

Multi-Axis Tabular Loads in ANSYS Workbench Revisited (Part 2)

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- In part 1*, we covered the preferred method of applying tabular loads and boundary conditions in ANSYS Workbench.
- In that post, we pointed out that in Workbench, the user may select a single independent variable (x, y, z, or time) with which the load or boundary condition may vary. We then explained how this limitation may be overcome by using the 'External Data' tool
- In this related post, we'd like to give users another alternative, by inserting commands in Mechanical. In short: we'll leverage APDL to define the tabular loading. This has certain advantages which we'll explain later

* <http://www.padtinc.com/blog/wp-content/uploads/2017/03/PADT-ANSYS-Tabular-Loading-ANSYS-18.pdf>

- We'll use the same tabular loading as before. We want to apply a convection boundary condition to a surface. The convection is defined over the times $t=(0s, 50s, 200s, 600s)$.

Both h and T vary in x and y for each of the four time points...

convection coefficient, h ($W/m^2/C$)

t=0		
x/y	0	150
0	5	15
170	12	12

t=50		
x/y	0	150
0	10	25
170	32	32

t=200		
x/y	0	150
0	10	25
170	32	32

t=600		
x/y	0	150
0	5	15
170	12	12

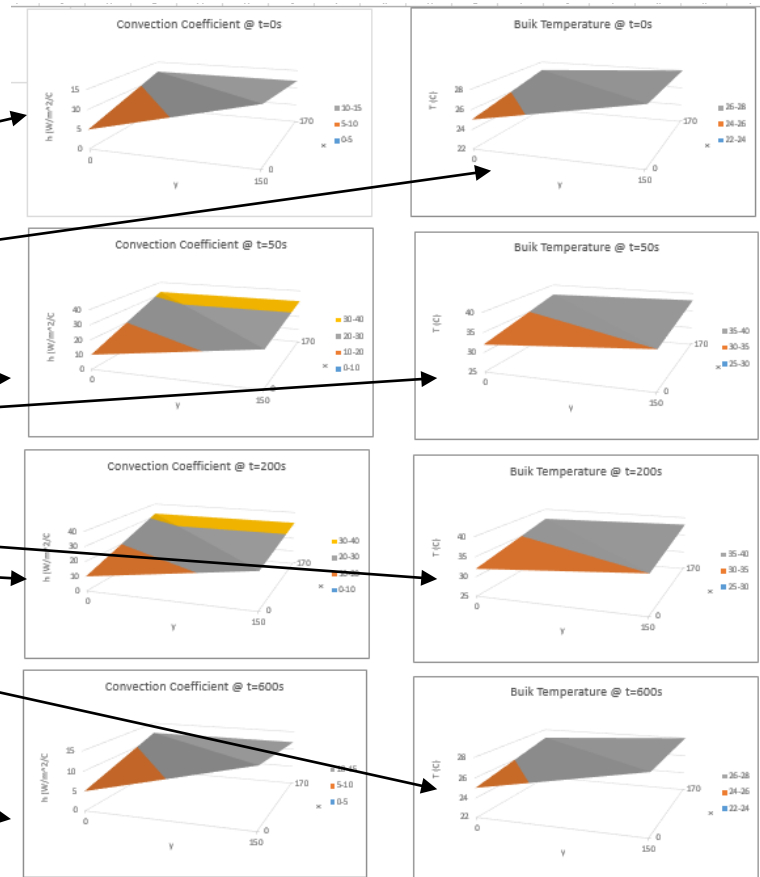
btemp, T (C)

t=0		
x/y	0	150
0	25	28
170	27	28

t=50		
x/y	0	150
0	32	35
170	37	38

t=200		
x/y	0	150
0	32	35
170	37	38

t=600		
x/y	0	150
0	25	28
170	27	28



h **T**

Correction: the x and y table dimensions are in millimeters, while the h is in MKS units. We'll fix this by using MKS model units and adjusting the tabular values accordingly.

- Recall that when defining these tables using the External Data tool, we needed to read as many input files as time points. This is an unavoidable consequence of the table architecture in Workbench. MAPDL does not have this restriction, however.
- What this means is that we can define a ‘dummy’ convection table in Mechanical – simply to establish a database link between the boundary condition and a tabular definition. This table will adhere to all the restrictions inherent in the Workbench environment.
- But we can then modify this table using MAPDL to make full use of MADPL’s enhanced table capabilities.

First step:
Define a
‘dummy’
convection BC
defined over the
relevant time
points...

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Convection: 22. °C, 25. W/m²·°C

0.000 0.100 (m)

0.050

Geometry | Print Preview | Report Preview

details of "Convection"

Scope

Scoping Method	Geometry Selection
Geometry	1 Face

Definition

ID (Beta)	1532
Type	Convection
<input type="checkbox"/> Film Coefficient	25. W/m ² ·°C (step a...
<input type="checkbox"/> Ambient Temperature	22. °C (step applied)
Convection Matrix	Program Controlled
Suppressed	No

Graph

1.e-4

1.e-4 200. 600.

2 3 4

Tabular Data

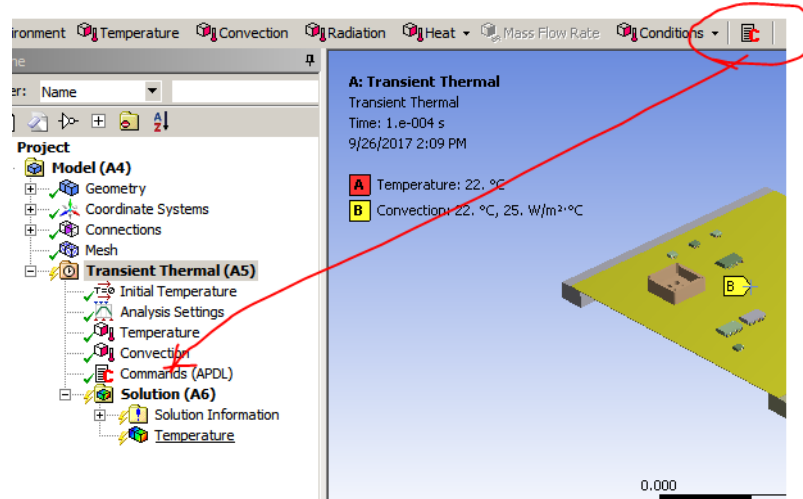
Steps	Time [s]	Convection Coefficient [W/m ² ·°C]	Temperature [°C]
1	1	0.	= 25.
2	1	1.e-004	25.
3	2	50.	= 25.
4	3	200.	= 25.
5	4	600.	= 25.

- After defining the dummy load, modify it using the load 'ID' in the details view
- In the corresponding MADPL input deck (DS.dat file), this load is usually referred to as “_loadvariID”, where ID is the ID in the details view. Convection loads have both a convection coefficient and a bulk temperature. The convection coefficient is defined by a table called “_convvariID”, while the bulk temperature is controlled by a variable called “_loadvariID”.
- Thus “_convvariID”, and “_loadvariID” are the two table names which we will modify.

The load ID is identified in the details view

Details of "Convection"	
Scope	
Scoping Method	Geometry Selection
Geometry	1 Face
Definition	
ID (Beta)	1532
Type	Convection
<input type="checkbox"/> Film Coefficient	25. W/m ² ·°C (step a...
<input type="checkbox"/> Ambient Temperature	22. °C (step applied)
Convection Matrix	Program Controlled
Suppressed	No

- We will define the four convection and bulk temperature tables (slide 3) using only two MAPDL tables. One for the convection coefficient, and one for the bulk temperature. For more information on APDL tables, the user is referred to a previous Focus article on this subject*
- To begin: With the 'Transient Thermal' environment of the tree outline highlighted, Insert a new command object



- * <http://www.padtinc.com/blog/the-focus/other-stuff-every-user-should-know-about-tables-in-ansys-mechanical-apdl-nesting-and-4-or-5-dimension-tables>

- Then cut-and-paste the following lines into the editor:

```
_convvari1532=  
*dim,_convvari1532(1),table,2,2,4,x,y,time  
*axis,_convvari1532(1),3,0,50,200,600  
_convvari1532(1,0,1) = 0,0.170  
_convvari1532(0,1,1) = 0,5,12  
_convvari1532(0,2,1) = 0.150,15,12  
_convvari1532(1,0,2) = 0,0.170  
_convvari1532(0,1,2) = 0,10,32  
_convvari1532(0,2,2) = 0.150,25,32  
_convvari1532(1,0,3) = 0,0.170  
_convvari1532(0,1,3) = 0,10,32  
_convvari1532(0,2,3) = 0.150,25,32  
_convvari1532(1,0,4) = 0,0.170  
_convvari1532(0,1,4) = 0,5,12  
_convvari1532(0,2,4) = 0.150,15,12  
  
_loadvari1532=  
*dim,_loadvari1532,table,2,2,4,x,y,time  
*axis,_loadvari1532,3,0,50,200,600  
_loadvari1532(1,0,1) = 0,0.170  
_loadvari1532(0,1,1) = 0,25,27  
_loadvari1532(0,2,1) = 0.150,28,28  
_loadvari1532(1,0,2) = 0,0.170  
_loadvari1532(0,1,2) = 0,32,37  
_loadvari1532(0,2,2) = 0.150,35,38  
_loadvari1532(1,0,3) = 0,0.170  
_loadvari1532(0,1,3) = 0,32,37  
_loadvari1532(0,2,3) = 0.150,35,38  
_loadvari1532(1,0,4) = 0,0.170  
_loadvari1532(0,1,4) = 0,25,27  
_loadvari1532(0,2,4) = 0.150,28,28
```

- Note that the ID number (1532 in this case) should be the same as the ID shown in the previous slide
- This will not be the case in general, and so users are encouraged to first cut-and-paste the lines to the left into a 3rd party text editor and change this number to the appropriate one

- ...And that's all there is to it.

Conclusions

- The tabular loading functionality within ANSYS Mechanical offers users the ability to vary loads spatially OR temporally. If a spatial variation in load is required, users are restricted to only one independent spatial variable with the options available in Mechanical
- The “preferred” Workbench solution to this restriction is to use the External Data object. This becomes impractical, however, with tables defined over a large number of discrete time points
- Command snippets and MAPDL offer an excellent and relatively compact alternative.