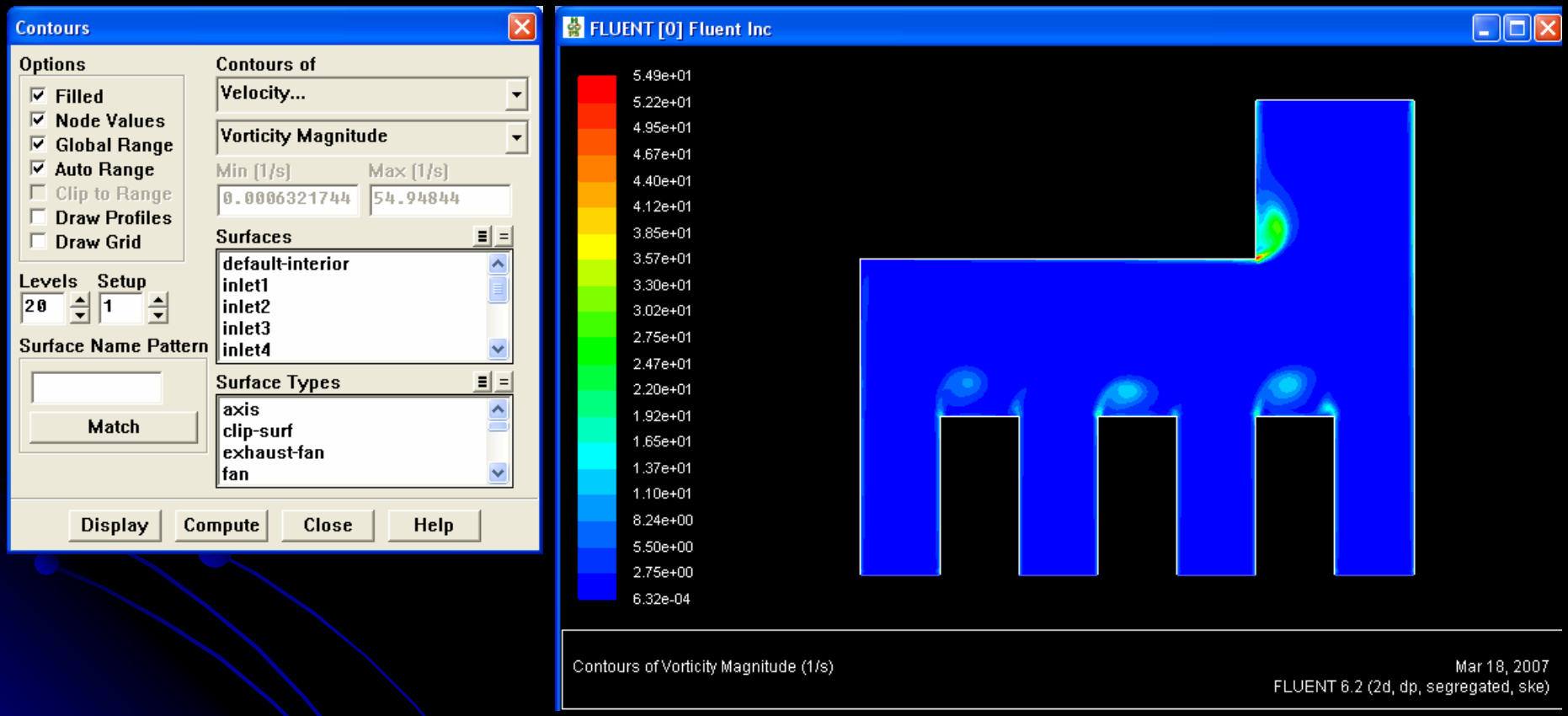
Display of Vectors – Velocity Magnitude



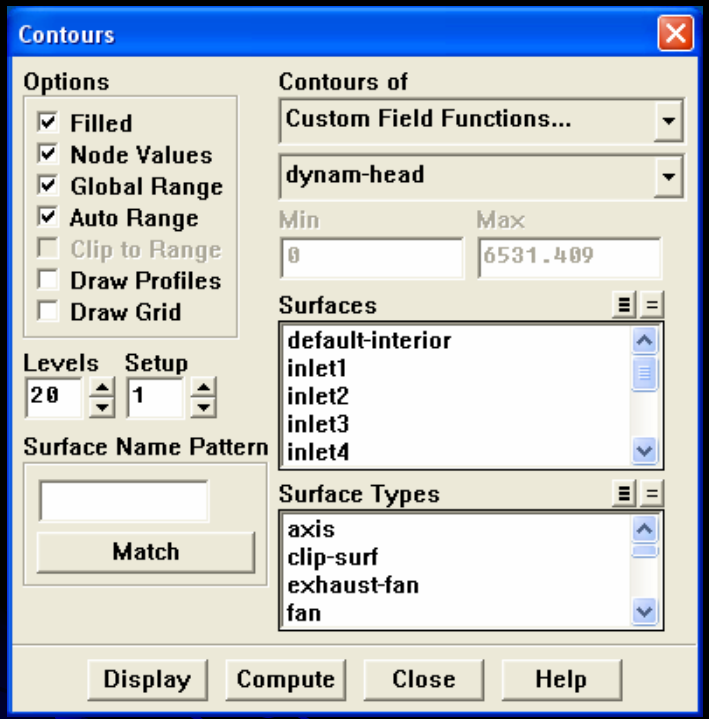
Display of Contours – Velocity Magnitude

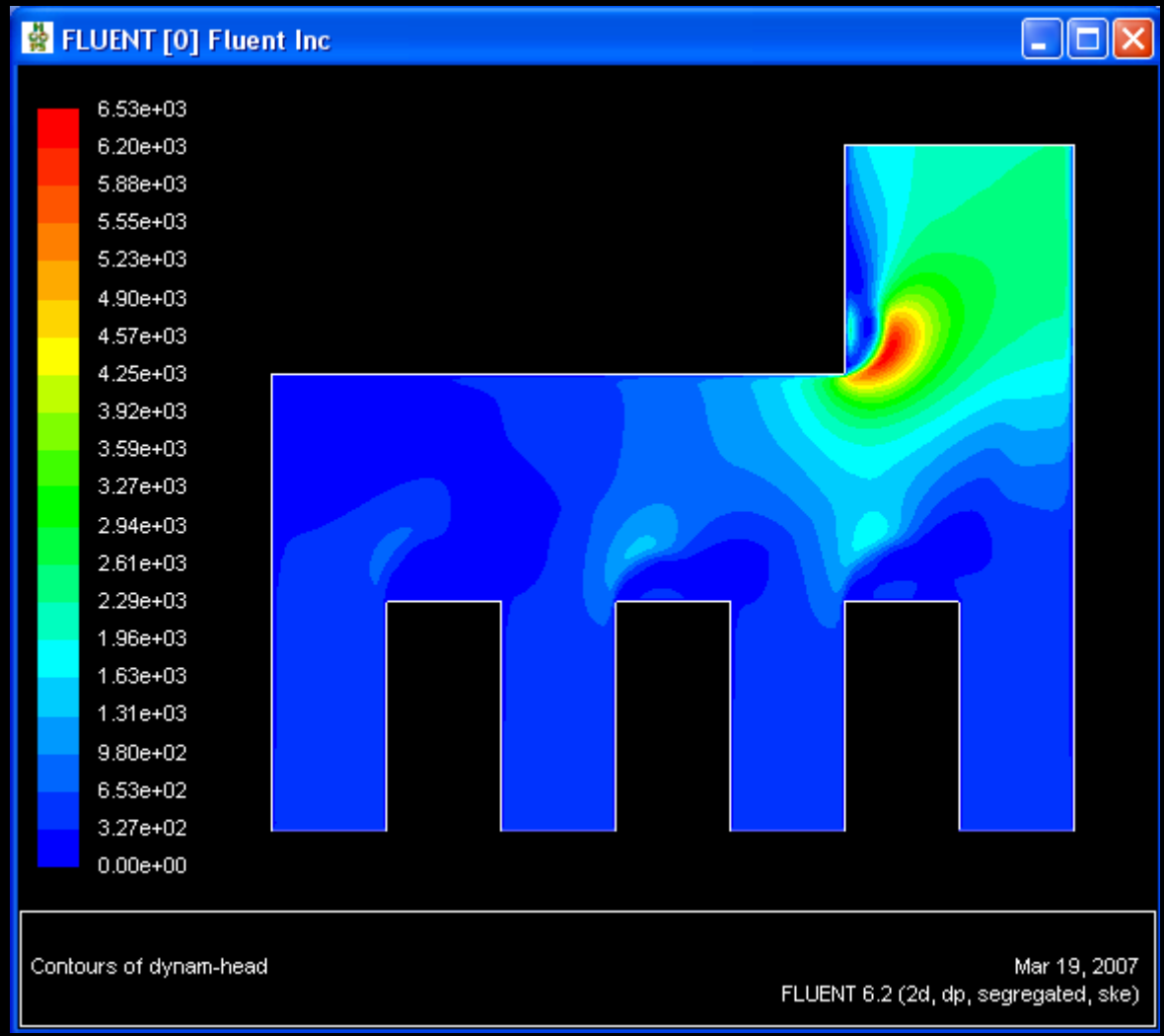


Display of Contours - Vorticity



Display of Contours – Dynamic Head





Laminar Flow in Manifold

(By considering only input velocities)

1. Data

Fluid : water
Density = 998.2 kg/m3
Dynamic viscosity = 0.001003 kg/m.s
The flow is laminar
Re ≈ 100 (at inlet)

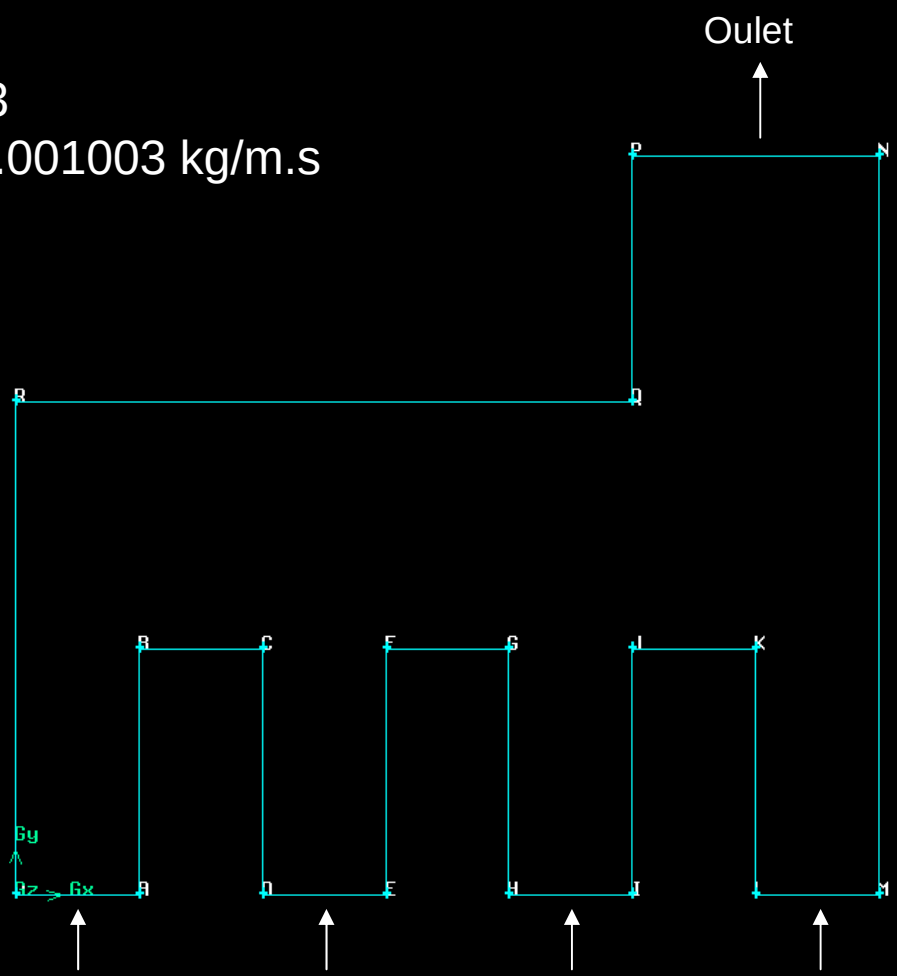
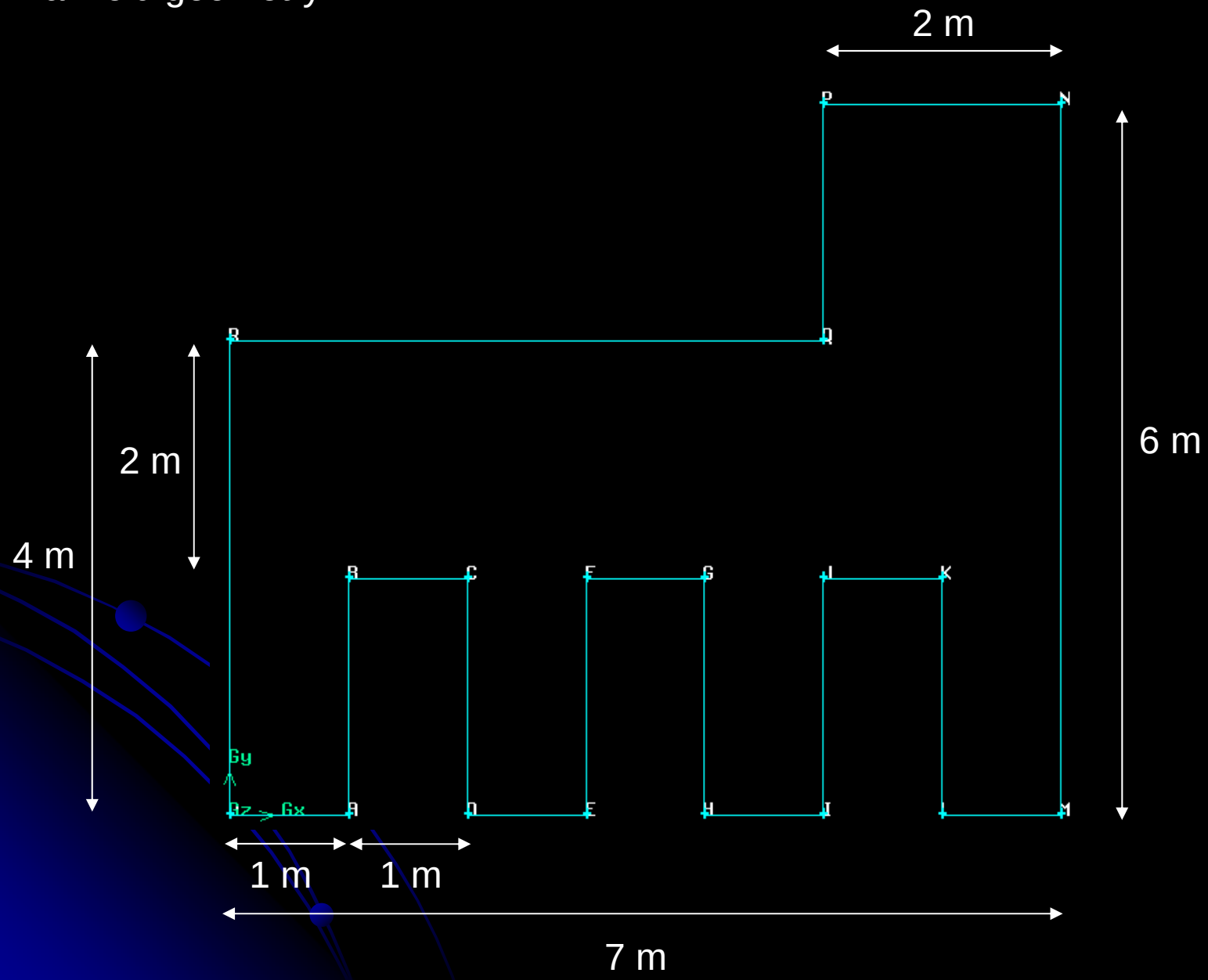


Fig. Manifold with 4 inlet pipes and 1 outlet pipe

Manifold geometry



Mesh generation with Gambit

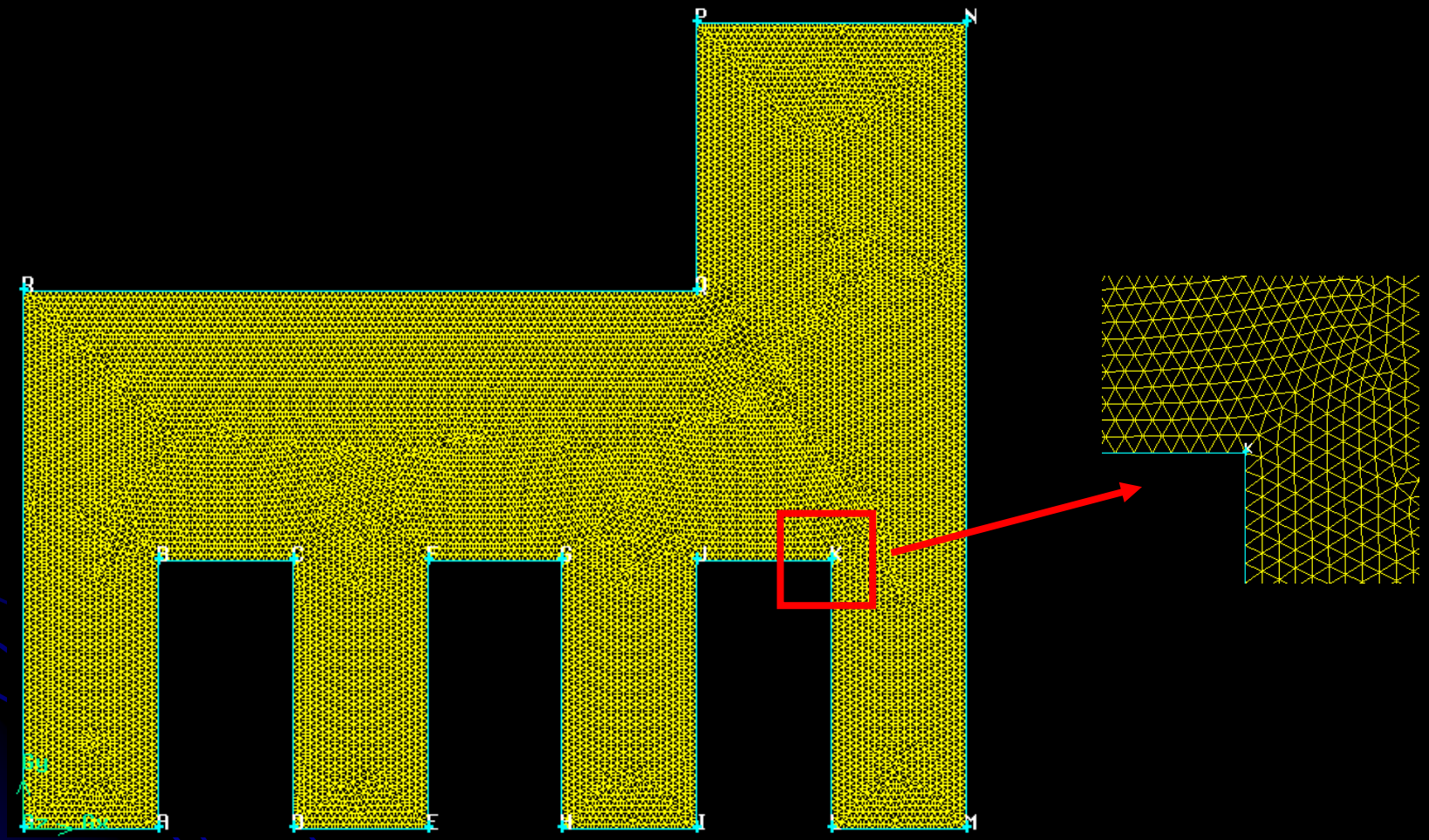
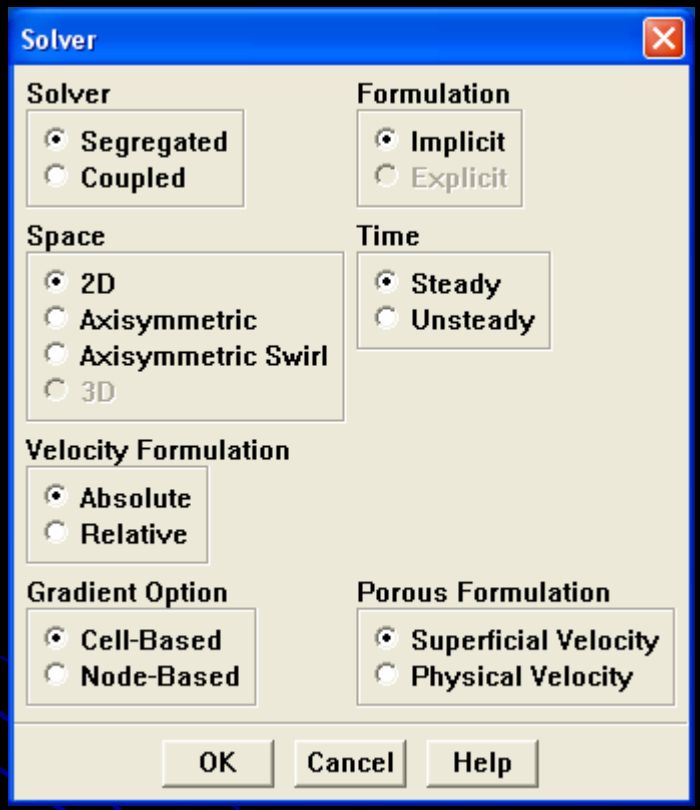
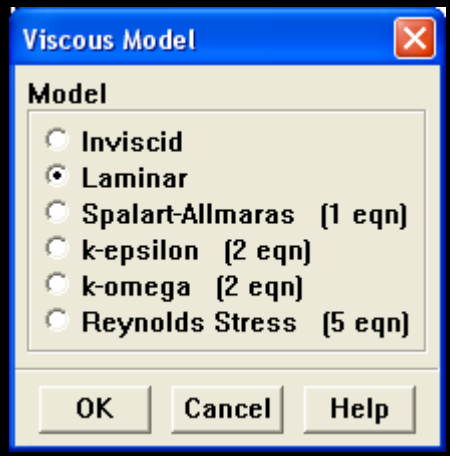


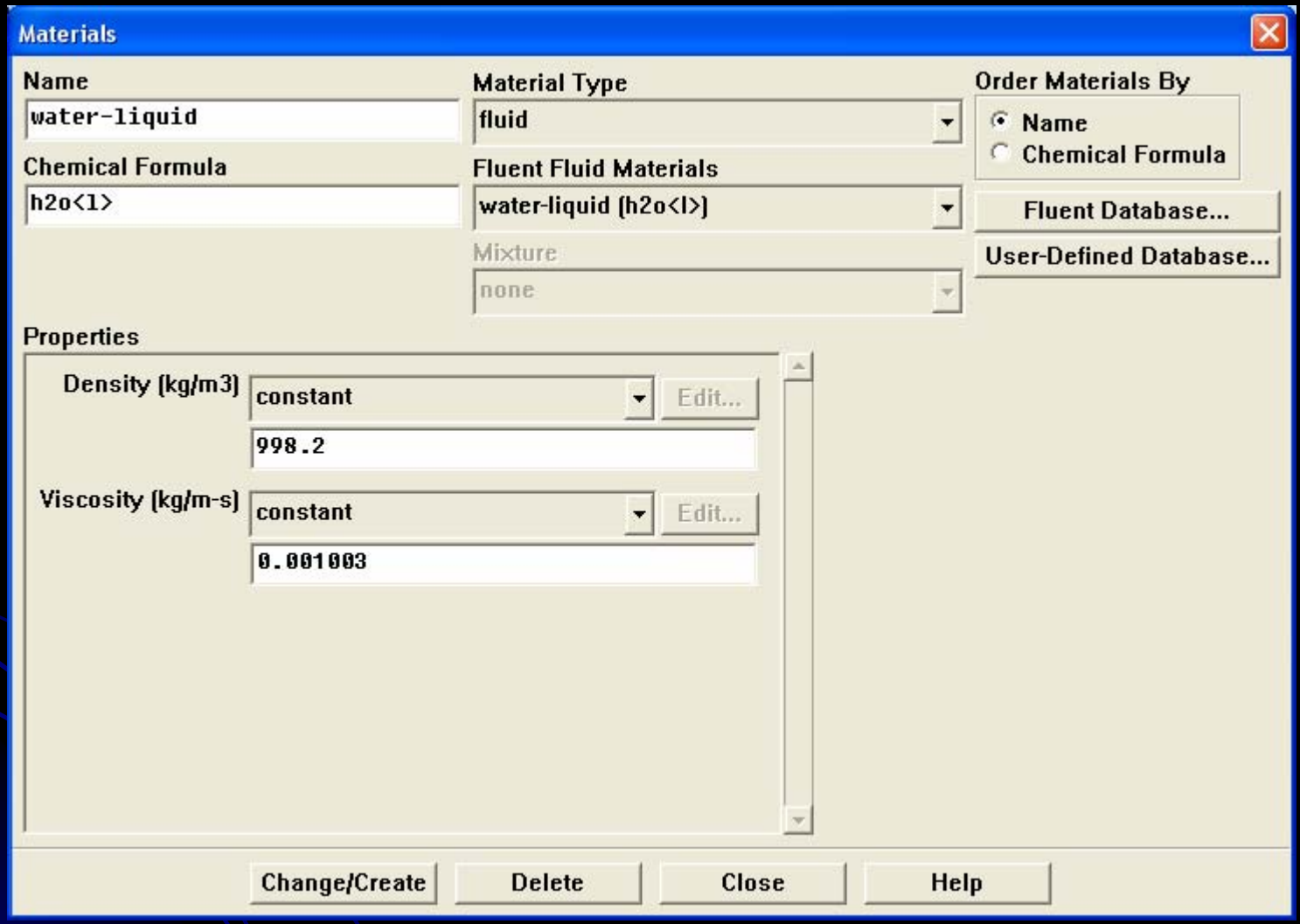
Fig. Triangular mesh created with Gambit

Define Solver and Viscous Model

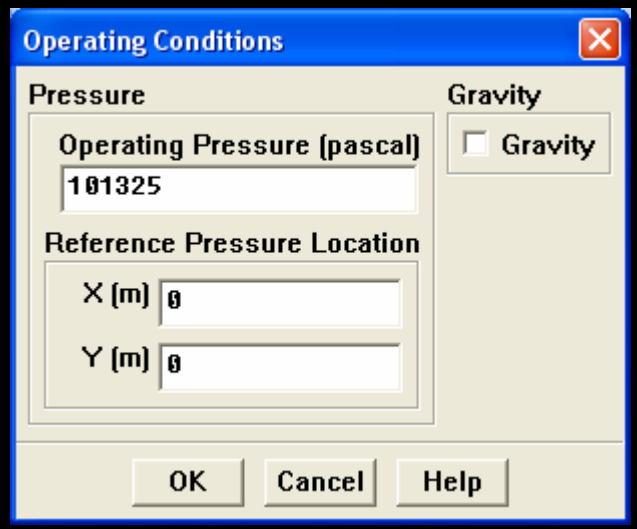




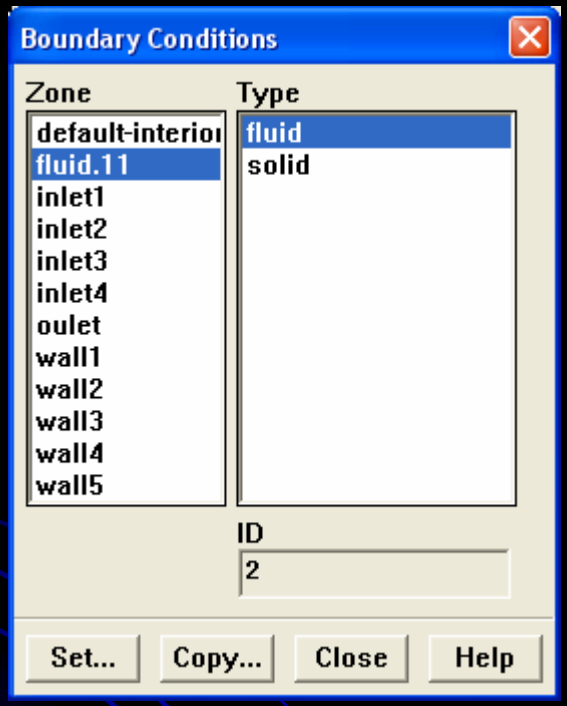
Define Fluid

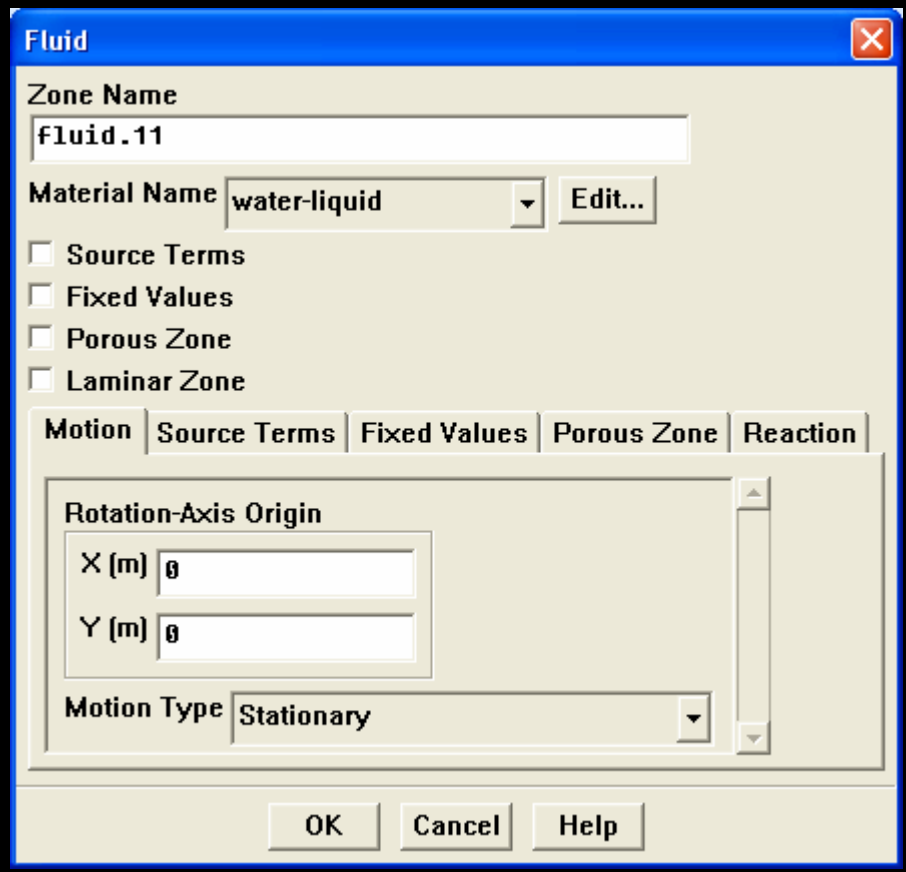


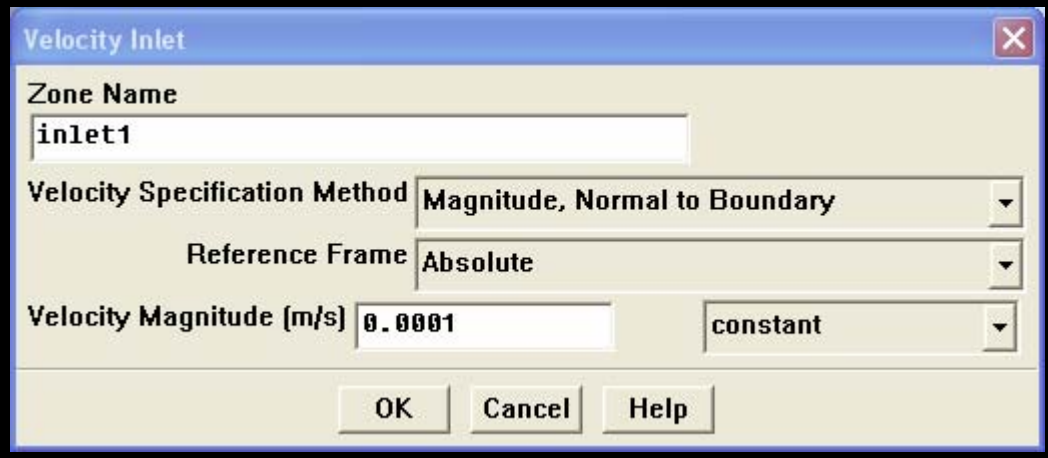
Define Operating Conditions

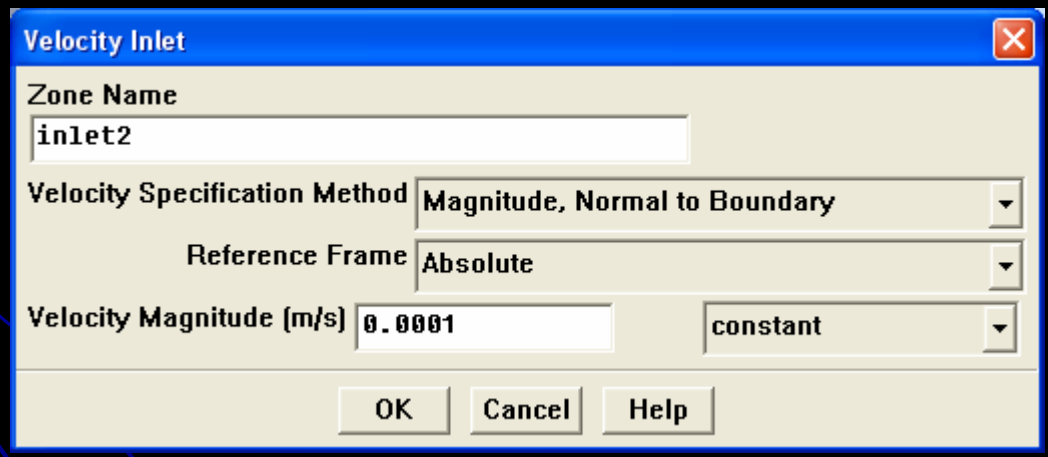


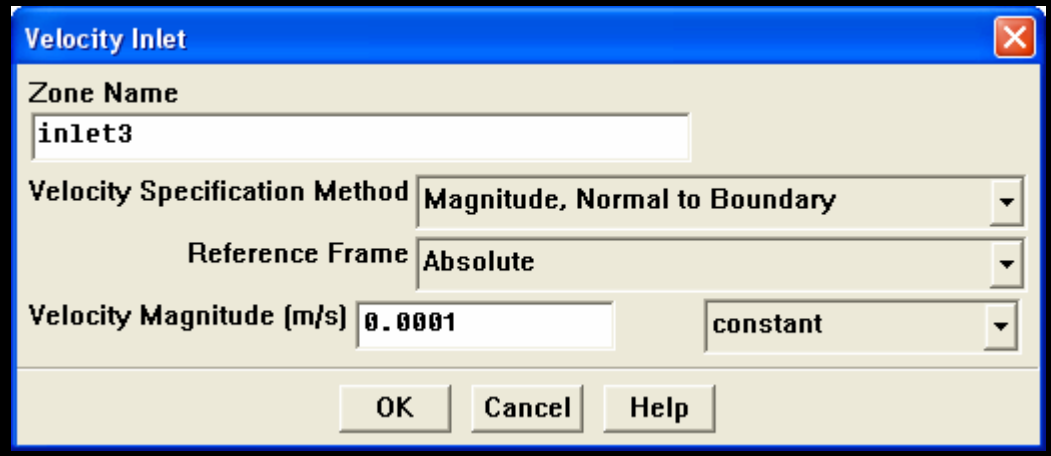
Define Boundary Conditions

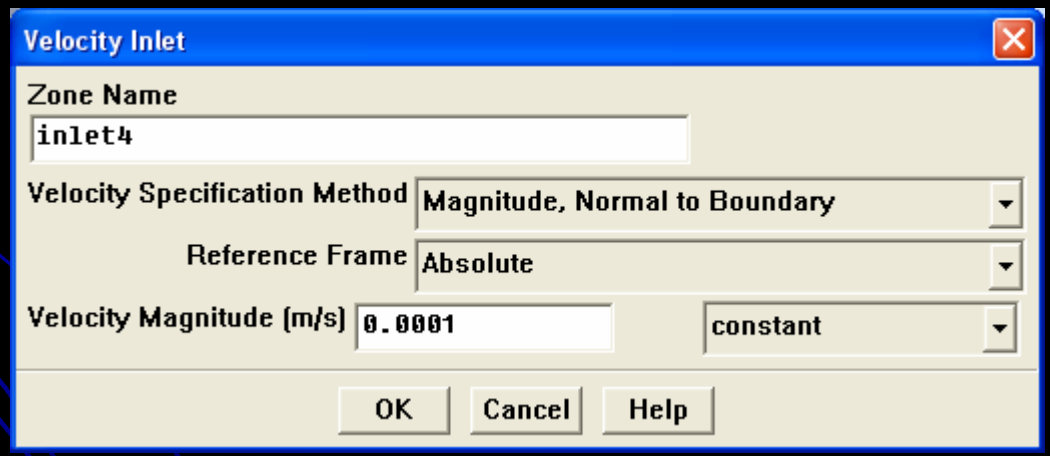


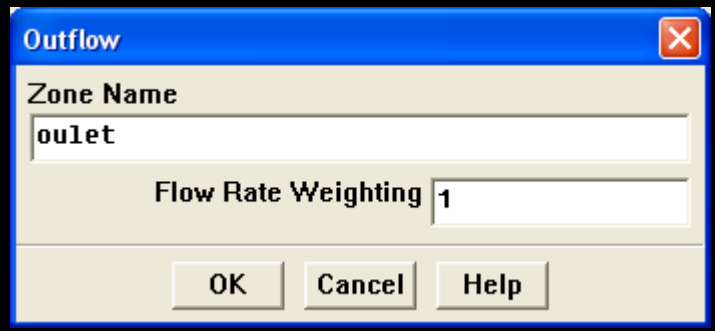


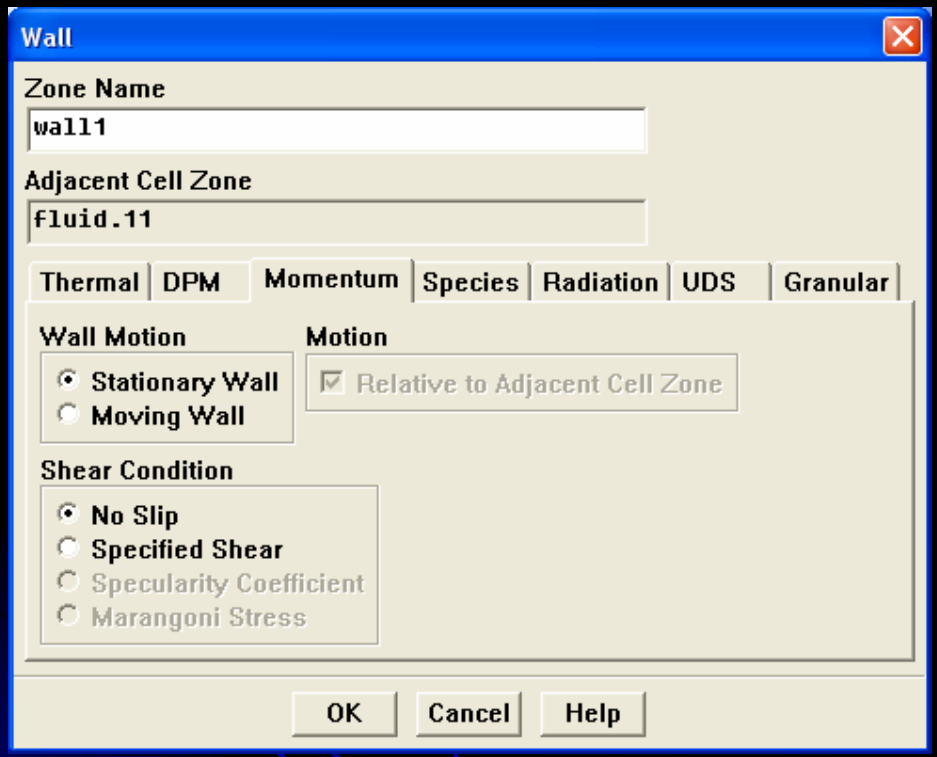

Velocity Inlet
Zone Name
inlet1
Velocity Specification Method
Magnitude, Normal to Boundary
Reference Frame
Absolute
Velocity Magnitude (m/s)
0.0001
constant
OK
Cancel
Help

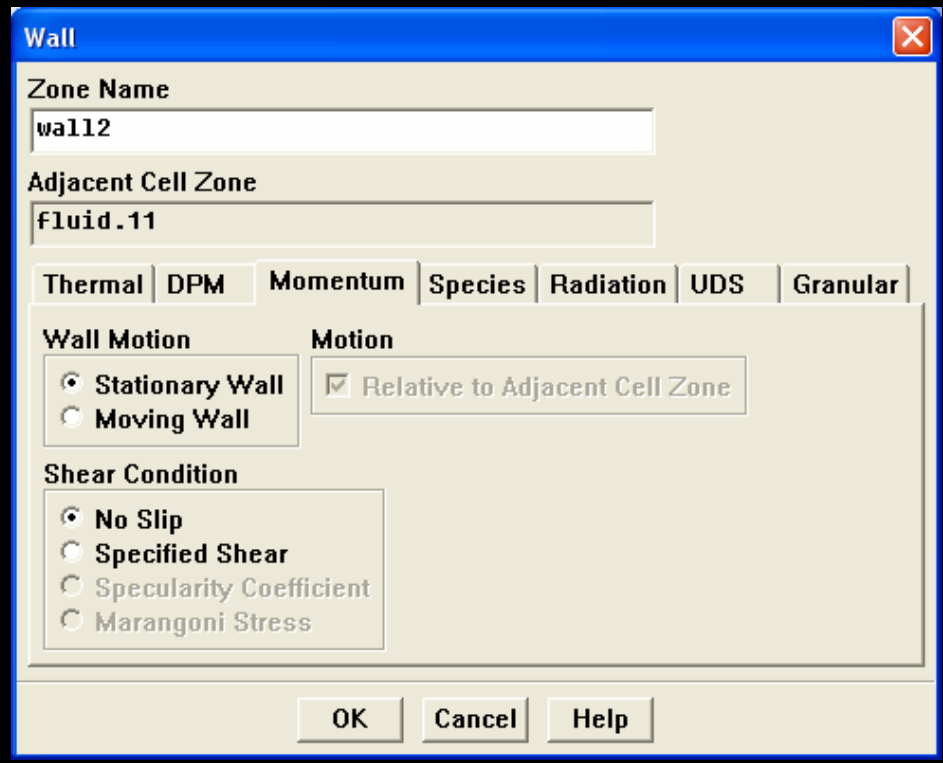

Velocity Inlet
Zone Name
inlet2
Velocity Specification Method
Magnitude, Normal to Boundary
Reference Frame
Absolute
Velocity Magnitude (m/s)
0.0001
constant
OK
Cancel
Help

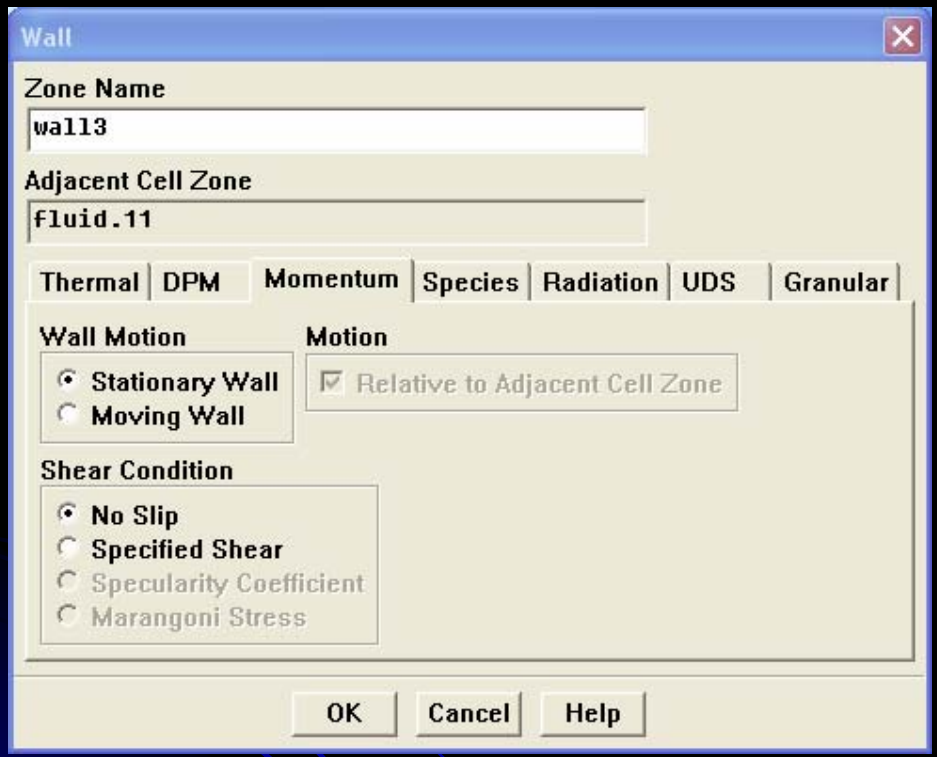

Velocity Inlet
Zone Name
inlet3
Velocity Specification Method
Magnitude, Normal to Boundary
Reference Frame
Absolute
Velocity Magnitude (m/s)
0.0001
constant
OK
Cancel
Help

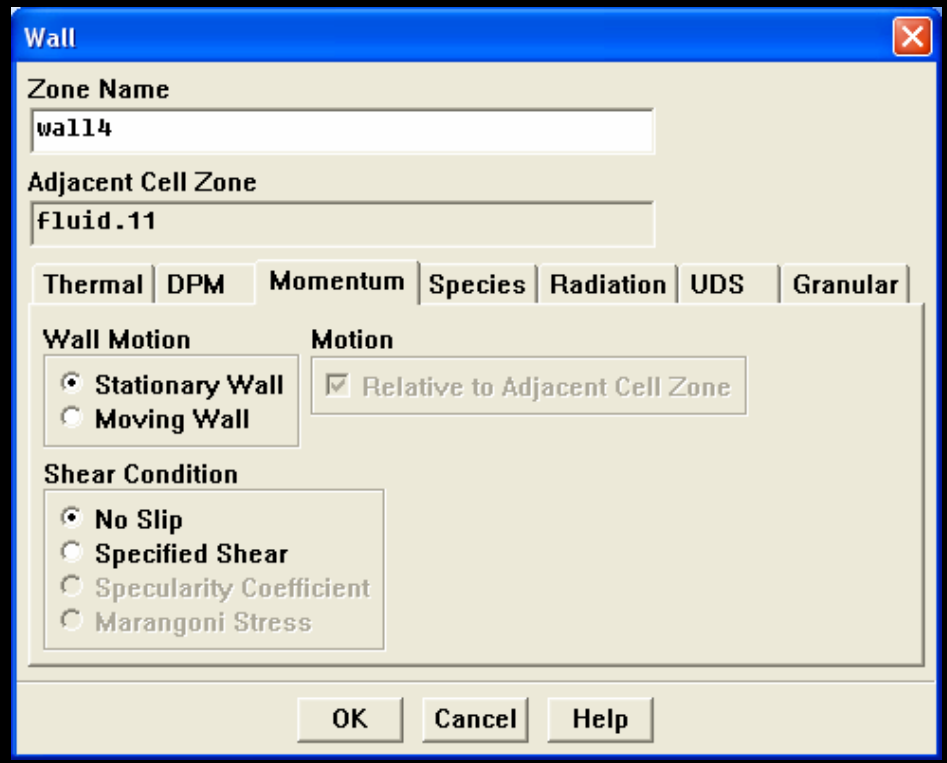

Velocity Inlet
Zone Name
inlet4
Velocity Specification Method
Magnitude, Normal to Boundary
Reference Frame
Absolute
Velocity Magnitude (m/s)
0.0001
constant
OK
Cancel
Help

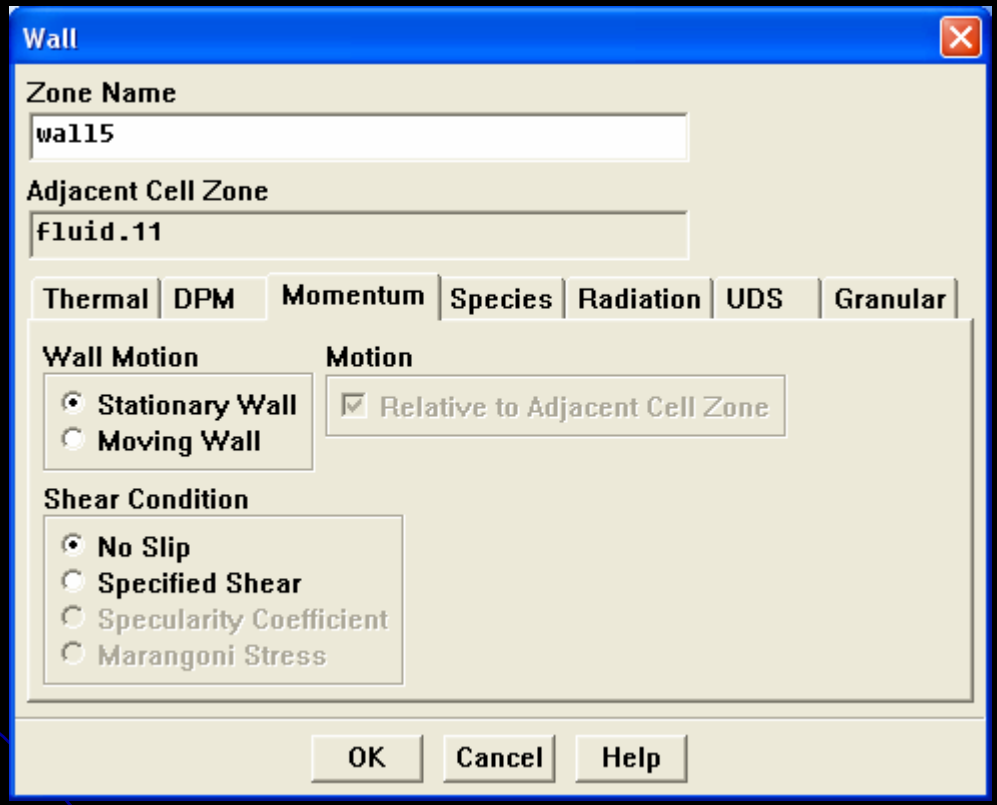

Outflow
Zone Name
oulet
Flow Rate Weighting
1
OK
Cancel
Help


Wall
Zone Name
wall1
Adjacent Cell Zone
fluid.11
Thermal
DPM
Momentum
Species
Radiation
UDS
Granular
Wall Motion
Stationary Wall
Moving Wall
Motion
Relative to Adjacent Cell Zone
Shear Condition
No Slip
Specified Shear
Specularity Coefficient
Marangoni Stress
OK
Cancel
Help

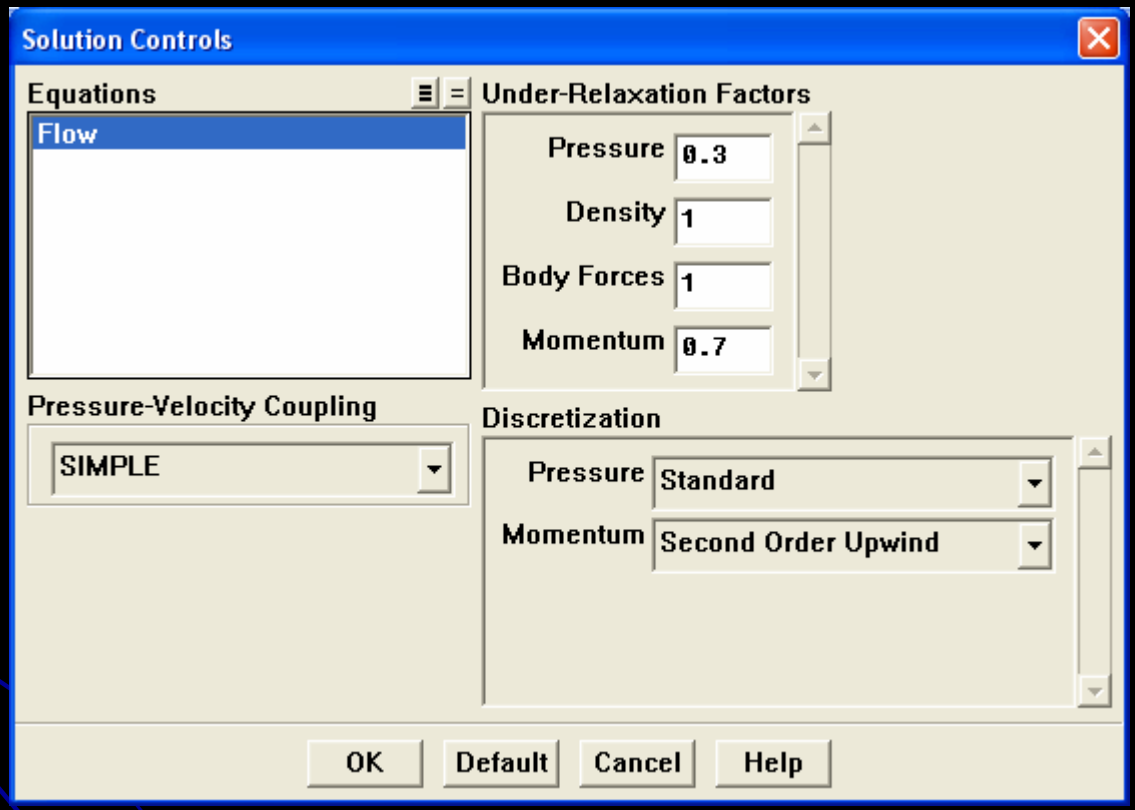

Wall
Zone Name
wall2
Adjacent Cell Zone
fluid.11
Thermal
DPM
Momentum
Species
Radiation
UDS
Granular
Wall Motion
Stationary Wall
Moving Wall
Motion
Relative to Adjacent Cell Zone
Shear Condition
No Slip
Specified Shear
Specularity Coefficient
Marangoni Stress
OK
Cancel
Help


Wall
Zone Name
wall3
Adjacent Cell Zone
fluid.11
Thermal
DPM
Momentum
Species
Radiation
UDS
Granular
Wall Motion
Stationary Wall
Moving Wall
Motion
Relative to Adjacent Cell Zone
Shear Condition
No Slip
Specified Shear
Specularity Coefficient
Marangoni Stress
OK
Cancel
Help

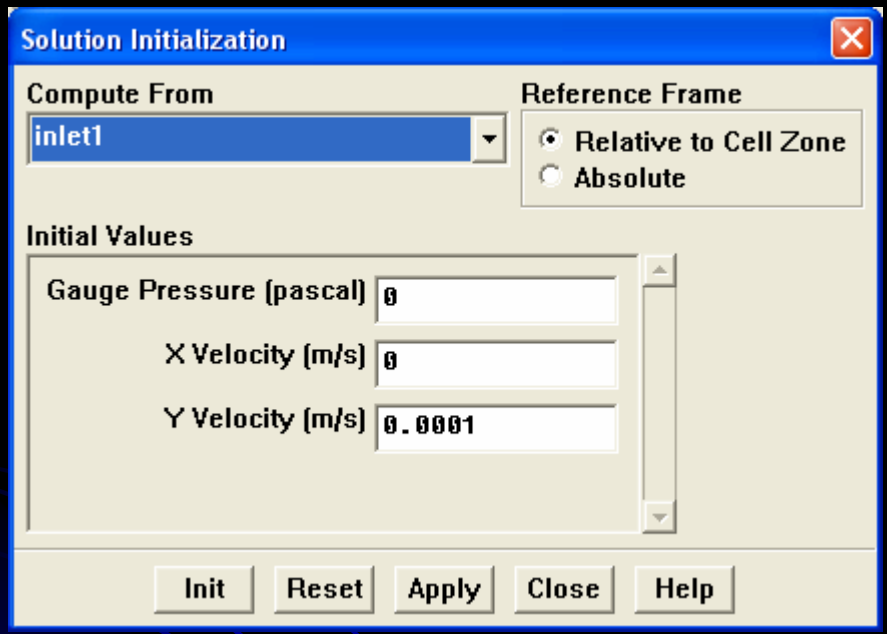

Wall
Zone Name
wall4
Adjacent Cell Zone
fluid.11
Thermal
DPM
Momentum
Species
Radiation
UDS
Granular
Wall Motion
Stationary Wall
Moving Wall
Motion
Relative to Adjacent Cell Zone
Shear Condition
No Slip
Specified Shear
Specularity Coefficient
Marangoni Stress
OK
Cancel
Help

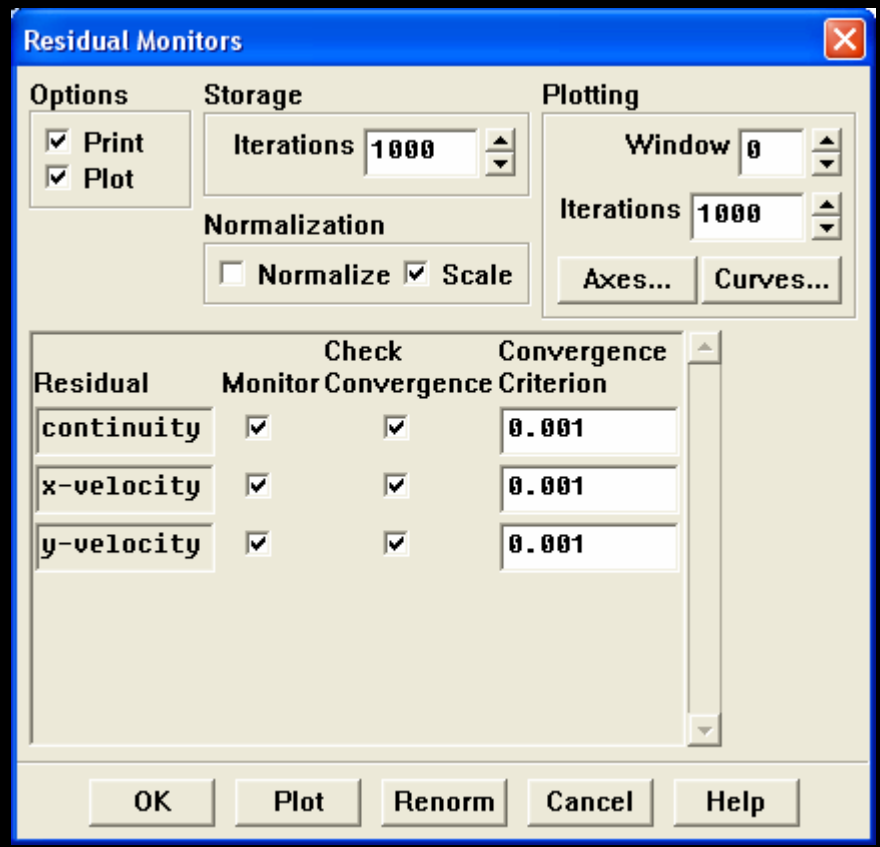

Wall
Zone Name
wall5
Adjacent Cell Zone
fluid.11
Thermal
DPM
Momentum
Species
Radiation
UDS
Granular
Wall Motion
Stationary Wall
Moving Wall
Motion
Relative to Adjacent Cell Zone
Shear Condition
No Slip
Specified Shear
Specularity Coefficient
Marangoni Stress
OK
Cancel
Help

Solve control solutions

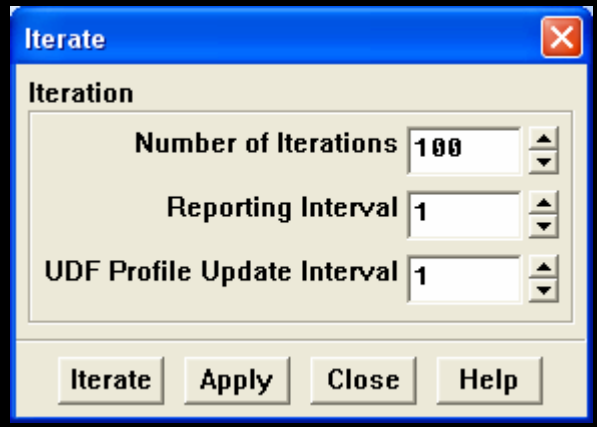


Solve Solution Initialization and Residual Monitors

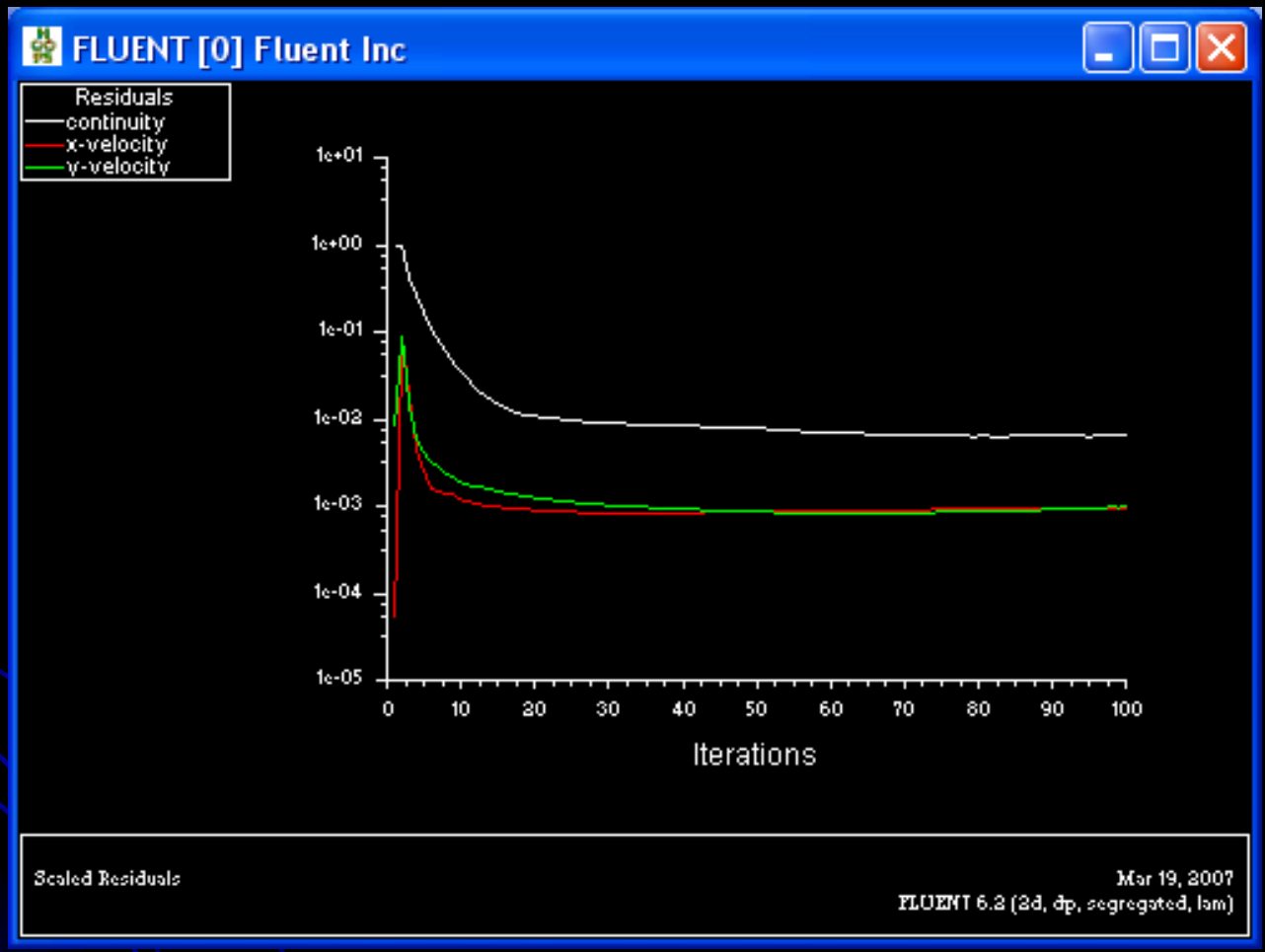




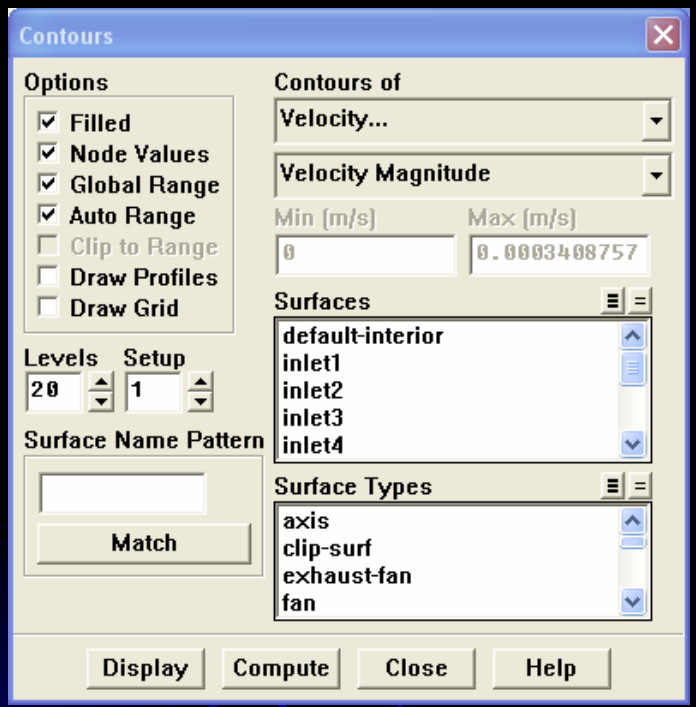
Solve Iteration

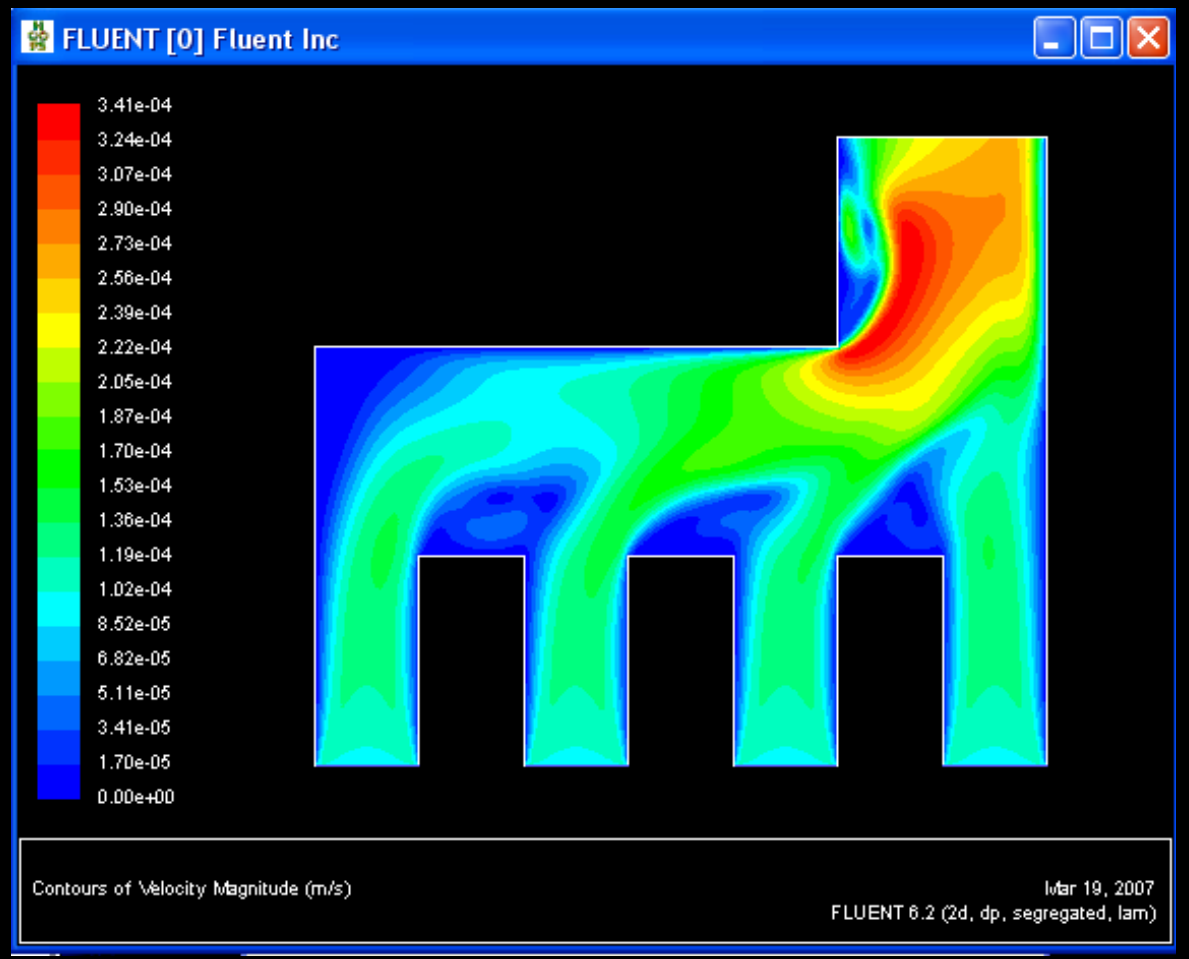


Convergence of solution

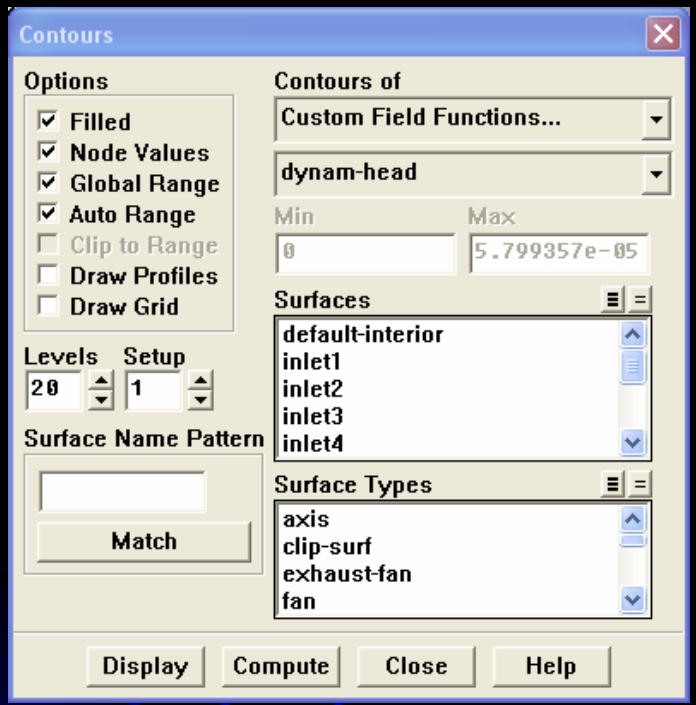


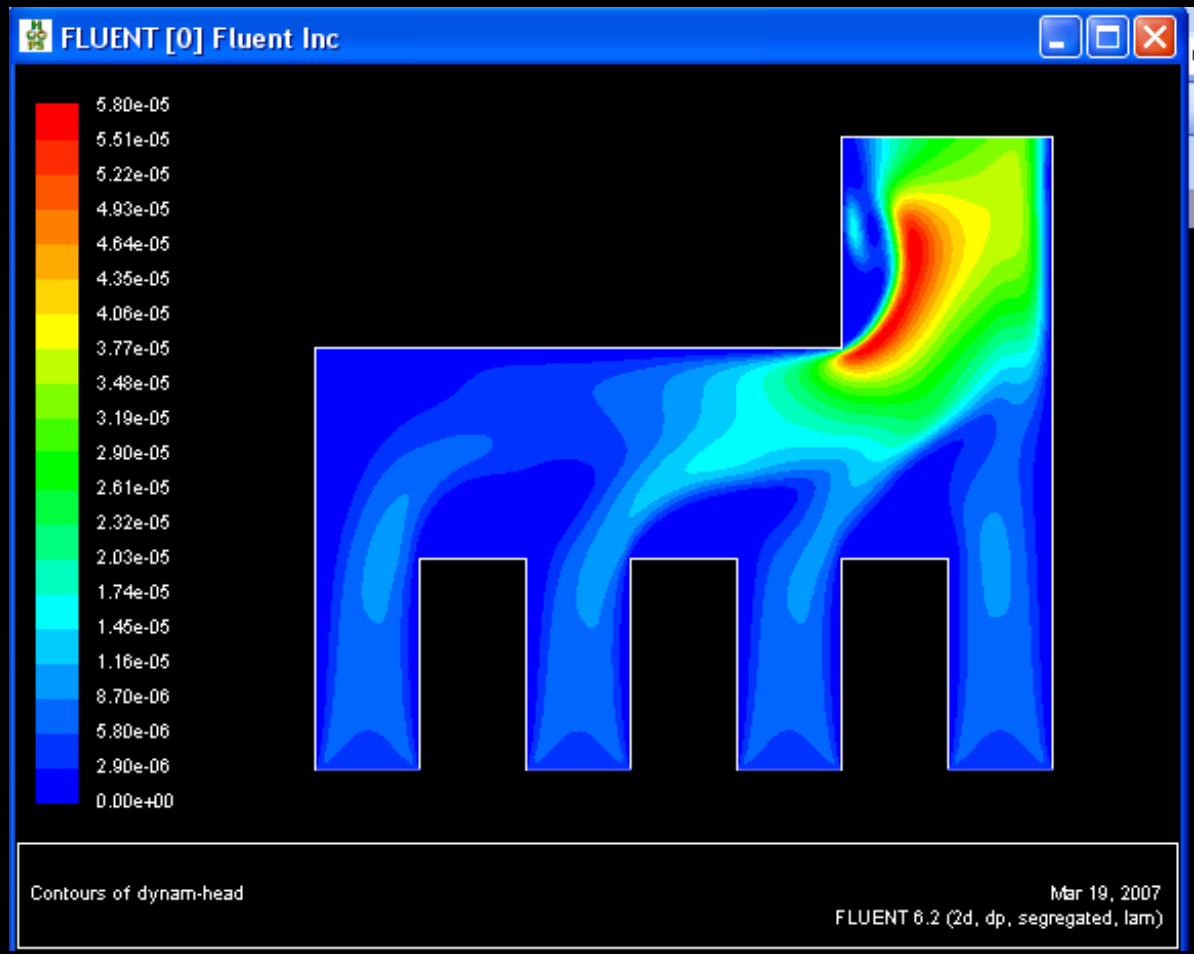
Display of Contours – Velocity Magnitude





Display of Contours – Dynamic Head





Display of Vectors – Velocity Magnitude