

FloTHERM V10 Upgrade Tutorial

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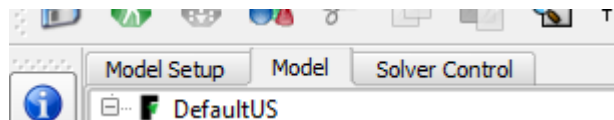
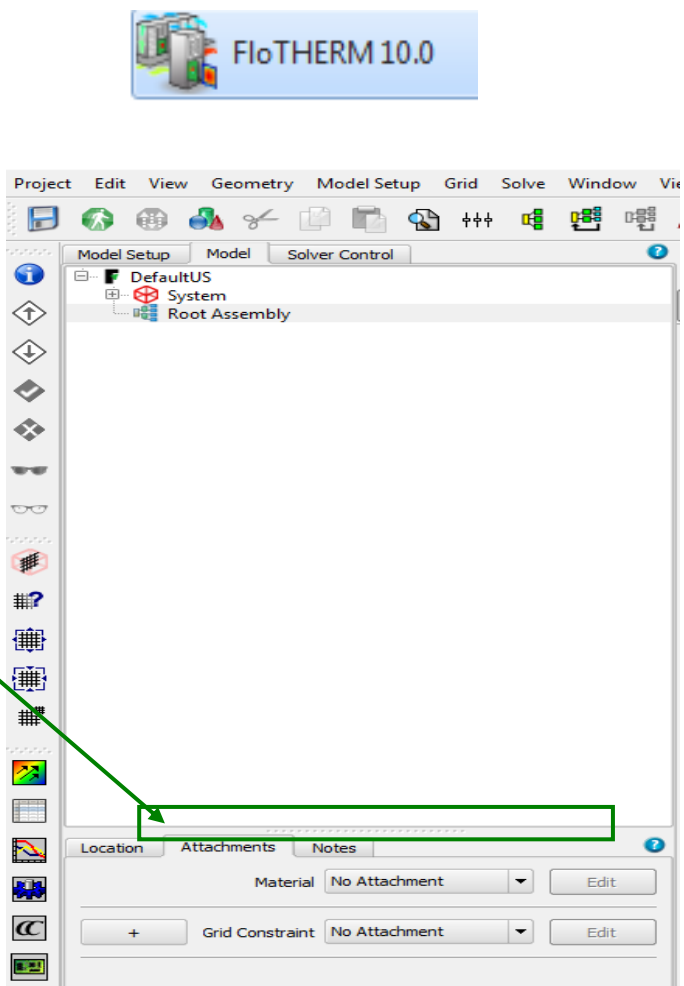
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Introduction

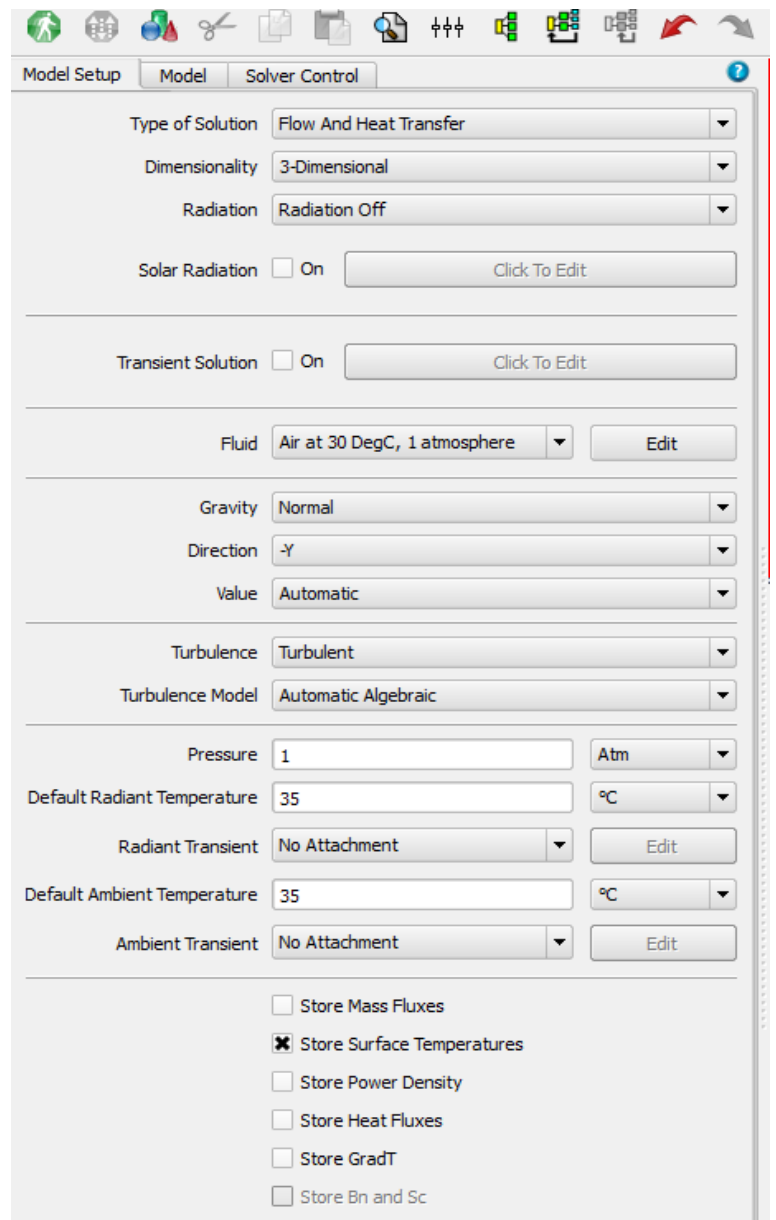
This is a simple tutorial to help you get familiar with the new FloTHERM project manager and drawing board interface. It is intended for users familiar with the operation of previous FloTHERM versions.

Tutorial

- Launch FloTHERM V10
- Note the new user interface, the integration of drawing board and message window into project manager
- Select Root Assembly and note the property sheet below in project manager area. All attributes for all objects are attached through that property sheet, no floating windows
- Move the cursor to the bottom of the project manager just above the property sheet till it turns to a double arrow, then click and move to resize the property sheet
- Note the three tabs on top of project manager area: Model Setup, Model, Solver Control



Click on Model Setup tab. Familiarize yourself with the modeling options: type of solution, dimensionality, radiation and so on

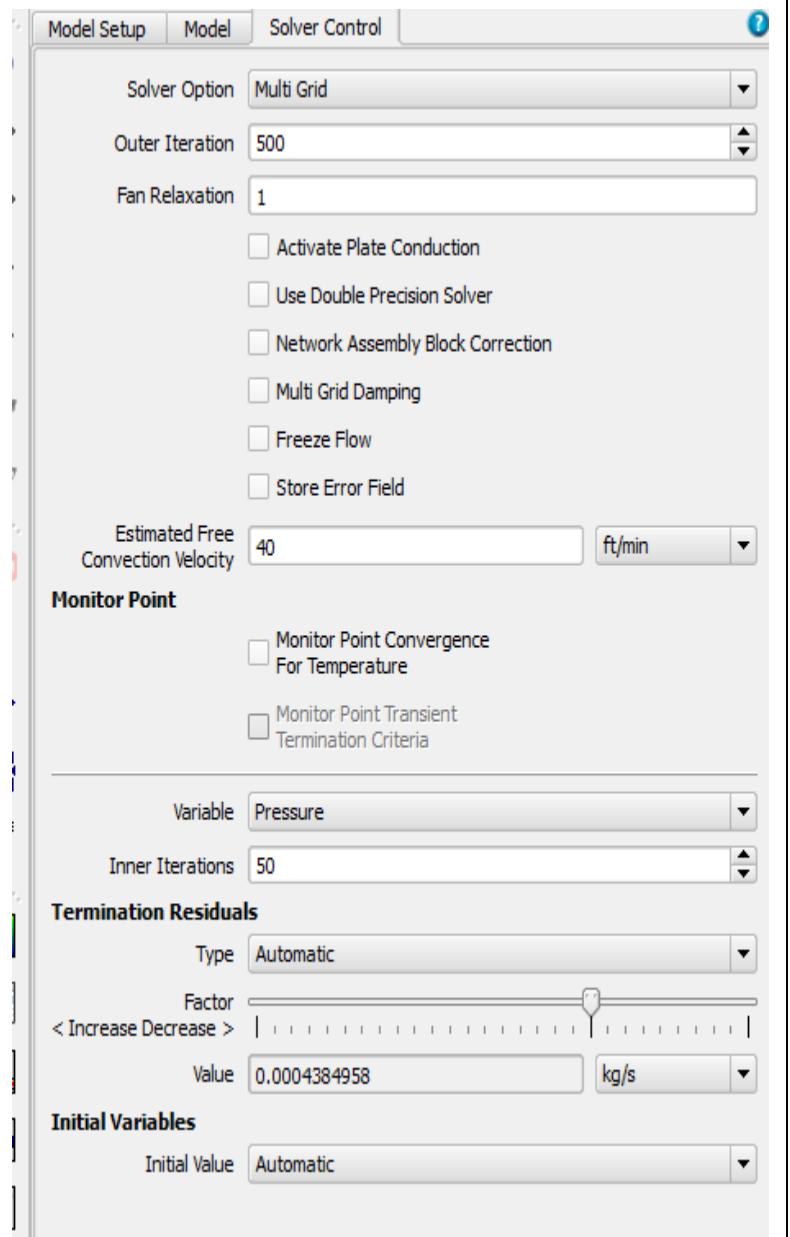
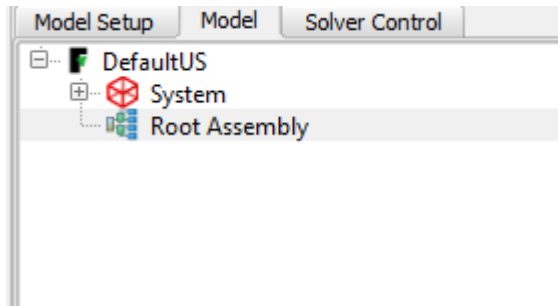


The screenshot shows the 'Model Setup' dialog box in FloTHERM. The 'Model Setup' tab is selected. The settings are as follows:

- Type of Solution: Flow And Heat Transfer
- Dimensionality: 3-Dimensional
- Radiation: Radiation Off
- Solar Radiation: ☐ On [Click To Edit](#)
- Transient Solution: ☐ On [Click To Edit](#)
- Fluid: Air at 30 DegC, 1 atmosphere [Edit](#)
- Gravity: Normal
- Direction: -Y
- Value: Automatic
- Turbulence: Turbulent
- Turbulence Model: Automatic Algebraic
- Pressure: 1 [Atm](#)
- Default Radiant Temperature: 35 [°C](#)
- Radiant Transient: No Attachment [Edit](#)
- Default Ambient Temperature: 35 [°C](#)
- Ambient Transient: No Attachment [Edit](#)
- Store Mass Fluxes: ☐
- Store Surface Temperatures: ☒
- Store Power Density: ☐
- Store Heat Fluxes: ☐
- Store GradT: ☐
- Store Bn and Sc: ☐

Click on Solver Control tab. Notice that all solver control options are integrated into this location

Click on Model tab. This will resume the project tree in project manager

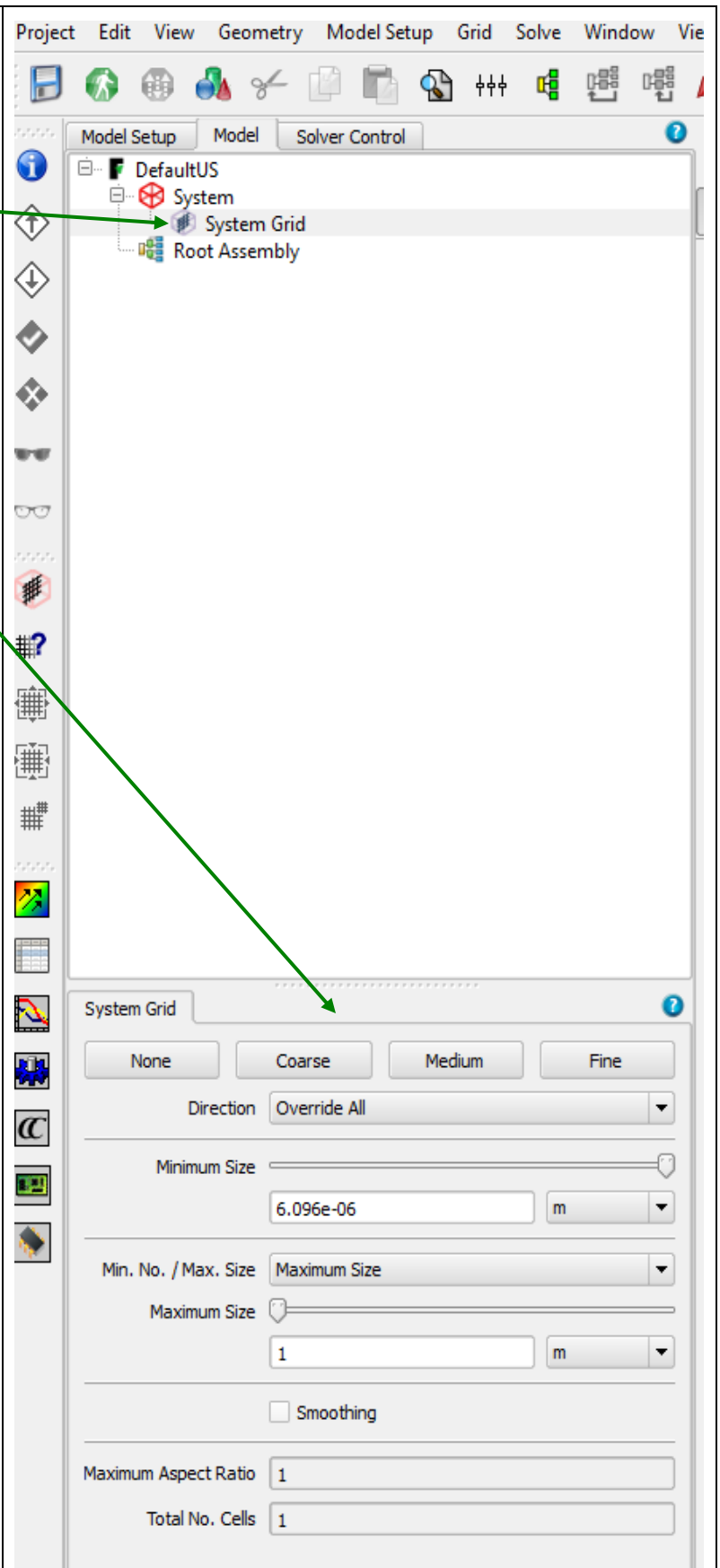


Click on System grid icon on the left vertical side of project manager:



Notice that "System Grid" node is added to the project manager tree just above Root Assembly.

Also note that all the control in System Grid is now available in the property sheet area.



- Save as “V10_tutorial”

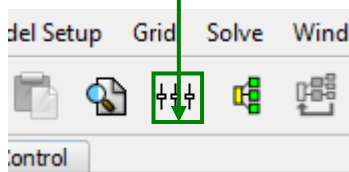
■ Create a assembly

- Select the root assembly
- In the “project manager create” pallet, click on the subassembly icon (Simply click on the left red arrow to activate the

project manager pallet:

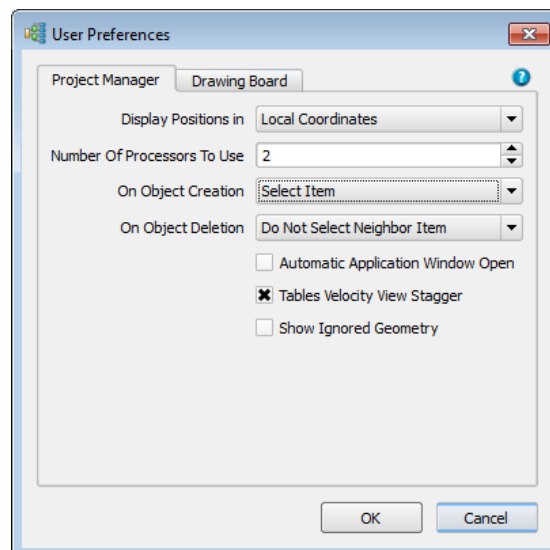
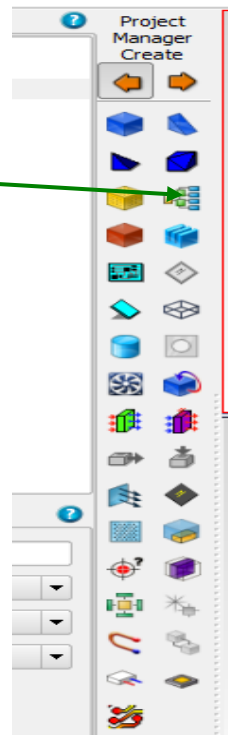


- Notice how the new subassembly wasn't selected automatically? To change that, go to [Edit/User Preferences...]

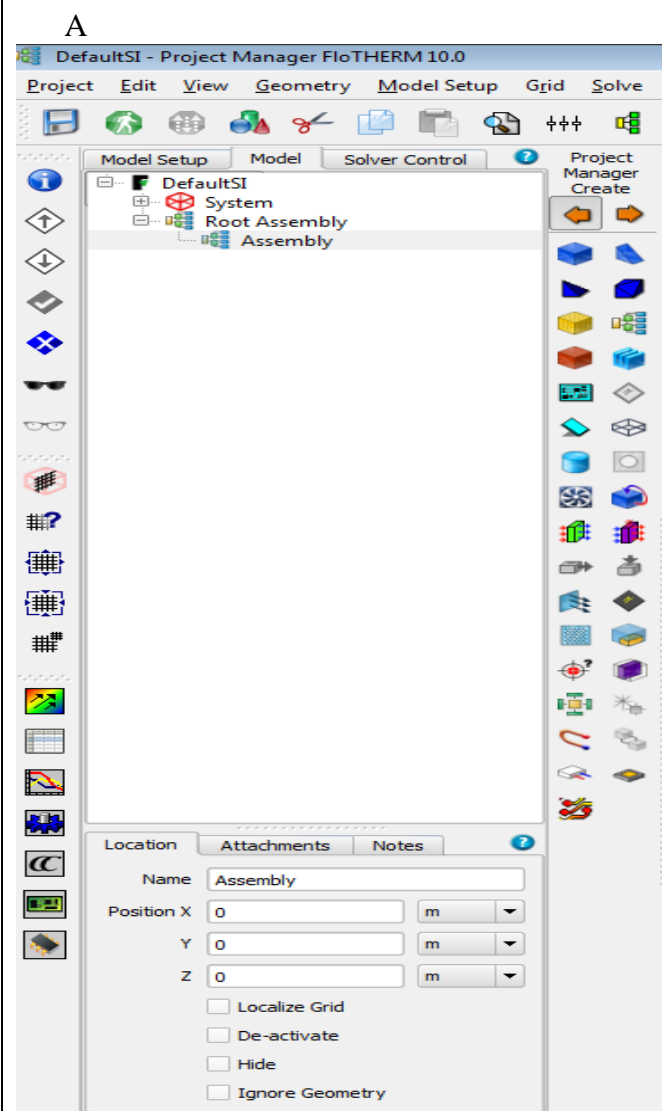
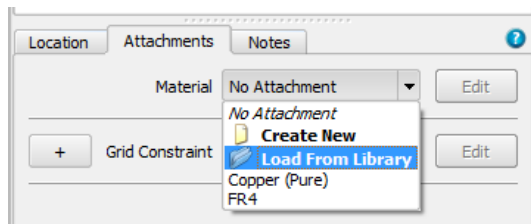


■

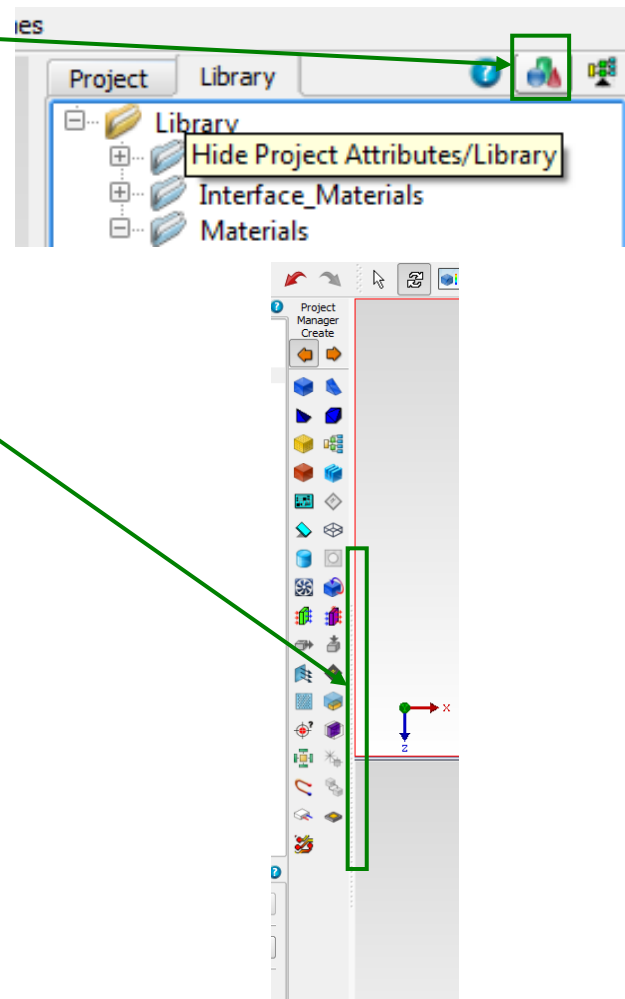
- Set “on object creation” to select item



- Delete the subassembly you just created, and create a new one
- In the property sheet that opens in the bottom left
 - Change the name to be V10. Click on Location tab first and then:
 - Apply data using Enter, or a click away
 - No more 'Apply/OK' in V10
 - Click on the Notes tab, and enter a note saying "my first V10 assembly"
 - Click on the Attachments Tab
 - Attach a material from the library (library is now on far left), Alloys/Steel (Mild) - Double click to attach

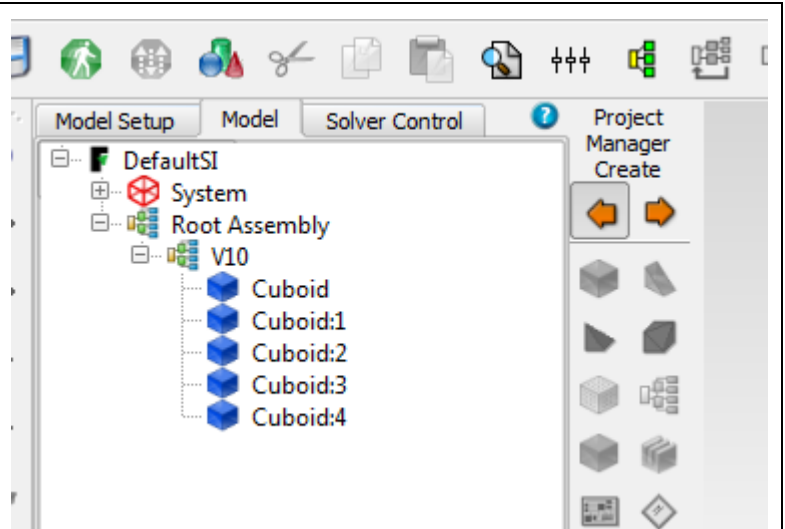


- Close the library manager by clicking on this icon
 - Or 'F7' shortcut, same as V9
- The project manager tree and property sheet are a bit squeezed, lets resize the window
 - Move the cursor to the right of the pallet, till it turns to a double arrow, then click and move to resize



Creating Cuboids

- Select the Subassembly 'V10'
 - Create 3 cuboids using Project manager create pallet
 - Create 2 cuboids using the drawing board create pallet
 - Click the Right Arrow to switch pallets
 - You will need to reselect the V10 subassembly
 - You will need to draw them in a drawing board area



Creating Cuboids

- Switch to Solid mode



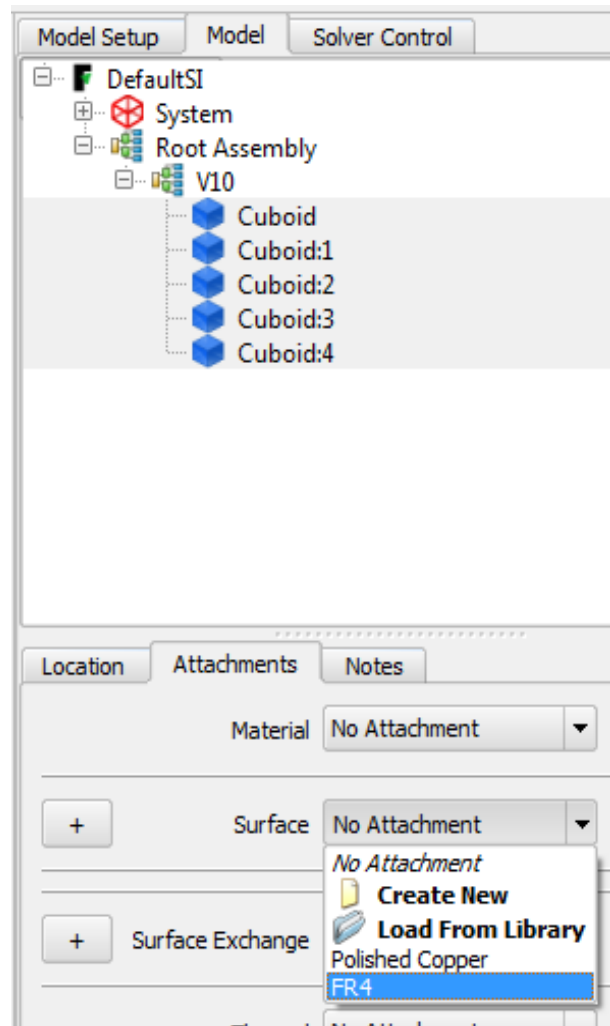
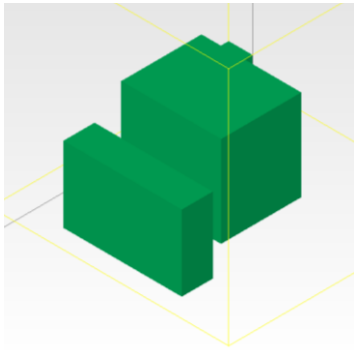
— Or press 's' on the keyboard

In V10 now you can display objects in drawing board in solid mode too.

- Click on the single, 4 view, horizontal, and vertical split icons to find a view you prefer

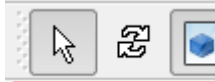


- In the Project Manager node tree shift select all cuboids, and attach a the surface property "FR4"

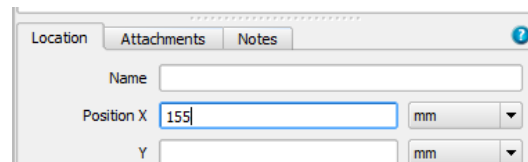
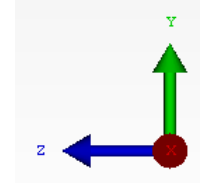
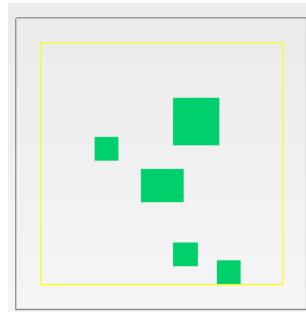


Creating Cuboids

- In the drawing board, switch to “select” mouse mode

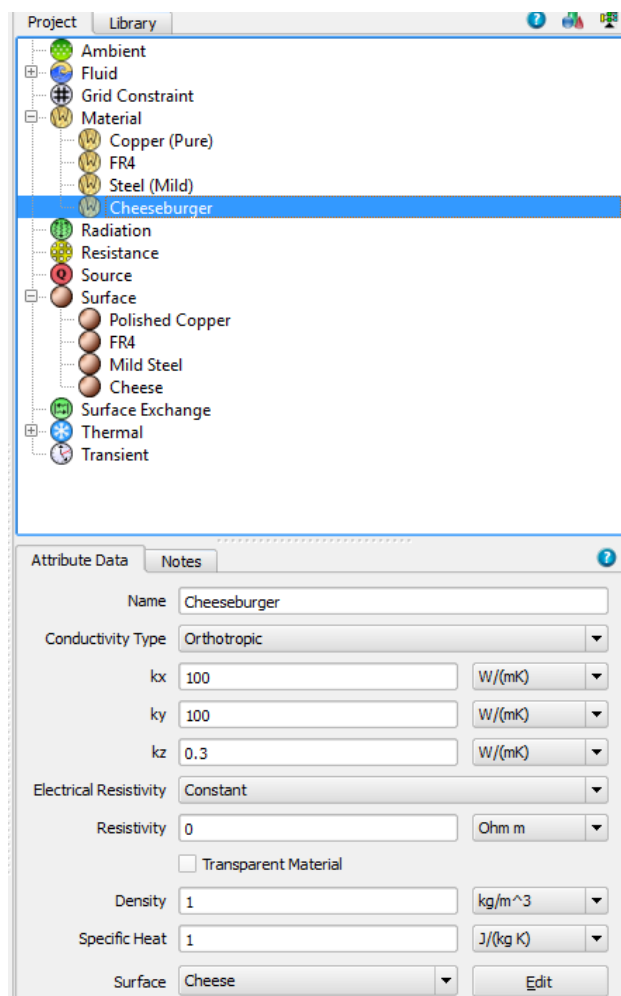


- In a Y/Z plane view adjust the positions of the cuboids so none are overlapping
 - Click to select, then drag
- ‘Rubber band’ select all the cuboids
- With all cuboids selected, set the X size = 155 mm
 - Select the Location tab
 - Change units to mm first



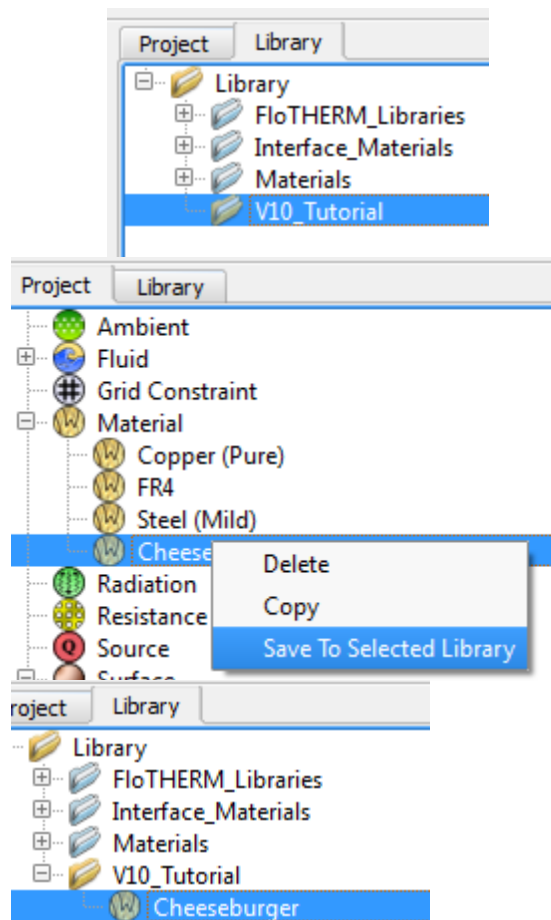
Creating Cuboids

- Select one cuboid, and attach a 'create new' material
 - Call the new material "Cheeseburger"
 - Orthotropic conductivity 100, 100, 0.3
 - Attach a 'Create New' surface to Cheeseburger with a yellow color, call it "Cheese"



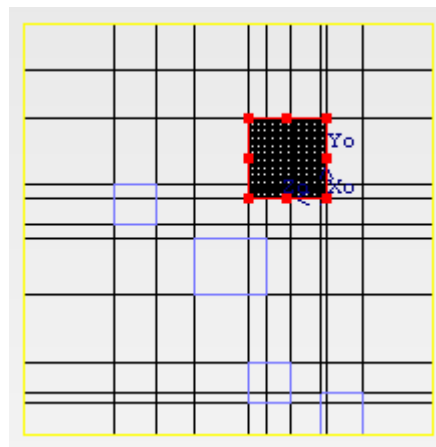
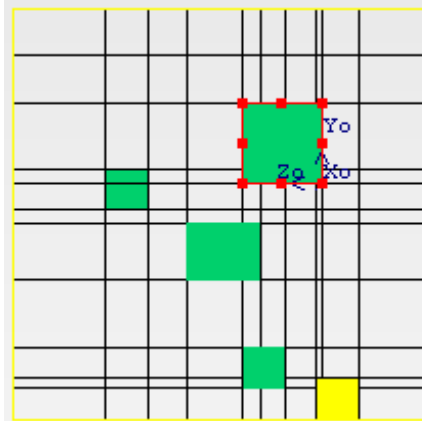
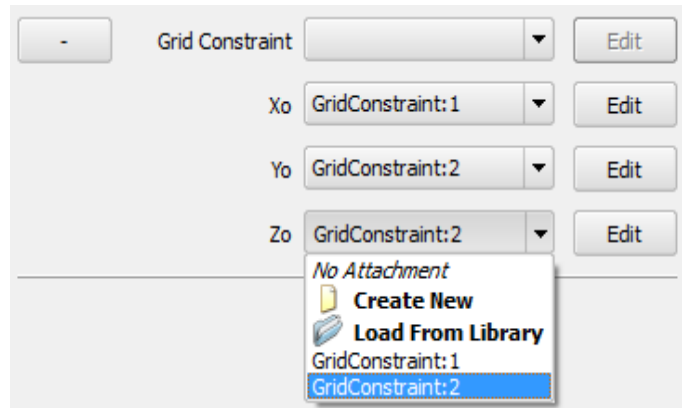
Creating Cuboids

- Why didn't the color change?
 - Because we explicitly stated the surface for all 5 cuboids was FR4, which supersedes the color of the material
 - Set the surface for this one cuboid to "no attachment"
 - Notice [Cheese] now appears as it's surface, inherited from cheeseburger material
- Cheeseburger will be used in future projects
 - Create a new folder in the Library Manager, and call it "V10_tutorial"
 - Select that new folder
 - Switch to the Project tab
 - Right click on Cheeseburger material and select "save to selected library"
- Close the Library Manager



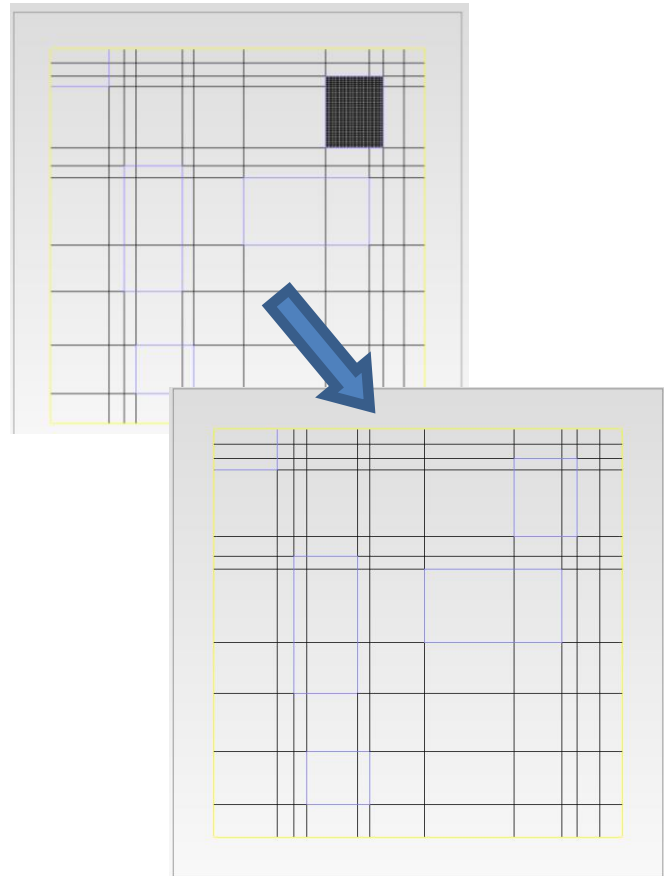
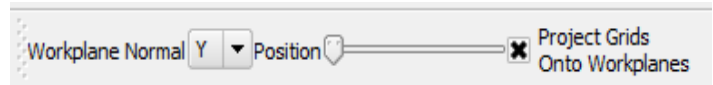
Creating Cuboids

- Attach a grid constraint to one of the cuboids
 - Click the + button in the attachment tab to expand the Grid Constraints
 - Xo Direction, Create New
 - Minimum Number = 50
 - Yo Direction, Create New
 - Minimum Number = 10
 - Zo Direction
 - Select the new grid constraint created for the Yo direction
- Localize the mesh ("l" key or local mesh icon)
- Show the grid ("g" key)
- Can not see the localized mesh?
 - Press 'w' for wireframe



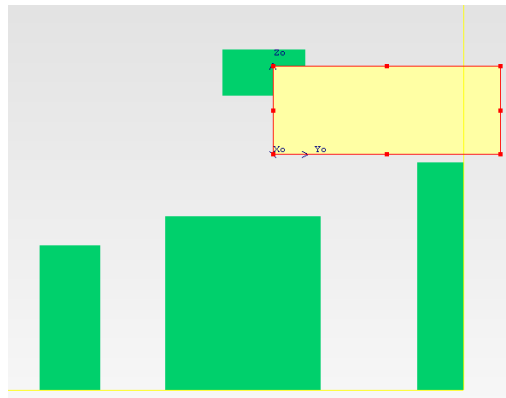
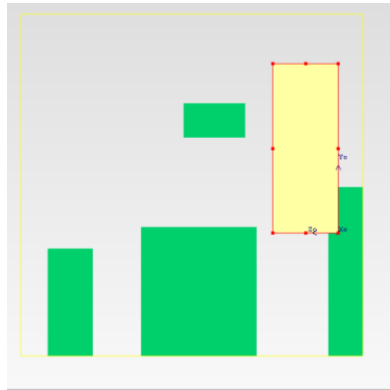
Work plane

- In the top tool bar, is a work plane tool
 - Switch to a single window view
 - Move the slider to show the grid at any position of the plane
 - De-select the “project grid on work plane”
 - Move the position of the work plane again
 - Notice the difference?
 - Try this in other view orientations
 - Hide the grid and make solid when you are done



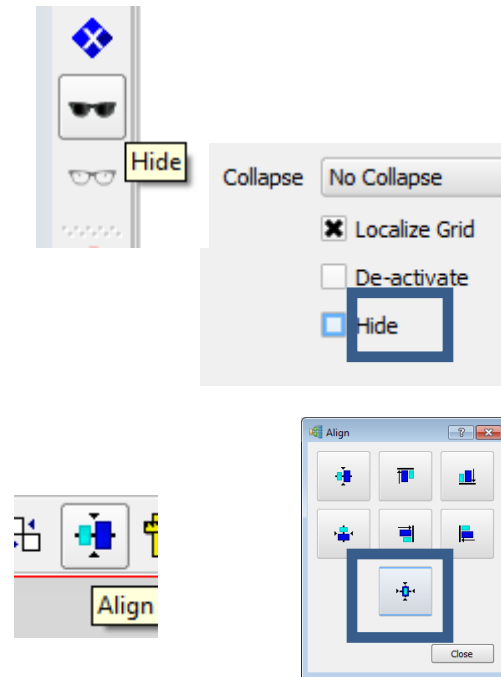
Moving Cuboid

- Select one cuboid, and rotate it 90 degrees about the X axis



Moving Cuboid

- We would like to move this cuboid so that it's edge lines up with one of the other cuboid edges
 - Select desired cuboid in the drawing board window
 - Hold down "alt" key
 - Use left/right or up/down arrows to move the cuboid from one edge to the next
- Hide this cuboid
- Select 2 other cuboids, and align both their centers
 - Ctrl select 2 cuboids, click on align tool, and select center button

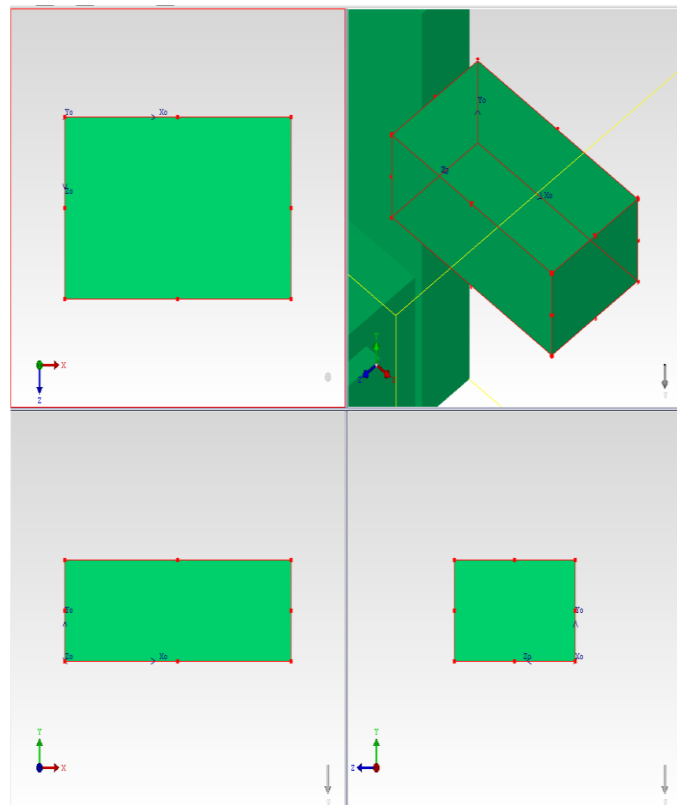


View Selected

- Often it's hard to find in the graphics window, the selected object in the Project Manager tree
- Set the drawing board to Solid View, and set to 4 views
- Select Cuboid:1 in Project Manager tree
- Use the "v" key to zoom in on that object in all 4 views

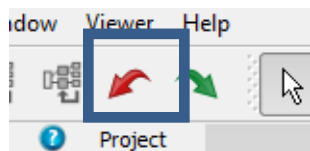
— Shortcut to:

[Viewer/View Selected]



Undo

- Save model
- Click [Edit/Undo] (ctrl-Z or



) multiple times till when only the V10 subassembly was made

- Where did we save this model? Look at the bottom of the window to find the Solution Directory listed, among other important information

Title: Default Project with SI Units Solution Directory: C:\Program Files (x86)\MentorMA\flouite_v10\floutherm\flouser\ Number of Selected Objects: 1

Rack and Cooler SmartParts

- 2 new SmartParts have been added for Data Center Modeling
 - Rack
 - Cooler
- Create both using the Project Manager Pallet
- Both will default with one supply and one extract object
 - Support multiple supplies/extracts
- Examine the construction tab for Rack and Cooler

The screenshot shows the 'Construction' tab of a SmartPart configuration window. The tabs at the top are 'Location', 'Construction', 'Attachments', and 'Notes'. The settings are as follows:

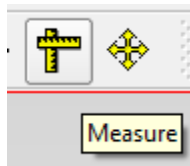
- Power Dissipation Rate:** 3000 W
- Flow Type:** Volume Flow Rate
- Volume Flow Rate:** 0.2265348 m³/s
- Airflow Adjustment:** ☒ (checked)
- Critical Temperature:** 35 °C
- Factor:** 80

The screenshot shows the 'Construction' tab of a SmartPart configuration window for a Cooler. The tabs at the top are 'Location', 'Construction', 'Attachments', and 'Notes'. The settings are as follows:

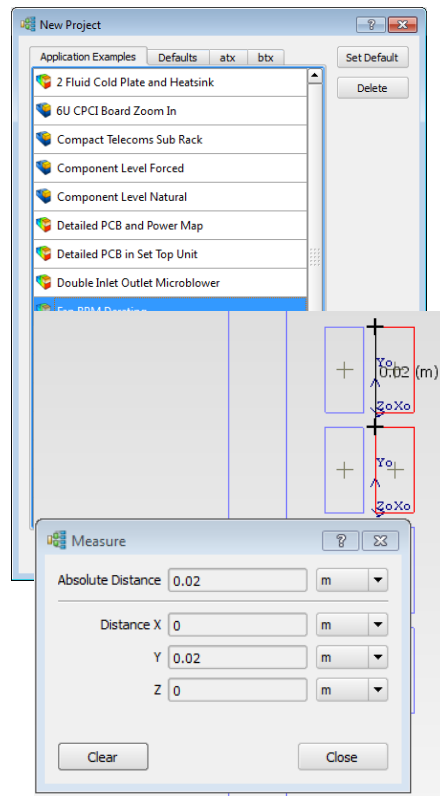
- Flow Type:** Remote Rack Temperature Control
- Rack Inlet Temperature:** Average
- Maximum Flow Rate:** 1.368648 m³/s
- Minimum Flow Rate:** 0.5427396 m³/s
- Target Temperature:** 25 °C
- Temperature Set Point:**
 - Location:** Supply
 - Temperature:** 20 °C
- Capacity:**
 - Capacity Limit:** Variable
 - Airflow:** 1.368648 m³/s
 - Airflow Reference Exponent:** 0
 - Capacity Curve:** [Click To Edit](#)

Fan Derating Model

- Go to Project – New, click on the application example tab, and launch the Fan Derating model
- Save As – V10_Fan_Tutorial
- Hit F6 to expand all
- Measure the Y distance between U7 and U9

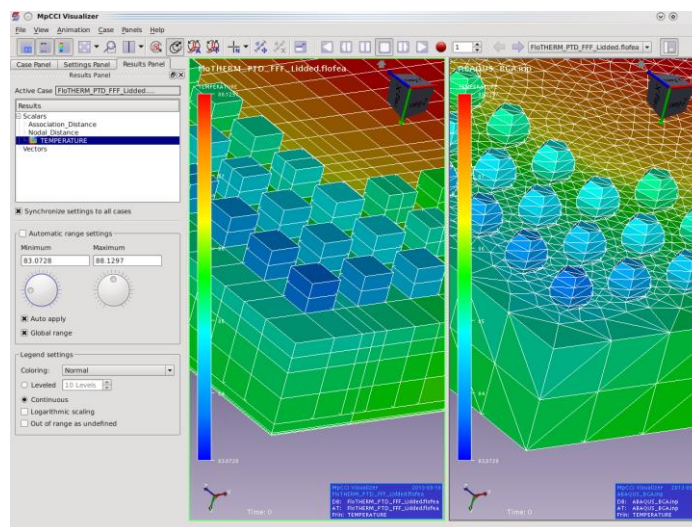
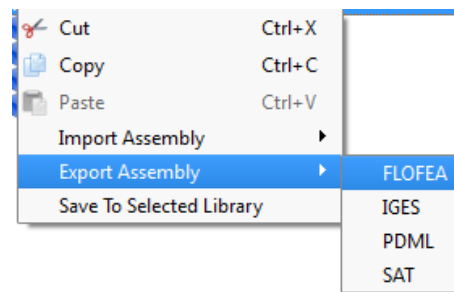


- Click on the measure tool
- Ctrl click to select U7 and U9
- Graphically, move the mouse over the corners of the selected cuboids till a cross appears, then select that vertex for measurement
- Clear to remove the measurement from the screen



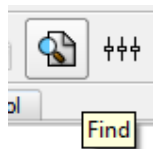
FloFEA

- As this model has results, we can export the FloTHERM solid temperatures for use in a stress analysis
- Select the V10 subassembly and export a FloFEA file
- This requires a 3rd party software, from Fraunhofer, called MPCCI mapper
 - <http://www.mpcci.de/mpcci-software/release-Infos-v43/fsimapping-from-flothermfloefd-to-fea.html>

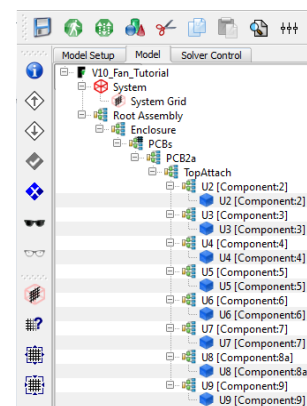
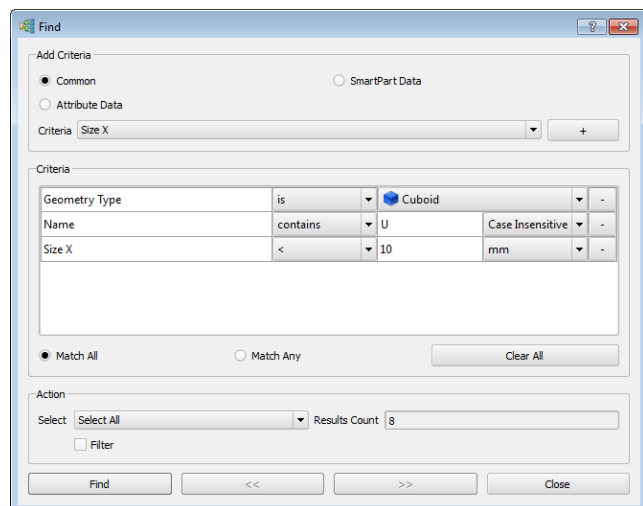


Find tool

■ Click on the Find Icon



- Search for all Cuboids, that contain “U” in their name and that have a X size smaller then 10 mm
 - All these find criteria are in ‘Common’
- Notice how all the cuboids were selected in the tree
- Check the filter option and click Find again
 - Notice how the tree is collapsed to just those objects



■ Try other searches, like

- Heatsinks modeled in Detail
- Everything that is Hidden
- Everything with a localized grid
- Fan with Power On
- Everything with a orthotropic conductivity

- Everything with a conductivity greater than 100 W/mK
- Anything with a surface resistance to solid not equal to 0
- Etc.
- Close the tool when you are done

Summary Columns

- Click on the summary column icon



- This expands out the project manager tree, with info icons related to all the possible attributes in our model
- Use the summary column to check if all parts
 - have materials attached
 - are keypointed
 - And check the total power in this system

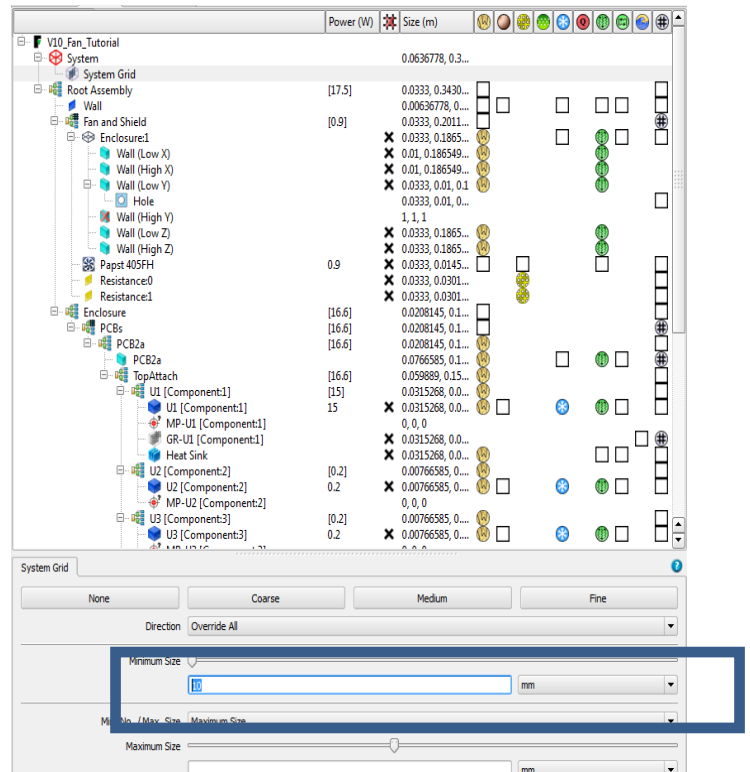
Model Setup		Model	Solver Control	Power (W)	Size (m)										
V10_Fan_Tutorial															
System					0.0636778, 0.3...										
System Grid															
Root Assembly															
Wall															
Fan and Shield															
Enclosure:1															
Wall (Low X)															
Wall (High X)															
Wall (Low Y)															
Hole															
Wall (High Y)															
Wall (Low Z)															
Wall (High Z)															
Papst 405FH															
Resistance:0															
Resistance:1															
Enclosure															
PCBs															
PCB2a															
TopAttach															
U1 [Component:1]															
U1 [Component:1]															
MP-U1 [Component:1]															
Heat Sink															
U2 [Component:2]															
U2 [Component:2]															
MP-U2 [Component:2]															
U3 [Component:3]															
U3 [Component:3]															
MP-U3 [Component:3]															
U4 [Component:4]															
U4 [Component:4]															
MP-U4 [Component:4]															
U5 [Component:5]															
U5 [Component:5]															
MP-U5 [Component:5]															
U6 [Component:6]															
U6 [Component:6]															
MP-U6 [Component:6]															
U7 [Component:7]															
U7 [Component:7]															
MP-U7 [Component:7]															
U8 [Component:8a]															
U8 [Component:8a]															
MP-U8 [Component:8a]															
U9 [Component:9]															
U9 [Component:9]															
MP-U9 [Component:9]															

Summary Columns

- Check the root assembly for total system power
 - Summed power from child objects appears in brackets, assigned power to an object does not
- Check the second column for any object with no keypoints
 - There should be none
- To check this column works,
 - Edit the system grid
 - Set minimum cell size to 10 mm
 - Black X's should now appear in the column



- Hover over the black X to see which faces of the object are not keypointed



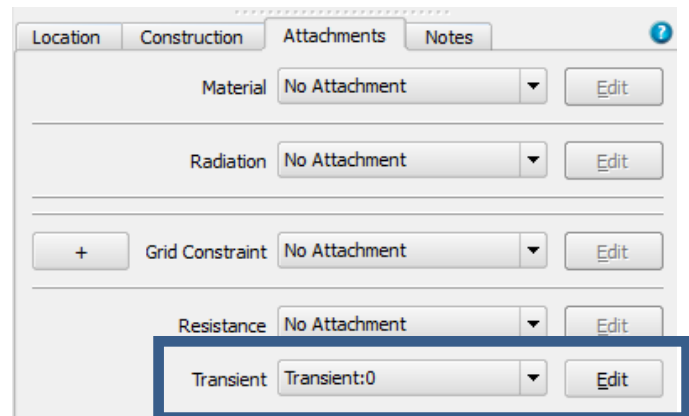
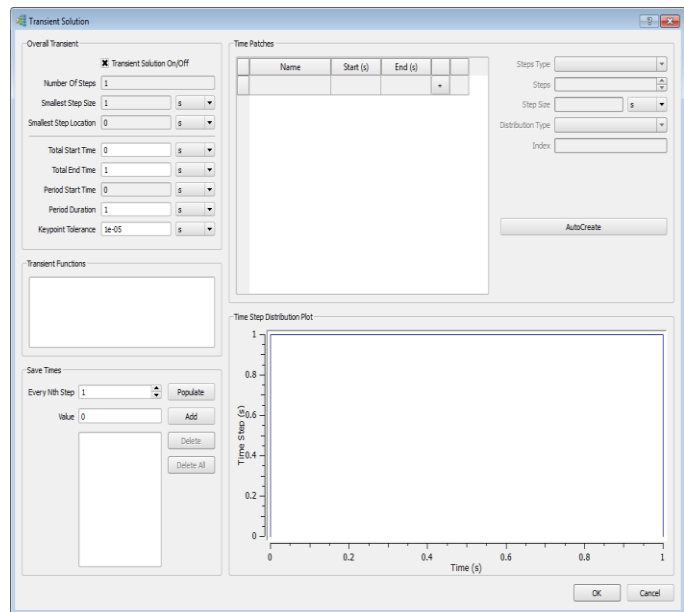
Summary Columns

- In the materials column, objects with a black square outline, indicate a material could be attached, but isn't
- Hover the mouse over the material icon in the enclosure row to find the material that is attached to that object
- Other questions. What objects have:
 - Thermal powers?
 - Radiation?
 - Grid Constraints?

Model Setup		Model	Solver Control			Power (W)	Size (m)				
V10_Fan_Tutorial											
System							0.0636778, 0.3...				
System Grid											
Root Assembly						[17.5]	0.0333, 0.3430...				
Wall							0.00636778, 0.0...				
Fan and Shield						[0.9]	0.0333, 0.2011...				
Enclosure:1						X	0.0333, 0.1865...				
Wall (Low X)						X	0.01, 0.186549...				
Wall (High X)						X	0.01, 0.186549...				
Wall (Low Y)						X	0.0333, 0.01, 0.1				
							n n n n n n n				

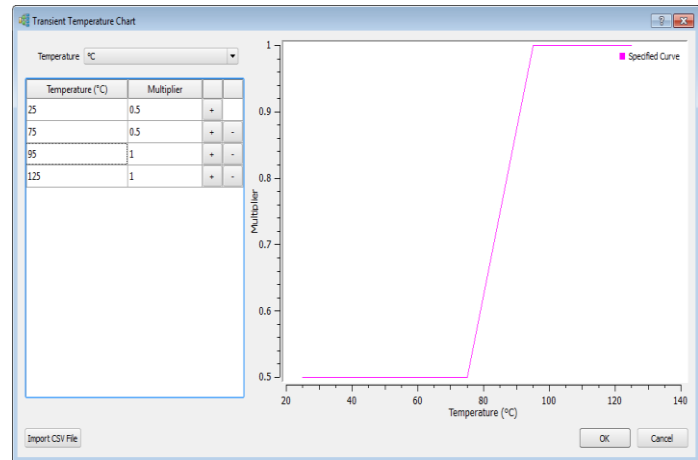
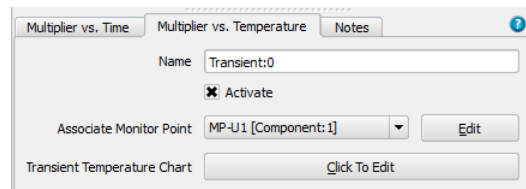
Transient

- Set this model to be a transient
 - Model setup – Transient solution
 - Check Transient solution On/Off
 - Leave default settings
 - Check “continue with existing project”
 - Select the Papst fan, go to the attachment tab, and create new transient attribute



Transient

- Change the Transient tab to “Multiplier vs. Temperature”
 - This will let the derating factor of the fan be modified based on the temperature of a monitor point
 - Click Activate
 - Pull down to select Monitor point for U1
 - Click to edit the transient temperature chart
 - Define a chart similar to the one shown
 - Ok to exit this window, and close the project manager



Solver Setup

- Activate the parallel solver
 - [Edit/User Preferences] Number of processors to use > 1
- Enable Multi-Grid solver
 - In Project manager tree, select Solver Control Tab
 - Pull down Solver Option to be Multi Grid
 - Notice the Variable Control options are at the bottom of the window

Model Setup | Model | Solver Control

Solver Option: Multi Grid

Outer Iteration: 500

Fan Relaxation: 0.6

☐ Activate Plate Conduction

☐ Use Double Precision Solver

☐ Network Assembly Block Correction

☐ Multi Grid Damping

☐ Freeze Flow

☐ Store Error Field

Estimated Free Convection Velocity: 0.2 m/s

Monitor Point

☐ Monitor Point Convergence For Temperature

☐ Monitor Point Transient Termination Criteria

Variable: Pressure

Inner Iterations: 100

Termination Residuals

Type: Automatic

Factor:

< Increase Decrease >

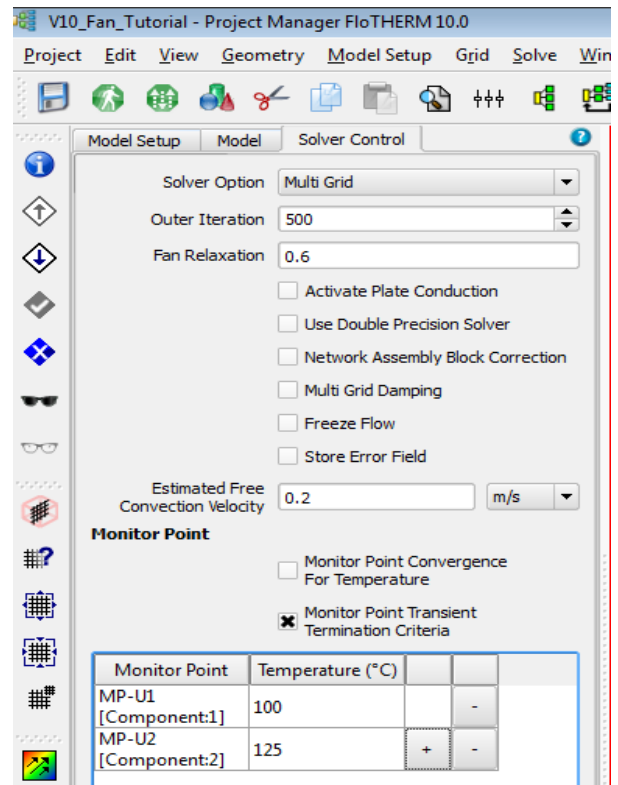
Value: 1.452083e-05 kg/s

Initial Variables

Initial Value: Automatic

Solver Setup

- Activate 'Monitor Point Transient Termination Criteria'
 - Select MP-U1, and set temperature to 100
 - Add another criteria, for MP-U2, at 125 degC



Model Setup

- Click on the Model Setup Tab
- Enable
 - Store Heat Fluxes
 - Store Gradient Temperature
 - Store Bottleneck and Shortcut numbers
- Change the default ambient and radiant temperature to 25 degC

Ambient

- Click on the Model Tab, and select the System Node
 - Select the Boundaries Tab
 - In the Ambient pull down
 - Load from **Library**
 - Double click 25 degC ambient
 - In the Ambient Pull down, select the newly loaded 25 degC ambient



List of Some Useful Shortcuts

- V Zoom to selected object in all views
- F9 Toggle between Object Select and View Manipulate
- F6 Expand All
- G Show/Hide grid
- Cntrl-Z Undo
- Alt+Arrow Object snap moving (ensure object select mode is active)
- L/R Arrow Move workplane to next grid cell
- Cntrl+drag Graphical object copy
- Shift+drag Constrain object move to one direction
- Middle mouse button click+drag Object move only, not resize
- Select a viewport without losing object selection:
 - Click with middle mouse button