

Transient Analysis Example

This example builds on the “Non-isothermal Example w/ a Bracket Attached”. The previous model is converted to a model in which a steady-state analysis with fluid flow is first run and is then followed by a transient analysis with no fluid flow.

The transient conditions to be modeled are:

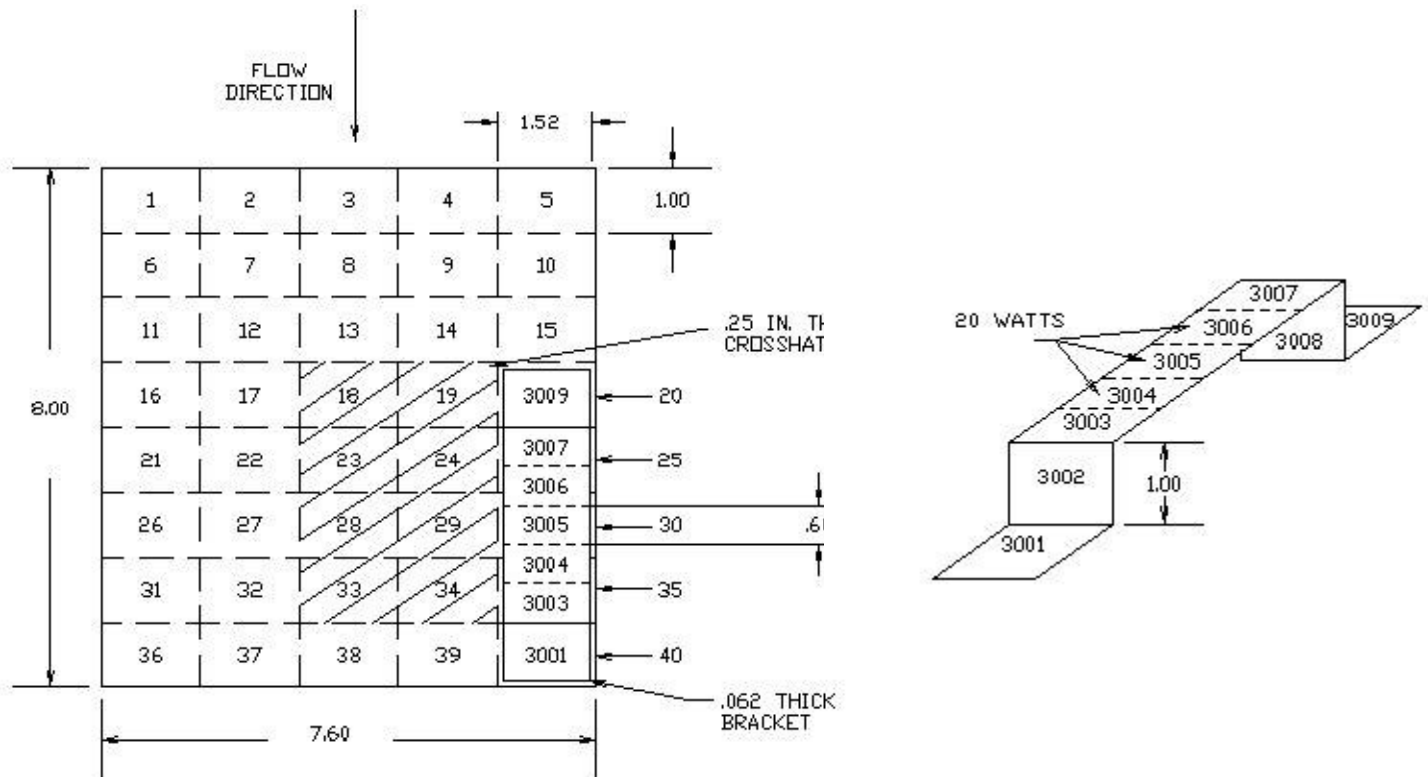
- assume that the thermal mass of the other parts of the assembly that is not being modeled has the effect of quintupling the specific heat of the cold plate base plate so that its effective aluminum specific heat is $5 \times 7.07 = 35.35 \text{ W-MIN/(LB-C)}$
- the thermal mass of nodes 3001,3002, 3008 and 3009 is $7.07 \text{ W-MIN/(LB-C)} \times (.062 \text{ IN. Thick}) \times (1.52 \text{ IN Wide}) \times (1.0 \text{ IN. LONG}) = .067 \text{ W-MIN/C}$
- the thermal mass of nodes 3003 and 3007 is $.6 \times .067 = .04 \text{ W-MIN/C}$
- the thermal mass of nodes 3004, 3005 and 3006 which includes a TO-3 component is $.12 \text{ W-MIN/C}$

Determine the temperatures after the model has reached steady-state and the fluid flow has been turned off for 3 minutes. Write out the results every .5minute.

First change the time units to minutes.

Set the type of analysis to a steady-state followed by a transient with no flow. Set the total time to 3 minutes and the output print time to 1.0 minute.

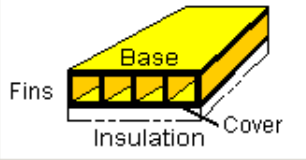
Plot the temperature of nodes 3, 38 and 3005.



Increased thermal mass of the base plate

Flow Thru Cooling [?] [X]

Geometry | Material | Fluid Properties | Power Dissipation | Pressure Drop | External Heat Transfer | Generate Plots

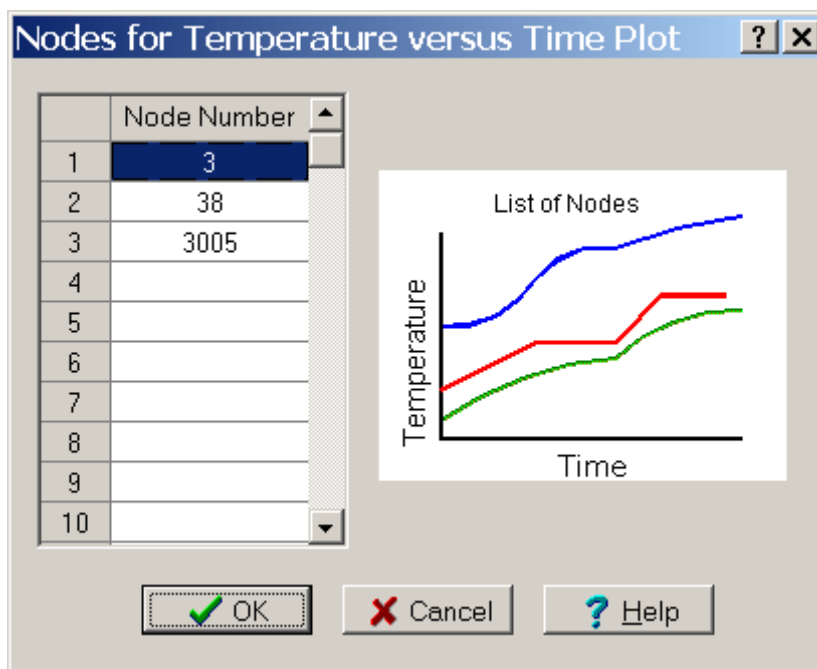
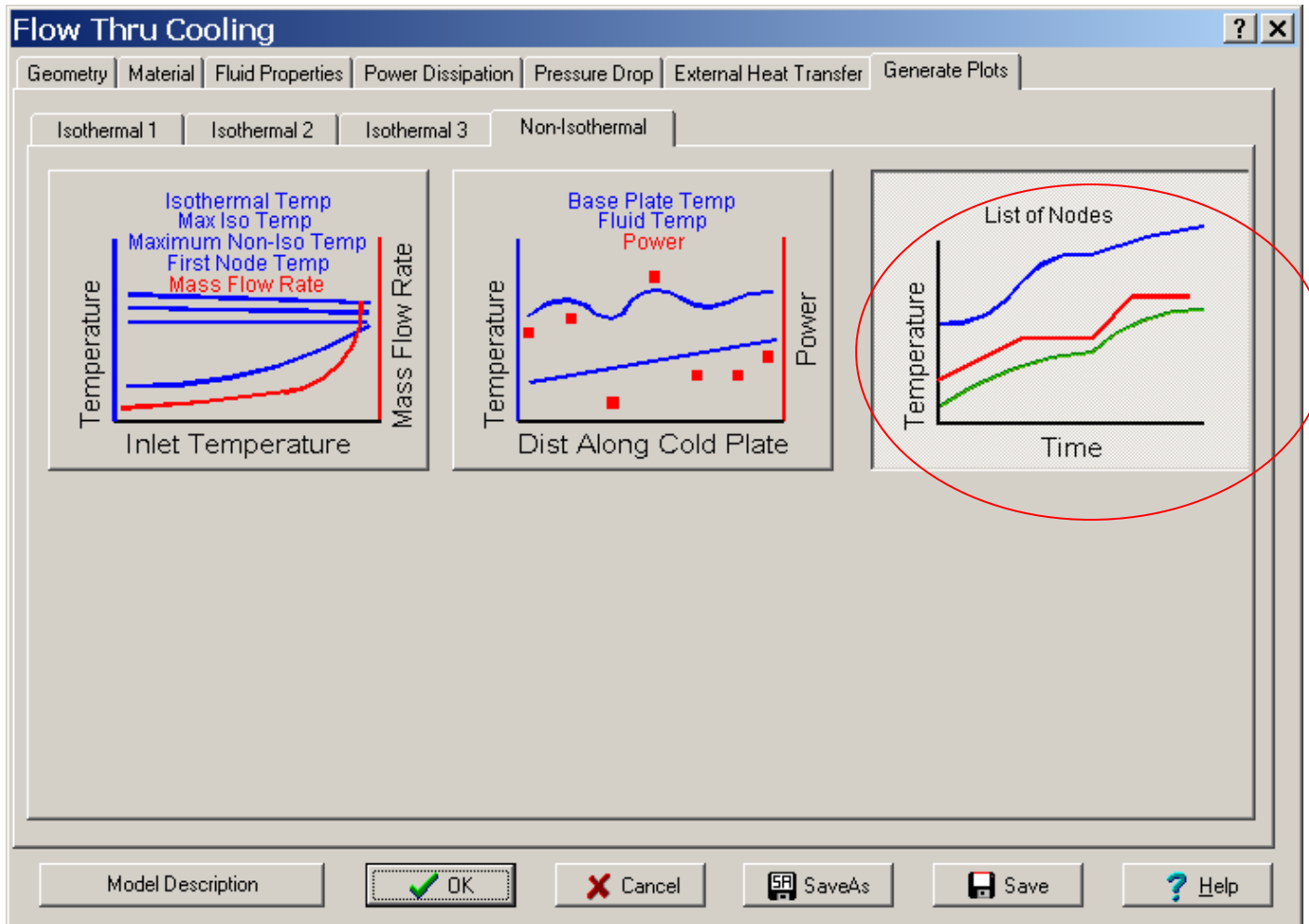


Set/Reset Properties to Aluminum

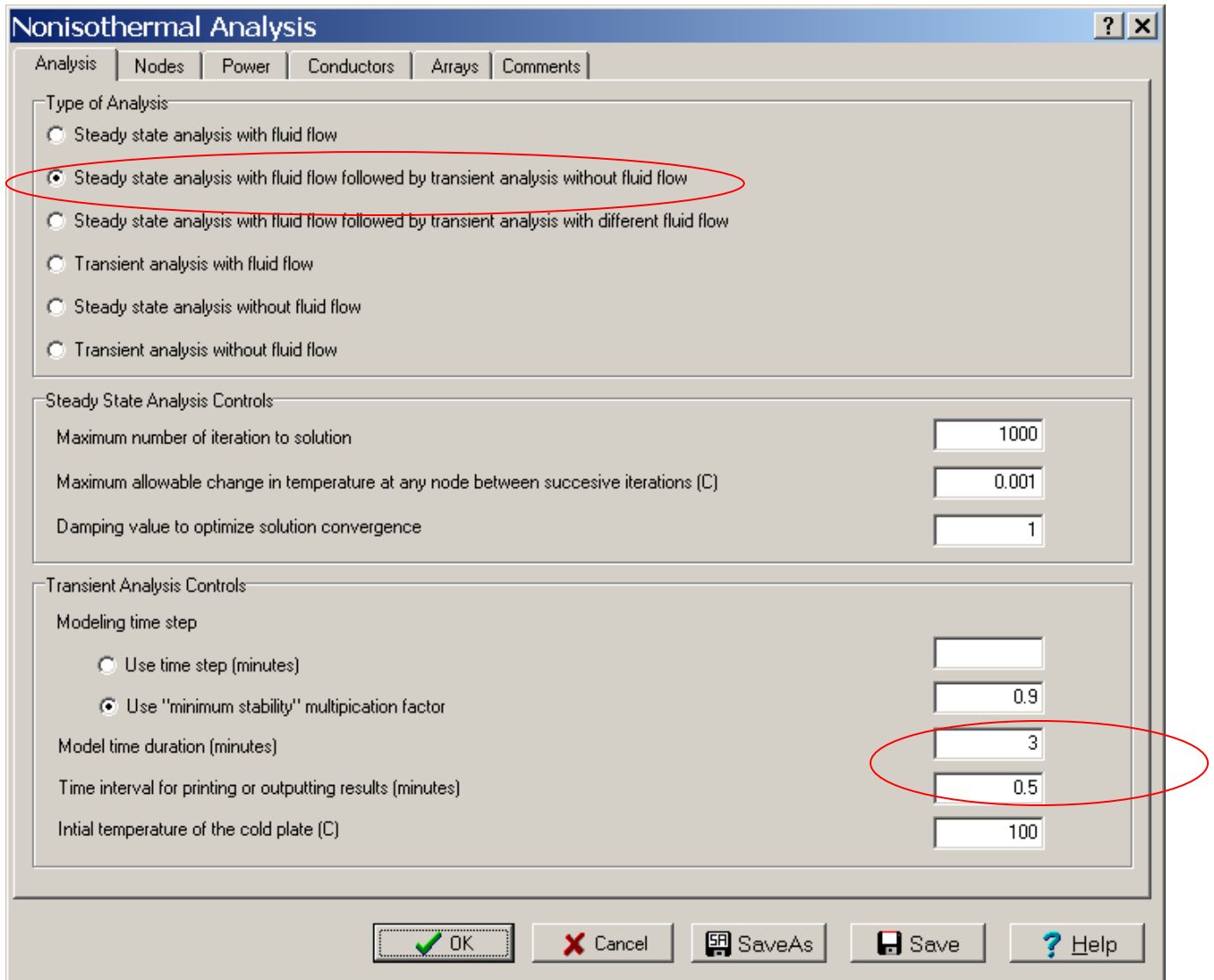
Component	Material	Thermal Cond (W/in.-C)	Specific Heat (W-min./lb-C)	Density (lb/in.^3)
Base	User Defined Properties	3.92	35.35	0.098
Fins	Default Aluminum Properties	3.92	7.07	0.098
Cover	Default Aluminum Properties	3.92	7.07	0.098
Insulation (if used)	None			

Model Description | [OK] | [Cancel] | [SaveAs] | [Save] | [Help]

Select Transient Plot to define the nodes to be plotted.



Select type of analysis to be preformed and define time duration and output print time.



Define the thermal mass of the bracket nodes.

Nonisothermal Analysis

Analysis | Nodes | Power | Conductors | Arrays | Comments

Cold Plate Nodes

Number of nodes along width:

Number of nodes along length:

Number of coolant passes:

Example: 5 Nodes along Length, 4 Nodes along Width

Flow Direction →

4	8	12	16	20
3	7	11	15	19
2	6	10	14	18
1	5	9	13	17

Node Layout Scheme

Coolant Pass Scheme

List of Extra Nodes

	Node Number	Initial Temperature (C)	Thermal Mass (W-min./C)	Comment Number
1				
2				
3				
4				
5				

Thermal Mass:
 D = Density
 V = Volume per Node
 Cp = Specific Heat
 Thermal Mass = D x V x Cp

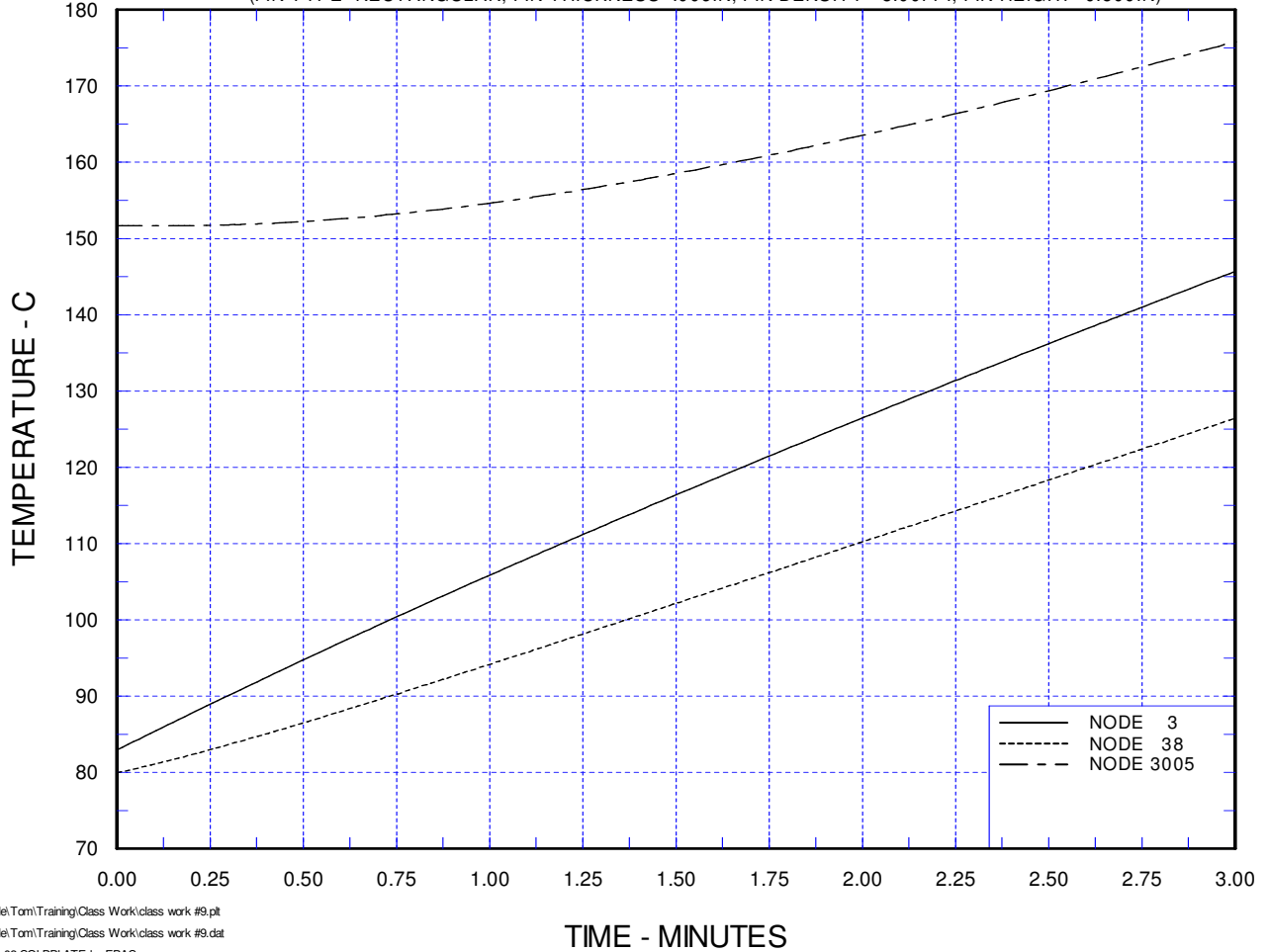
Groups of Extra Nodes

	Number of Nodes	Starting Node Number	Increment Value	Initial Temperature (C)	Thermal Mass (W-min./C)	Comment Number
1	2	3001	1	100	.067	
2	2	3008	1	100	.067	
3	2	3003	4	100	.04	
4	3	3004	1	100	.12	
5						

OK Cancel SaveAs Save Help

Results show temperature increase after 3 minutes without cooling air.

Class Work #9 - Class Work #5 model turned transient.
COLDPLATE TRANSIENT RESULTS - NODE TEMPERATURE VERSUS TIME
(FIN TYPE=RECTANGULAR, FIN THICKNESS=.006IN, FIN DENSITY= 8.00FPI, FIN HEIGHT=0.500IN)



C:\Userfile\Tom\Training\Class Work\class work #9.plt
C:\Userfile\Tom\Training\Class Work\class work #9.dat
2010-Dec-02 COLDPLATE by EPAC