CFD SOFTWARE LAB

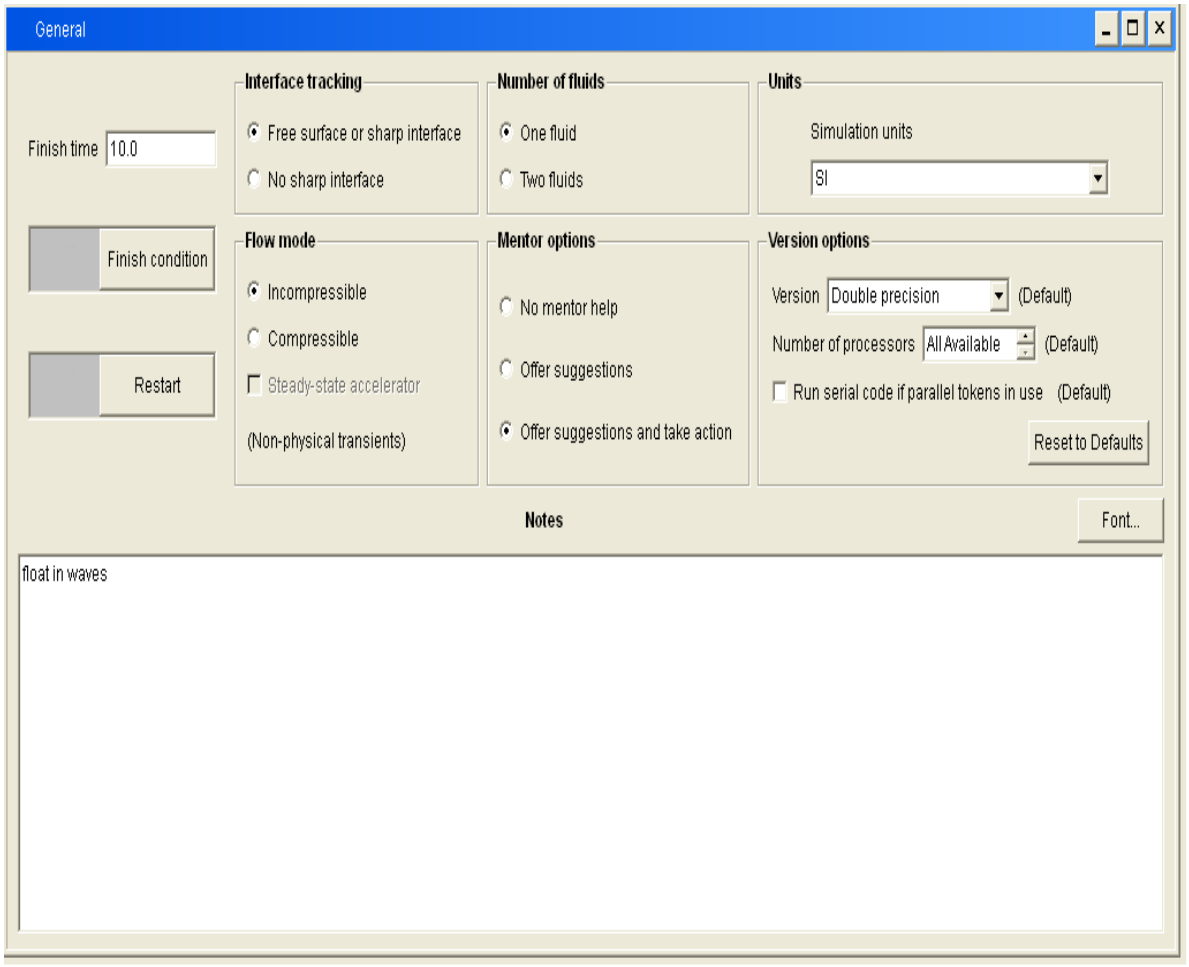
PURPOSE: The purpose of this lab is to give you some experience with CFD software. For it you will set up a simulation for a floating body in a wave tank. The body is the cylindrical float used in the Hydrodynamics lab. You will study the heave motion of the float with a round bottom and with a plate with holes bottom.

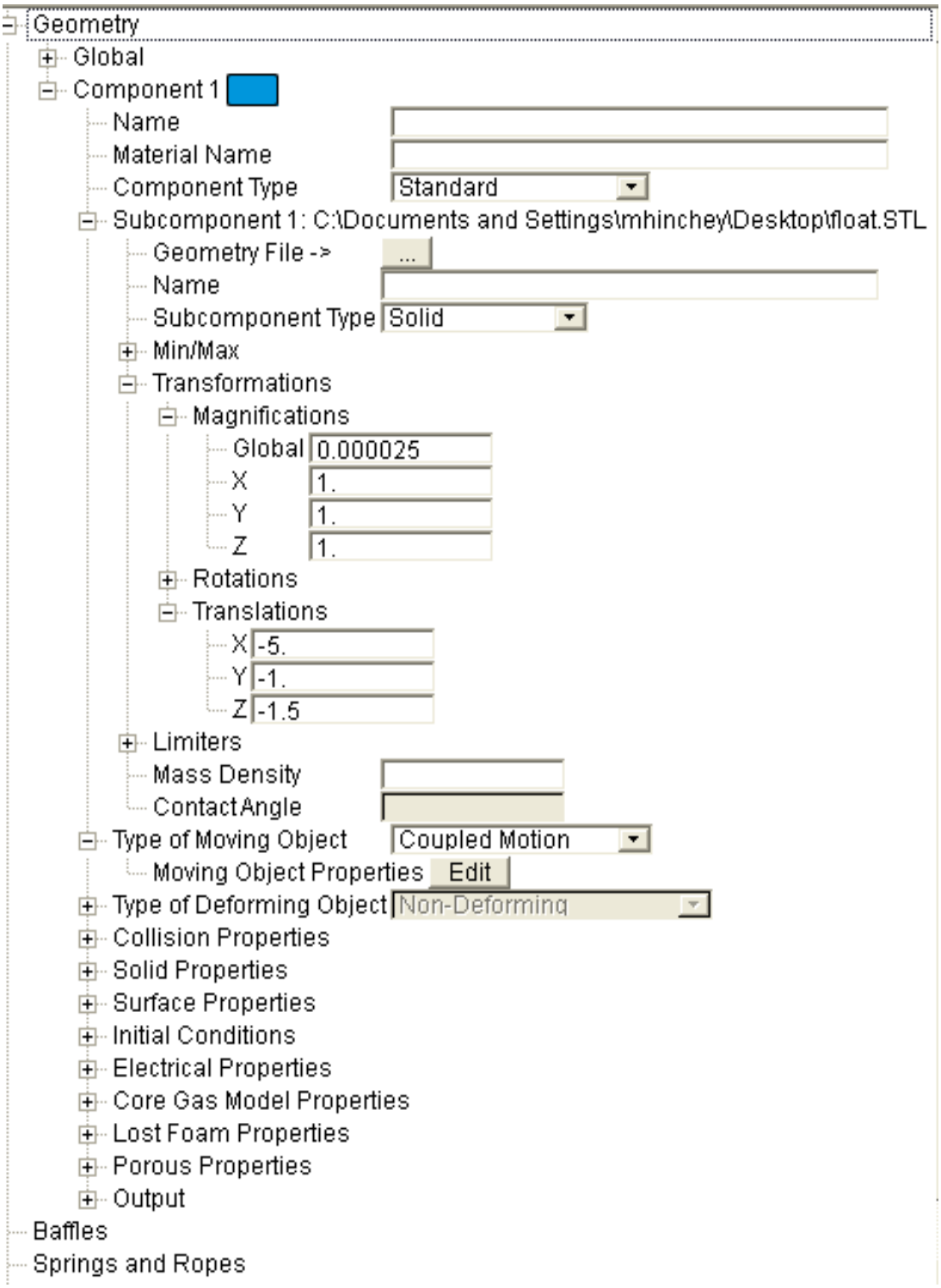
PROCEDURE: Create a CFD mesh of a wave tank. Import the STL file for the float into the mesh. Set the simulation parameters. Run the simulation to get the motion of the float step by step in time. Use the GENERAL HISTORY data source and GRAPHICAL output form under PROBE in ANALYZE to get the heave motion of the float. Use this to create the heave RAO of the float for various wave frequencies.

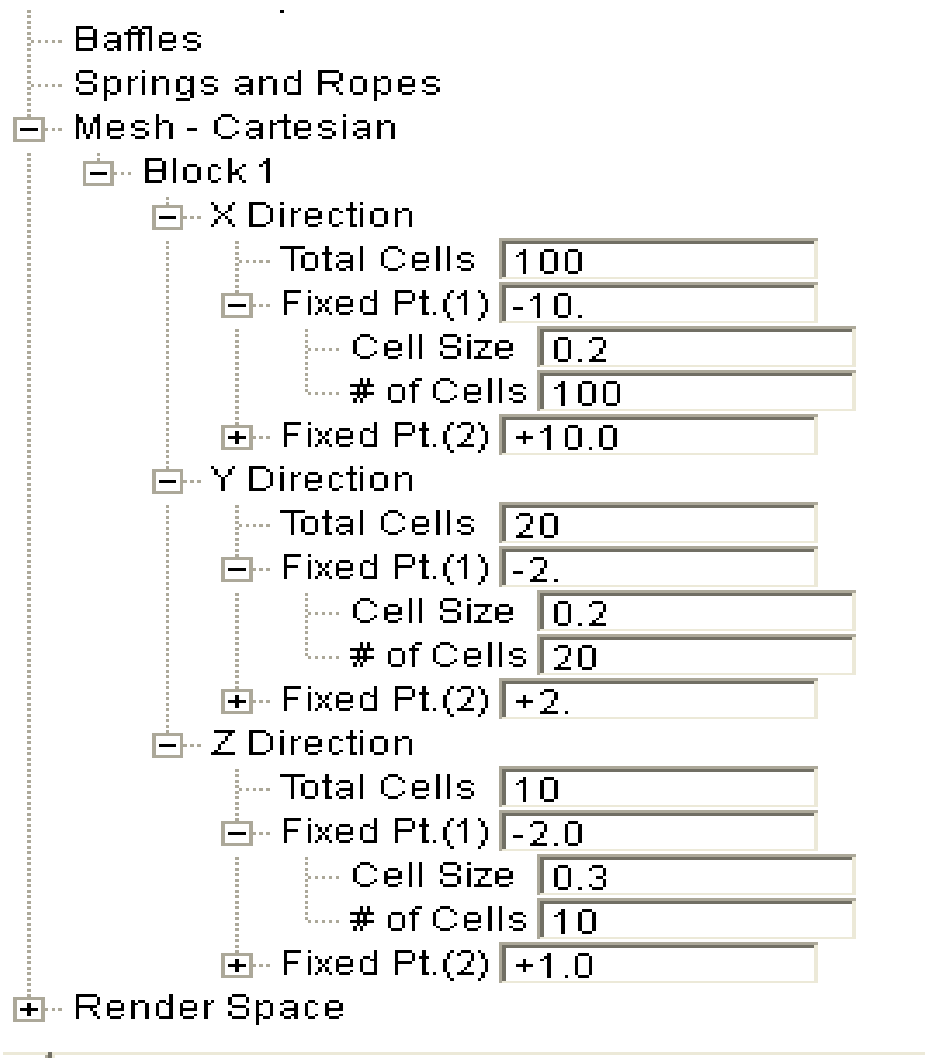
REPORT: Describe the steps you took to do the CFD. Present the most important menus used by the simulation. Present the RAO results. Compare the round and plate bottom cases.

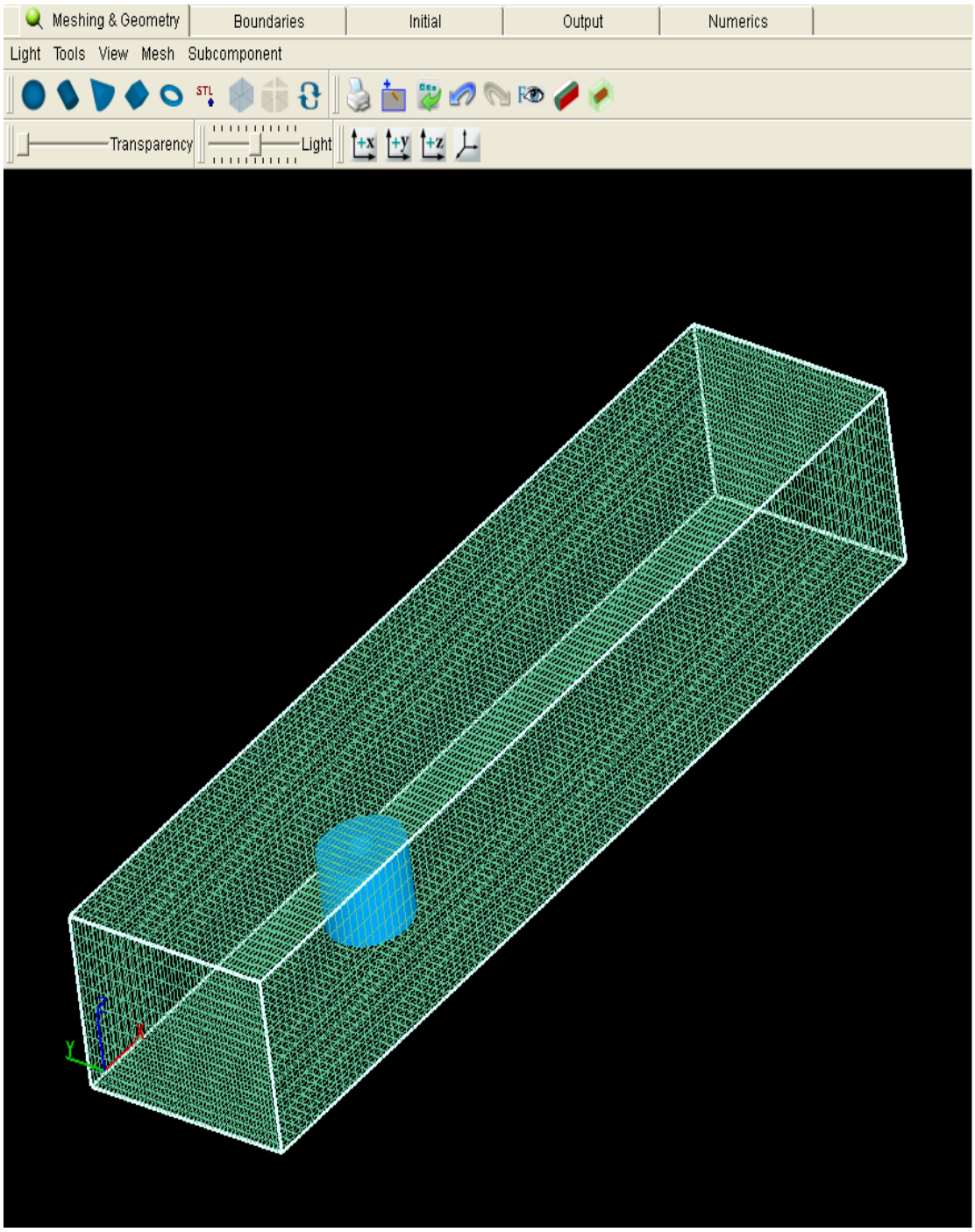
CFD LAB STEPS

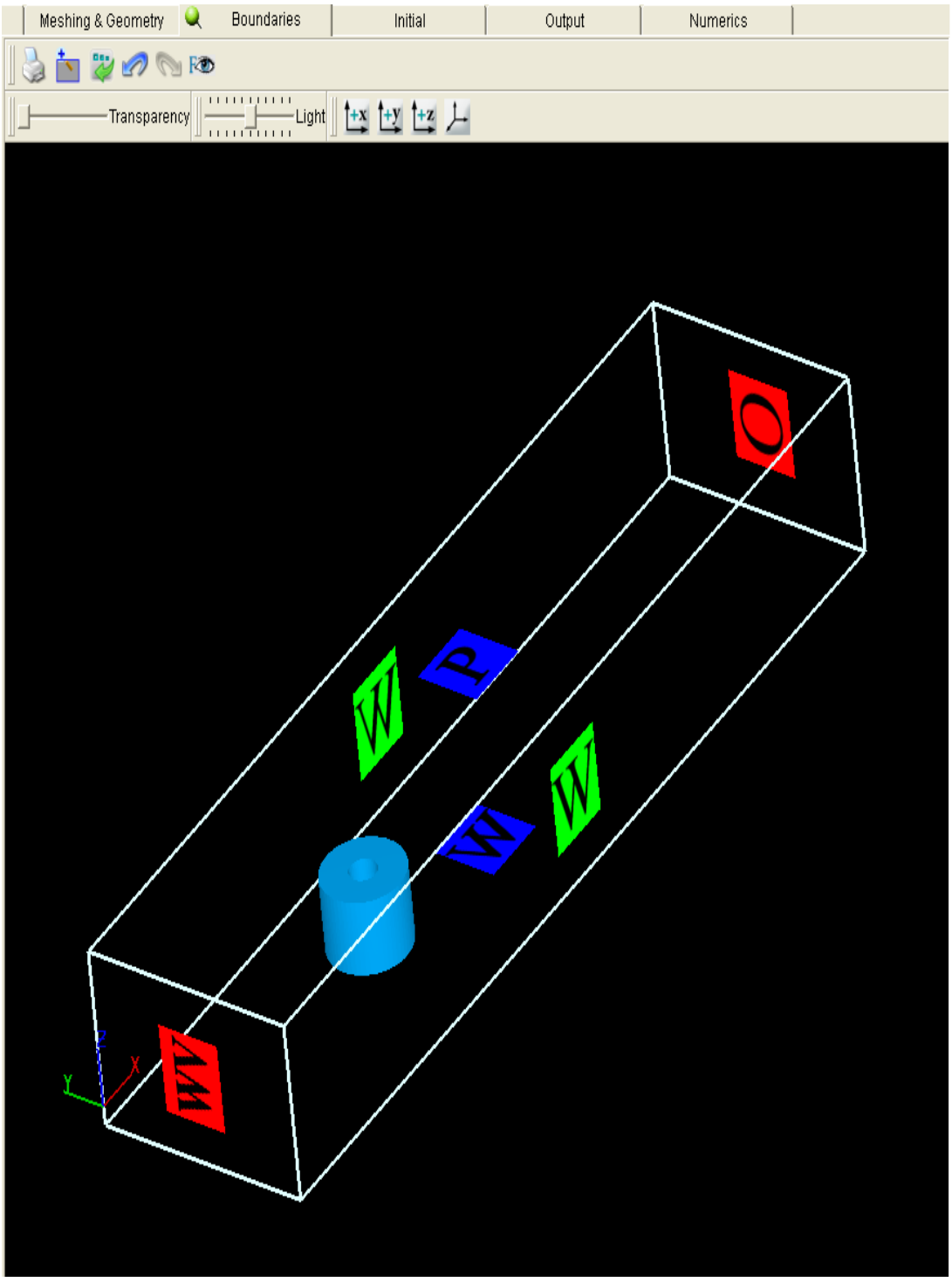
(1) Click on the FLOW 3D icon to get to Navigator. (2) Under Navigator create new workspace on desktop. (3) Under Navigator create new simulation on desktop. (4) Click on Model Setup to get its submenus. (5) Under General set things like free surface. (6) Under Physics activate things like GMO. (7) Under Fluids load data for water. (8) Under Mesh Setup create the mesh. (9) Under Mesh Setup import body STL file. (10) Scale and translate body to fit mesh. (11) Under Boundaries set boundary types. (12) Under Initial set things like speeds. (13) Under Output set data spacing. (14) Under Numerics click on one fluid with interface. (15) Under Simulation click on run. (16) Under Analyze click on 3D probe. (17) Expand time and click on STL and Render. (18) Click on animation (19) Under Analyze click on Probe and then on General History and then on Graphical Display (20) Record RAO data.

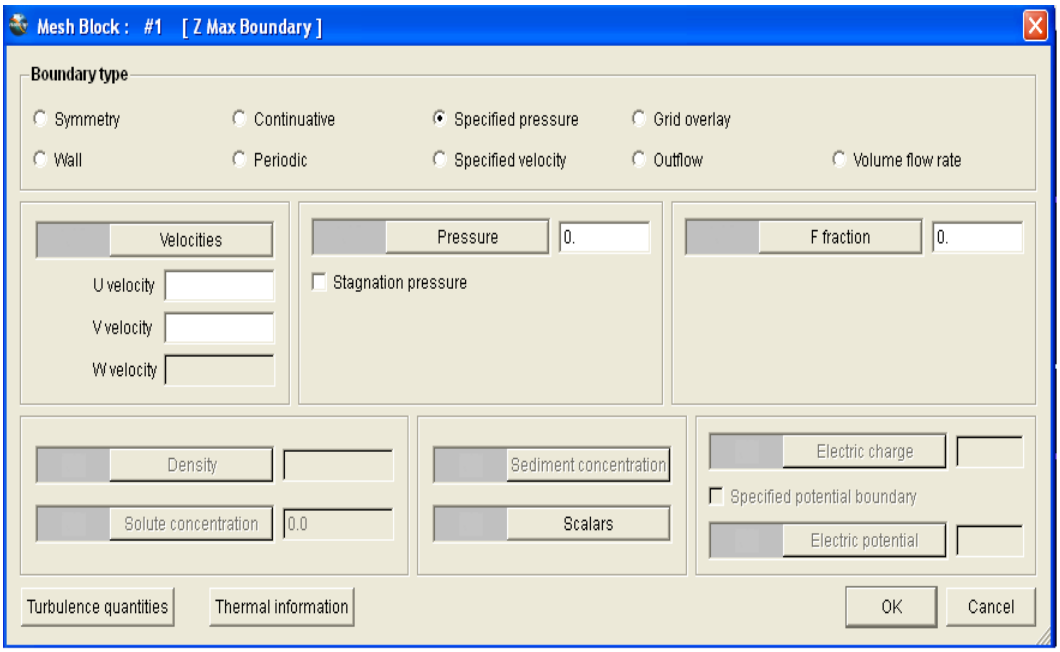

General
Finish time
10.0
Finish condition
Restart
Interface tracking
Free surface or sharp interface
No sharp interface
Number of fluids
One fluid
Two fluids
Units
Simulation units
SI
Flow mode
Incompressible
Compressible
Steady-state accelerator
(Non-physical transients)
Mentor options
No mentor help
Offer suggestions
Offer suggestions and take action
Version options
Version
Double precision
(Default)
Number of processors
All Available
(Default)
Run serial code if parallel tokens in use
(Default)
Reset to Defaults
Notes
Font...
float in waves

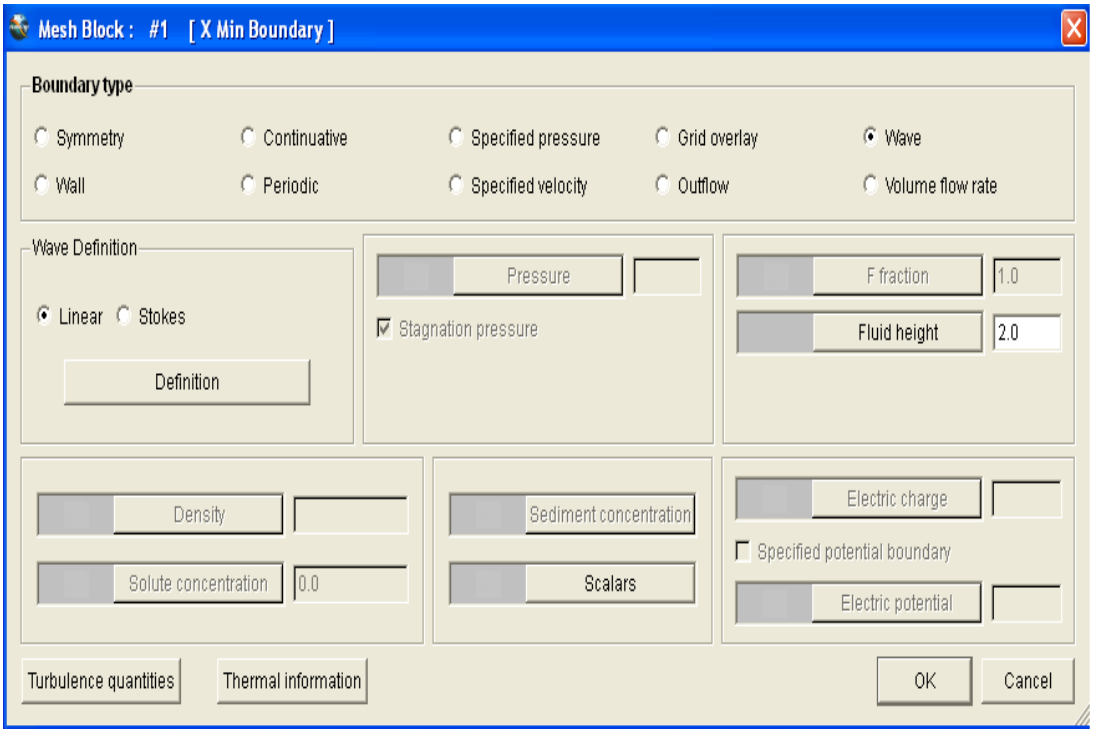

Geometry
Global
Component 1
Name
Material Name
Component Type
Standard
Subcomponent 1: C:\Documents and Settings\mhinchey\Desktop\float.STL
Geometry File ->
...
Name
Subcomponent Type
Solid
Min/Max
Transformations
Magnifications
Global
0.000025
X
1.
Y
1.
Z
1.
Rotations
Translations
X
-5.
Y
-1.
Z
-1.5
Limiters
Mass Density
Contact Angle
Type of Moving Object
Coupled Motion
Moving Object Properties
Edit
Type of Deforming Object
Non-Deforming
Collision Properties
Solid Properties
Surface Properties
Initial Conditions
Electrical Properties
Core Gas Model Properties
Lost Foam Properties
Porous Properties
Output
Baffles
Springs and Ropes

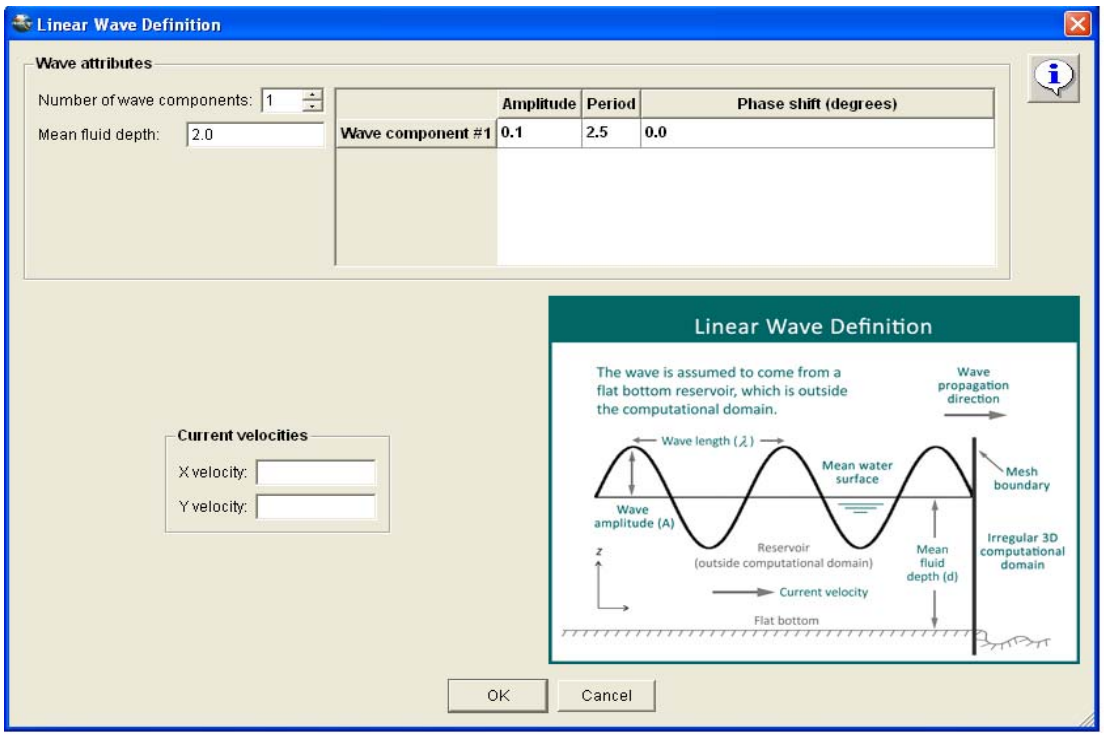

Baffles
Springs and Ropes
Mesh - Cartesian
Block 1
X Direction
Total Cells 100
Fixed Pt.(1) -10.
Cell Size 0.2
# of Cells 100
Fixed Pt.(2) +10.0
Y Direction
Total Cells 20
Fixed Pt.(1) -2.
Cell Size 0.2
# of Cells 20
Fixed Pt.(2) +2.
Z Direction
Total Cells 10
Fixed Pt.(1) -2.0
Cell Size 0.3
# of Cells 10
Fixed Pt.(2) +1.0
Render Space

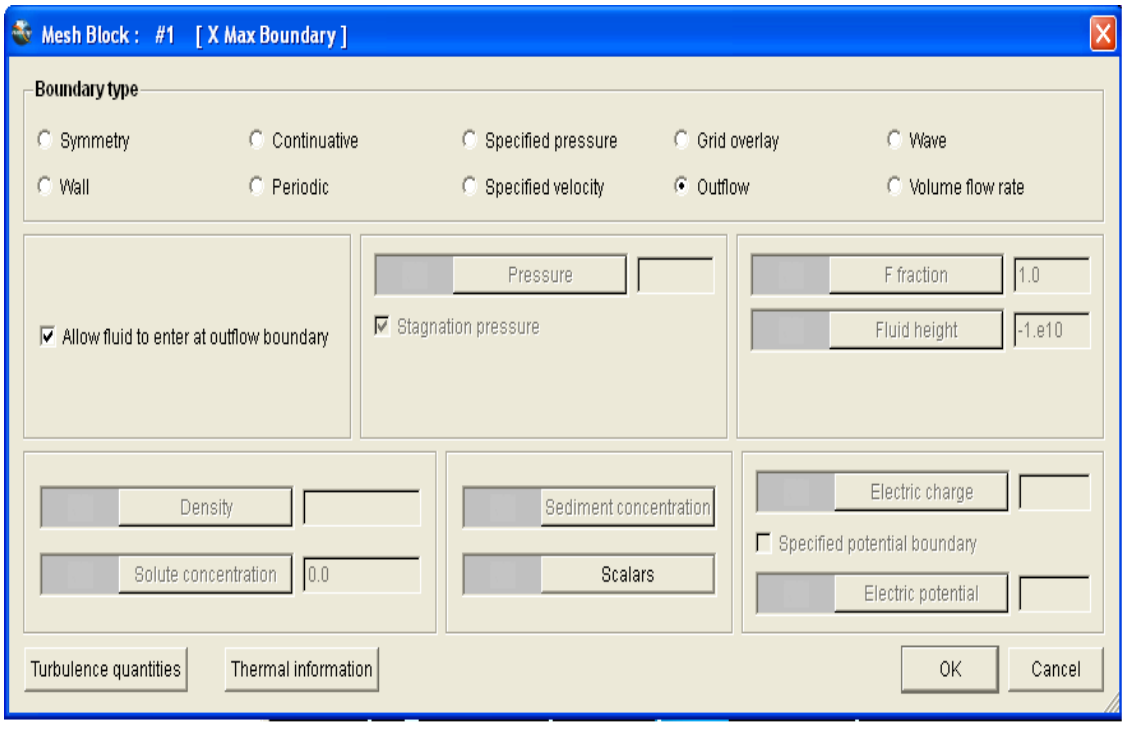

Meshing & Geometry
Boundaries
Initial
Output
Numerics
Light Tools View Mesh Subcomponent
Transparency
Light
Y

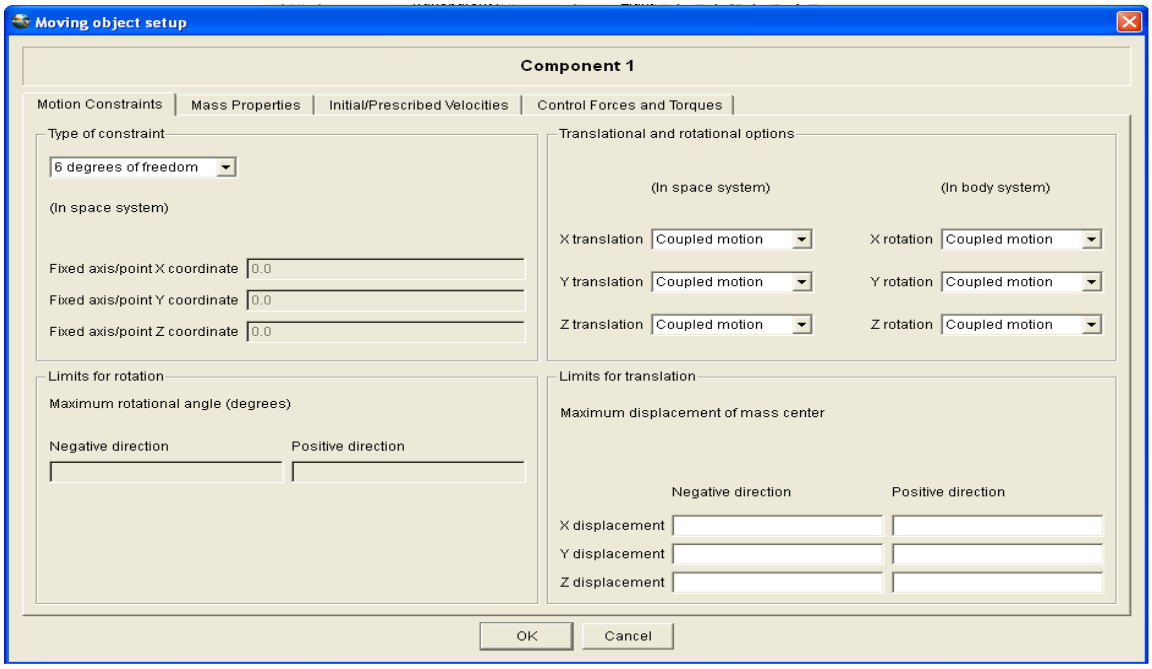

Meshing & Geometry
Boundaries
Initial
Output
Numerics
Transparency
Light
+x
+y
+z
O
W
P
W
W
W
Z
X
Y

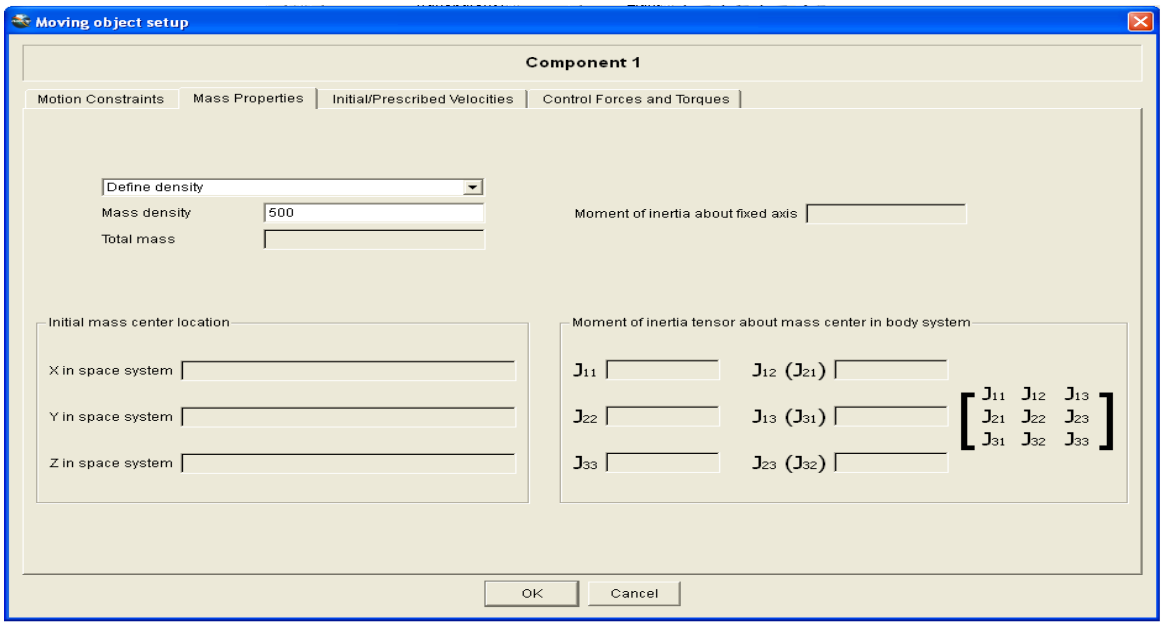

Mesh Block : #1 [Z Max Boundary]
Boundary type
Symmetry
Continuative
Specified pressure
Grid overlay
Wall
Periodic
Specified velocity
Outflow
Volume flow rate
Velocities
U velocity
V velocity
W velocity
Pressure
0.
Stagnation pressure
F fraction
0.
Density
Solute concentration
0.0
Sediment concentration
Scalars
Electric charge
Specified potential boundary
Electric potential
Turbulence quantities
Thermal information
OK
Cancel

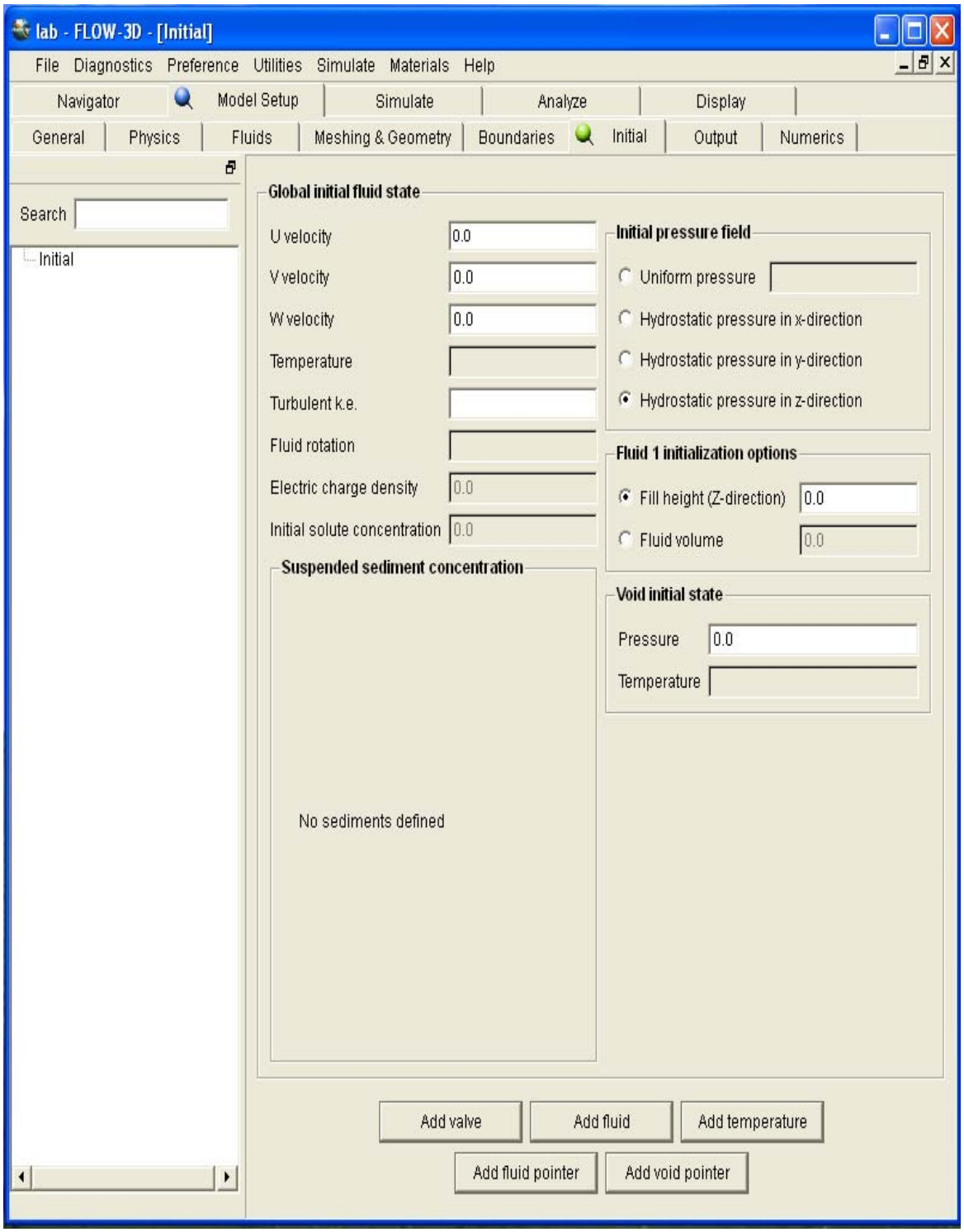

Mesh Block : #1 [X Min Boundary]
Boundary type
Symmetry
Continuative
Specified pressure
Grid overlay
Wave
Wall
Periodic
Specified velocity
Outflow
Volume flow rate
Wave Definition
Linear
Stokes
Definition
Pressure
Stagnation pressure
F fraction
1.0
Fluid height
2.0
Density
Solute concentration
0.0
Sediment concentration
Scalars
Electric charge
Specified potential boundary
Electric potential
Turbulence quantities
Thermal information
OK
Cancel

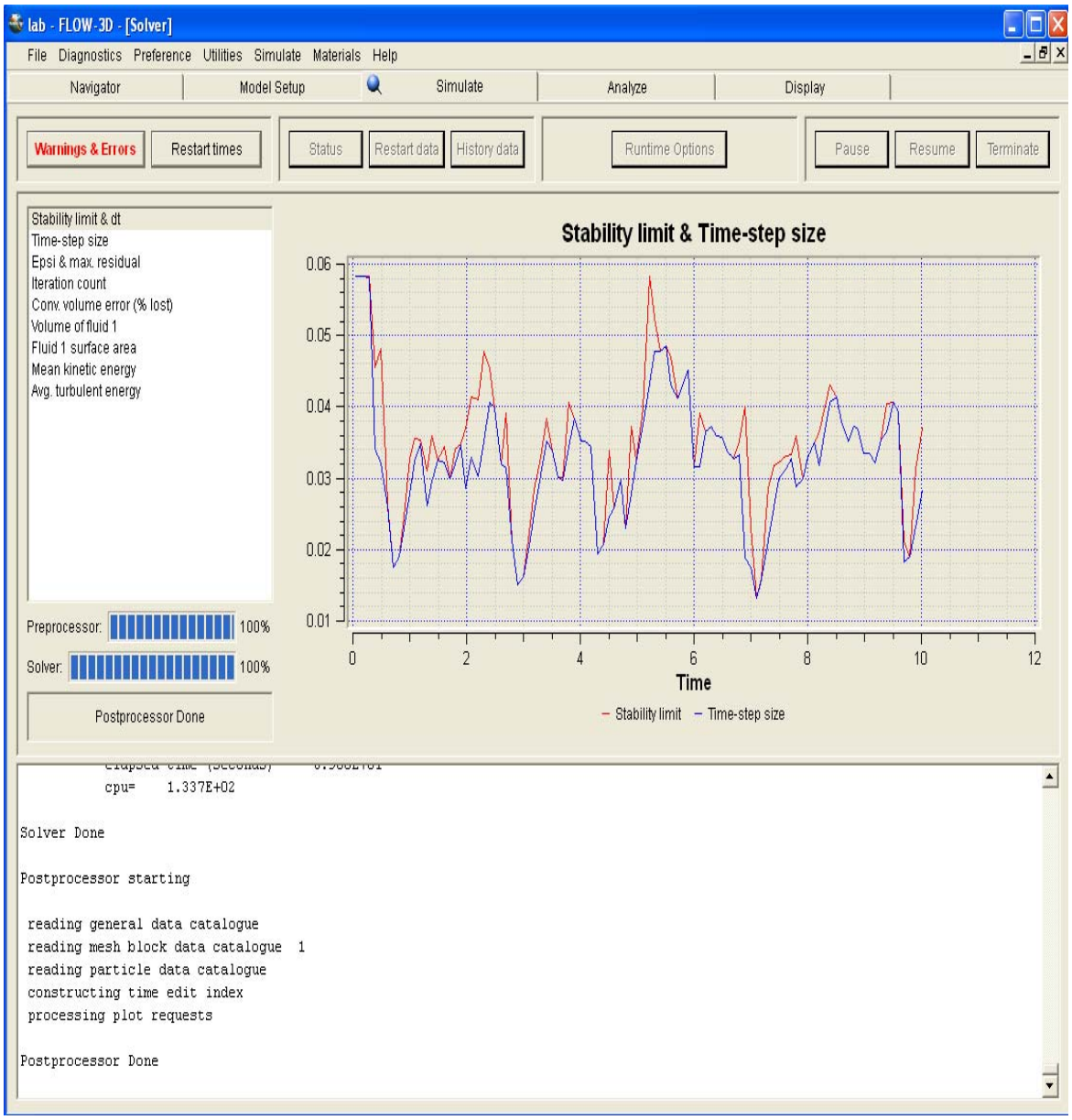

Linear Wave Definition
Wave attributes
Number of wave components: 1
Mean fluid depth: 2.0
Amplitude
Period
Phase shift (degrees)
Wave component #1
0.1
2.5
0.0
Current velocities
X velocity:
Y velocity:
Linear Wave Definition
The wave is assumed to come from a flat bottom reservoir, which is outside the computational domain.
Wave propagation direction
Wave length (λ)
Mean water surface
Mesh boundary
Wave amplitude (A)
Reservoir (outside computational domain)
Mean fluid depth (d)
Irregular 3D computational domain
z
Current velocity
Flat bottom
OK
Cancel

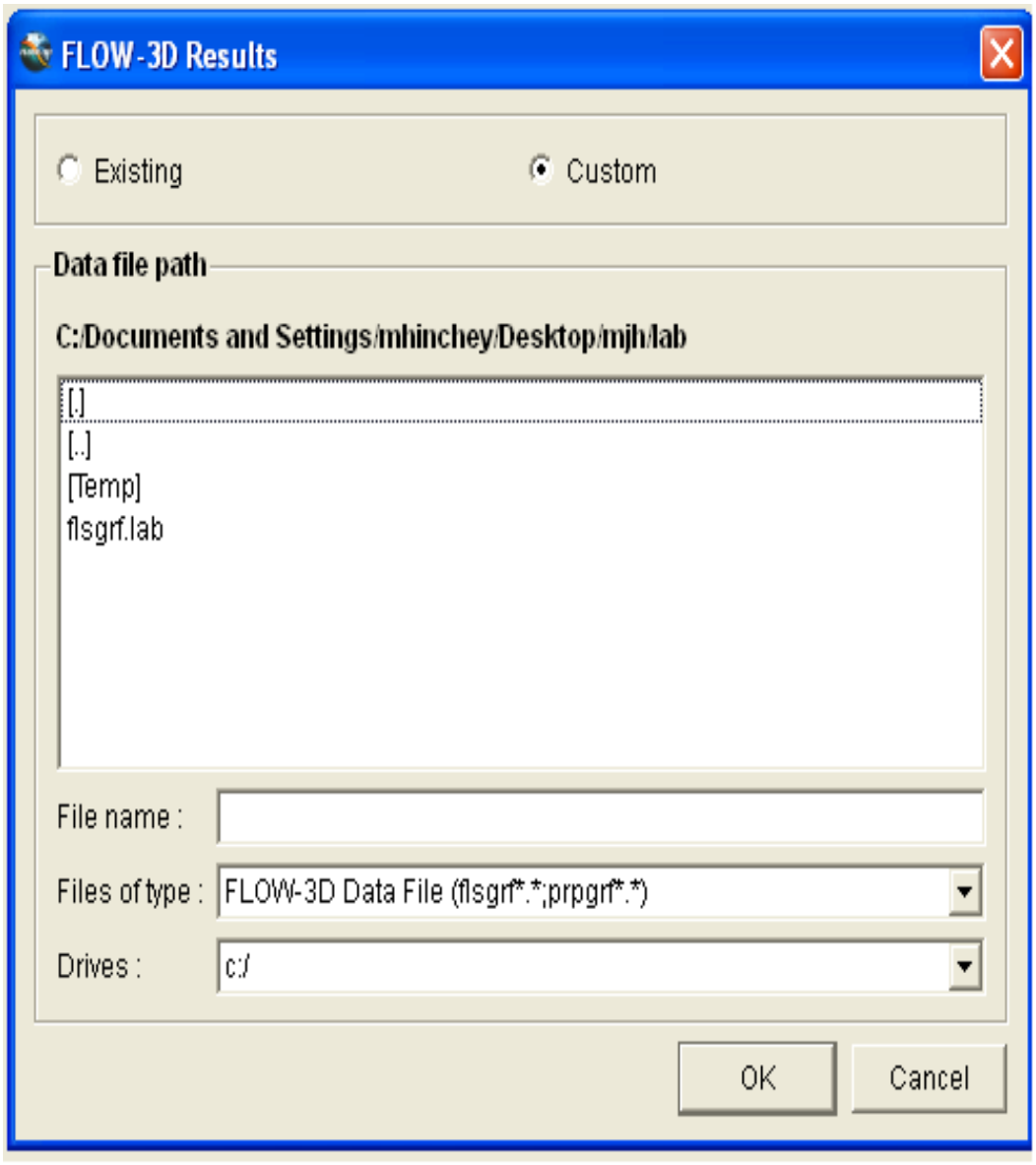

Mesh Block : #1 [X Max Boundary]
Boundary type
Symmetry
Continuative
Specified pressure
Grid overlay
Wave
Wall
Periodic
Specified velocity
Outflow
Volume flow rate
Allow fluid to enter at outflow boundary
Pressure
Stagnation pressure
F fraction
1.0
Fluid height
-1.e10
Density
Solute concentration
0.0
Sediment concentration
Scalars
Electric charge
Specified potential boundary
Electric potential
Turbulence quantities
Thermal information
OK
Cancel

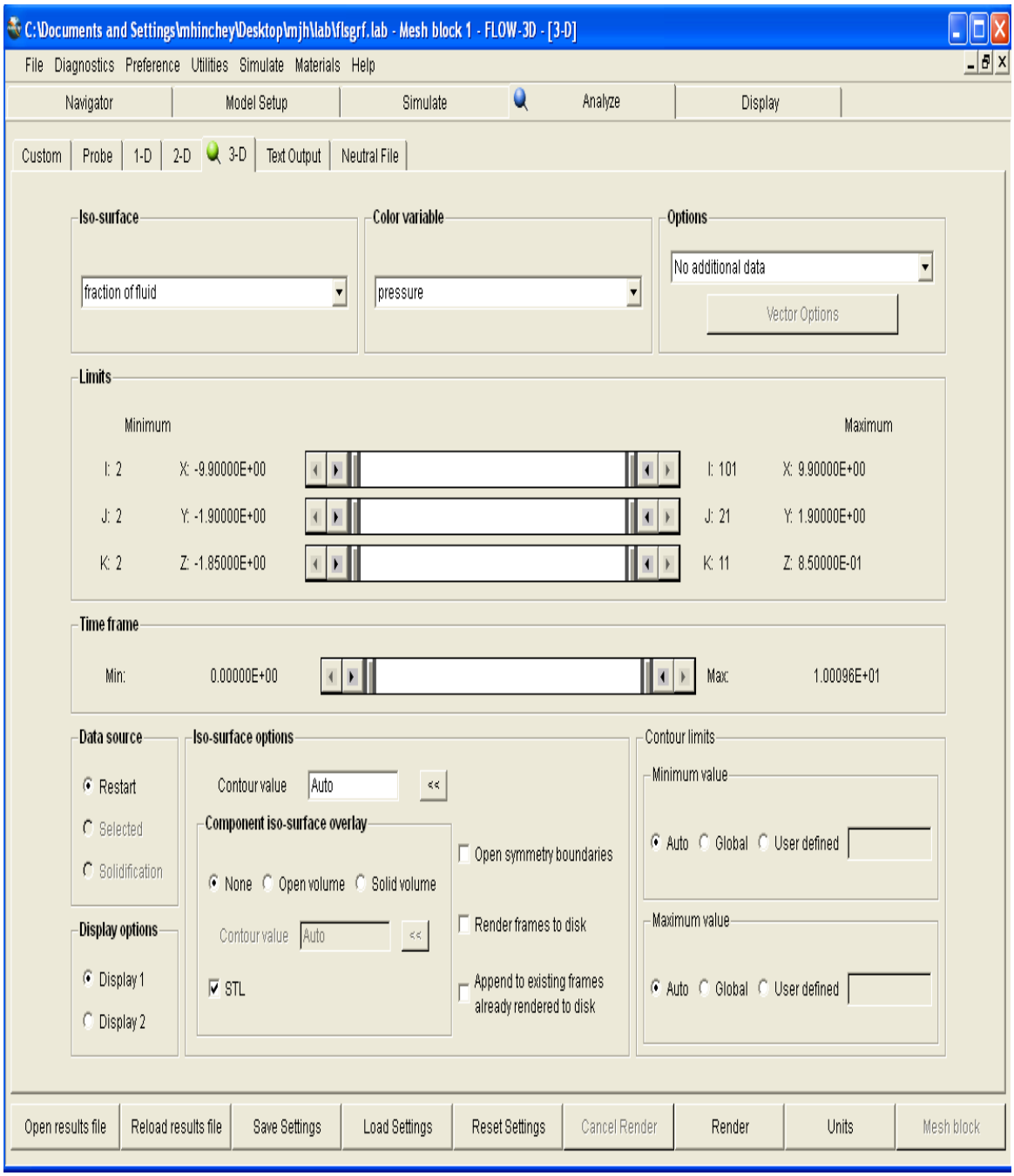

Moving object setup
Component 1
Motion Constraints
Mass Properties
Initial/Prescribed Velocities
Control Forces and Torques
Type of constraint
6 degrees of freedom
(In space system)
Fixed axis/point X coordinate
0.0
Fixed axis/point Y coordinate
0.0
Fixed axis/point Z coordinate
0.0
Translational and rotational options
(In space system)
(In body system)
X translation
Coupled motion
Y translation
Coupled motion
Z translation
Coupled motion
X rotation
Coupled motion
Y rotation
Coupled motion
Z rotation
Coupled motion
Limits for rotation
Maximum rotational angle (degrees)
Negative direction
Positive direction
Limits for translation
Maximum displacement of mass center
Negative direction
Positive direction
X displacement
Y displacement
Z displacement
OK
Cancel

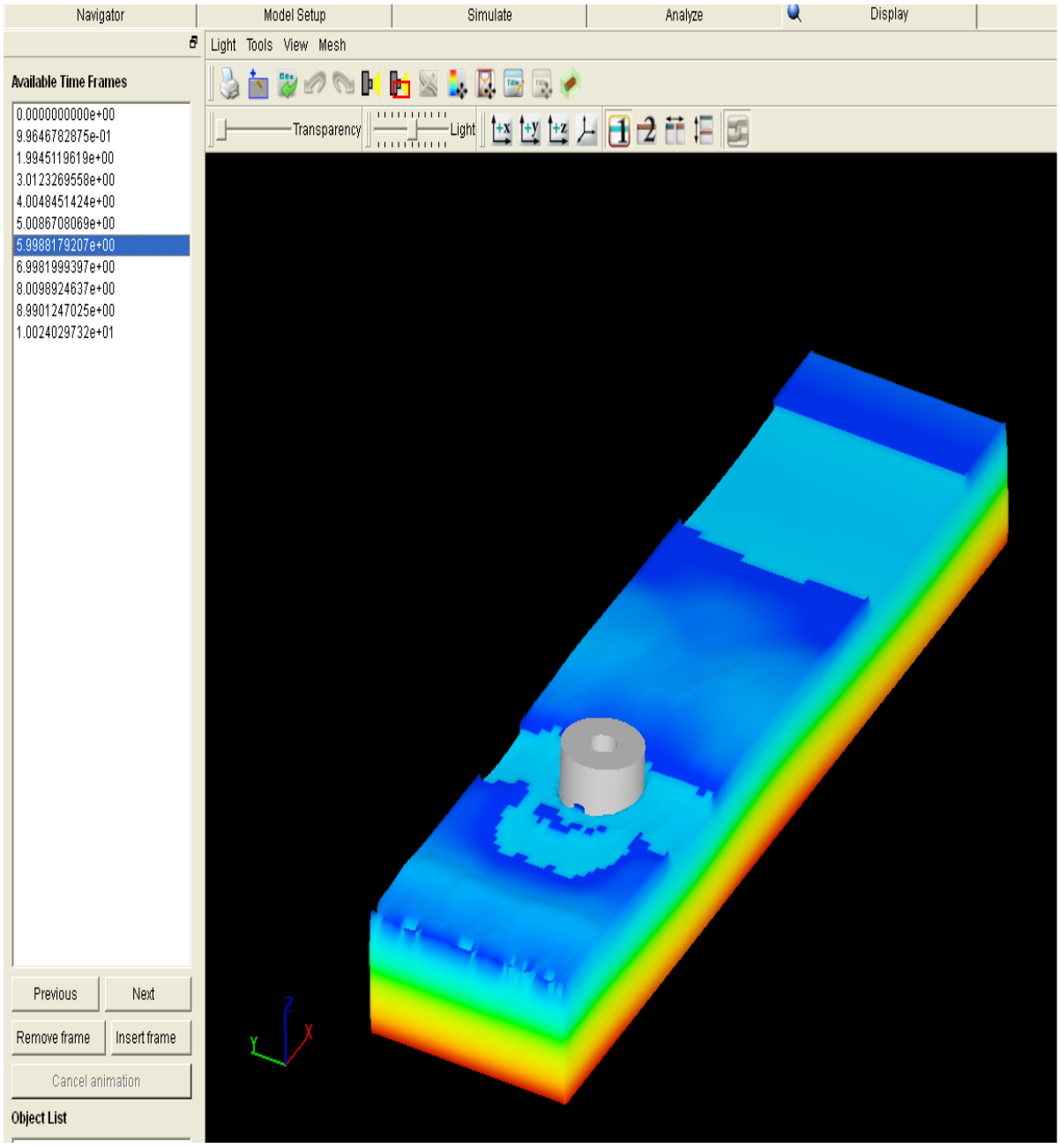

Moving object setup
Component 1
Motion Constraints
Mass Properties
Initial/Prescribed Velocities
Control Forces and Torques
Define density
Mass density
500
Total mass
Moment of inertia about fixed axis
Initial mass center location
X in space system
Y in space system
Z in space system
Moment of inertia tensor about mass center in body system
J11
J12 (J21)
J22
J13 (J31)
J33
J23 (J32)
J11 J12 J13
J21 J22 J23
J31 J32 J33
OK
Cancel


lab - FLOW-3D - [Initial]
File Diagnostics Preference Utilities Simulate Materials Help
Navigator
Model Setup
Simulate
Analyze
Display
General
Physics
Fluids
Meshing & Geometry
Boundaries
Initial
Output
Numerics
Search
Initial
Global initial fluid state
U velocity
0.0
V velocity
0.0
W velocity
0.0
Temperature
Turbulent k.e.
Fluid rotation
Electric charge density
0.0
Initial solute concentration
0.0
Suspended sediment concentration
No sediments defined
Initial pressure field
Uniform pressure
Hydrostatic pressure in x-direction
Hydrostatic pressure in y-direction
Hydrostatic pressure in z-direction
Fluid 1 initialization options
Fill height (Z-direction)
0.0
Fluid volume
0.0
Void initial state
Pressure
0.0
Temperature
Add valve
Add fluid
Add temperature
Add fluid pointer
Add void pointer


lab - FLOW-3D - [Solver]
File Diagnostics Preference Utilities Simulate Materials Help
Navigator
Model Setup
Simulate
Analyze
Display
Warnings & Errors
Restart times
Status
Restart data
History data
Runtime Options
Pause
Resume
Terminate
Stability limit & dt
Time-step size
Epsi & max. residual
Iteration count
Conv. volume error (% lost)
Volume of fluid 1
Fluid 1 surface area
Mean kinetic energy
Avg. turbulent energy
Preprocessor: 100%
Solver: 100%
Postprocessor Done
Stability limit & Time-step size
0.06
0.05
0.04
0.03
0.02
0.01
0
2
4
6
8
10
12
Time
Stability limit
Time-step size
cpu= 1.337E+02
Solver Done
Postprocessor starting
reading general data catalogue
reading mesh block data catalogue 1
reading particle data catalogue
constructing time edit index
processing plot requests
Postprocessor Done


FLOW-3D Results
Existing
Custom
Data file path
C:/Documents and Settings/mhinchey/Desktop/mjh/lab
[.]
[..]
[Temp]
flsgrf.lab
File name :
Files of type :
FLOW-3D Data File (flsgrf*.*;prpgrf*.*)
Drives :
c:/
OK
Cancel


C:\Documents and Settings\mhinchey\Desktop\mjh\lab\flsgrf.lab - Mesh block 1 - FLOW-3D - [3-D]
File Diagnostics Preference Utilities Simulate Materials Help
Navigator
Model Setup
Simulate
Analyze
Display
Custom
Probe
1-D
2-D
3-D
Text Output
Neutral File
Iso-surface
fraction of fluid
Color variable
pressure
Options
No additional data
Vector Options
Limits
Minimum
Maximum
I: 2
X: -9.90000E+00
I: 101
X: 9.90000E+00
J: 2
Y: -1.90000E+00
J: 21
Y: 1.90000E+00
K: 2
Z: -1.85000E+00
K: 11
Z: 8.50000E-01
Time frame
Min:
0.00000E+00
Max:
1.00096E+01
Data source
Restart
Selected
Solidification
Display options
Display 1
Display 2
Iso-surface options
Contour value
Auto
<<
Component iso-surface overlay
None
Open volume
Solid volume
Contour value
Auto
<<
STL
Open symmetry boundaries
Render frames to disk
Append to existing frames already rendered to disk
Contour limits
Minimum value
Auto
Global
User defined
Maximum value
Auto
Global
User defined
Open results file
Reload results file
Save Settings
Load Settings
Reset Settings
Cancel Render
Render
Units
Mesh block


Navigator
Model Setup
Simulate
Analyze
Display
Light Tools View Mesh
Transparency
Light
Available Time Frames
0.0000000000e+00
9.9646782875e-01
1.9945119619e+00
3.0123269558e+00
4.0048451424e+00
5.0086708069e+00
5.9988179207e+00
6.9981999397e+00
8.0098924637e+00
8.9901247025e+00
1.0024029732e+01
Previous
Next
Remove frame
Insert frame
Cancel animation
Object List
Z
Y
X