

Introduction to FEMdesigner AD: Steady State Heat Transfer Tutorial

In this steady state heat transfer tutorial, we will analyse a bracket with unequal length arms to understand the temperature distribution in the part when subjected to a constant temperature heat load in the central lug of the bracket while the remainder of the bracket is being cooled by convection of air at room temperature.

The geometry length units are inches are automatically the same as those the drawing and these correspond to inch-second-°F units for thermal properties. A metric drawing would use SI units. The mouse operations for view rotation and panning are the same as in Alibre. In the current version of Alibre the Femdesigner tab is available from the main menu and consists of the button bar shown below.

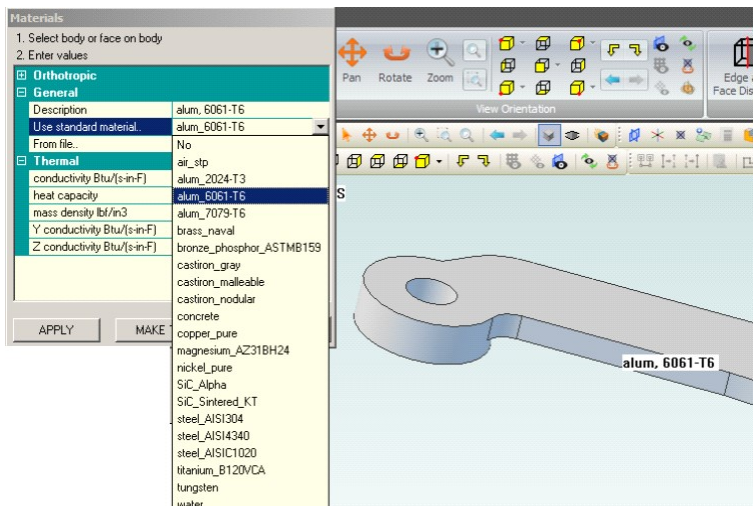


Press 'Activate Menu' to unhide the buttons. If you need to subsequently alter the model you should first deactivate the menu as Alibre may produce an error message otherwise.

Open File / Create Loadcase

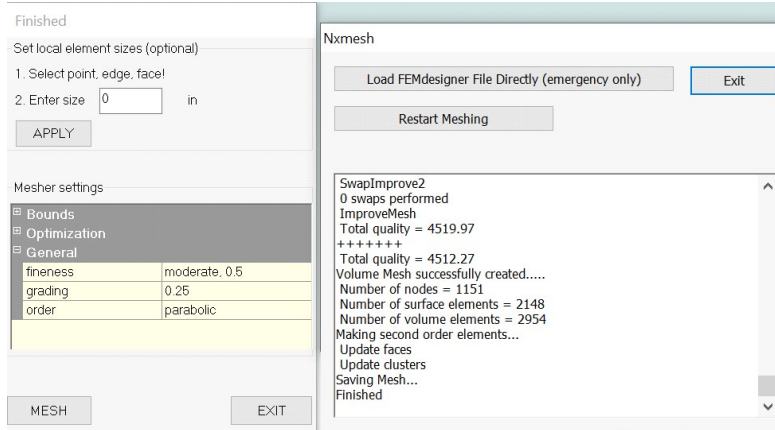
The corresponding zip file has a part file; Thermal Bracket.AD_PRT.

- Unzip the file to a folder.
- Click on 'Loadcase' command button to bring up the 'Loadcase' dialog box.
- Select 'Create New Loadcase', type a name and click 'Thermal'.
- Click 'Apply'.



Assign Material

- Click on 'Attach Materials' command.
- Select any face.
- Select alum 6061 from the 'Standard Materials' drop-down list and click 'APPLY'
- Click 'EXIT'.

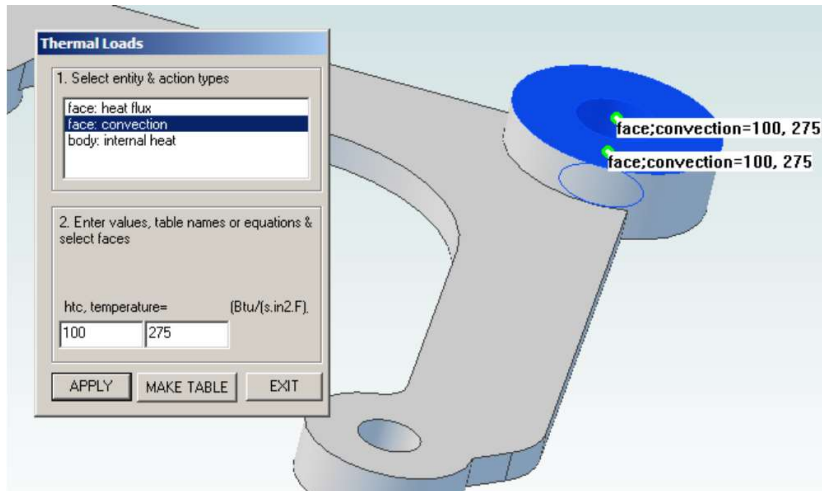


Create/View Mesh

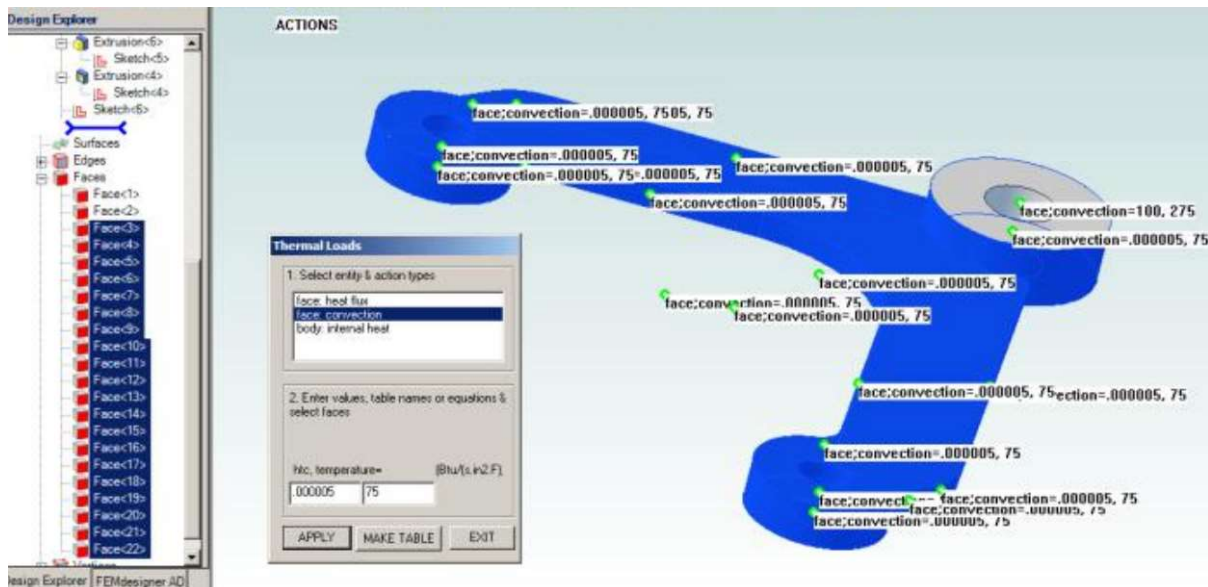
- Click on 'Build Mesh' command to display the assembly mesh dialog box.
- Click the 'MESH' button.
- When the word 'Finished' appears 'EXIT' both mesh dialog boxes.

Apply Heat Loads

We create a constant temperature heat load in FEMdesigner AD by assigning a convection condition with the fluid at the desired temperature and with a very high heat transfer coefficient (HTC), many orders of magnitude higher than a 'normal' HTC to insure a constant temperature.



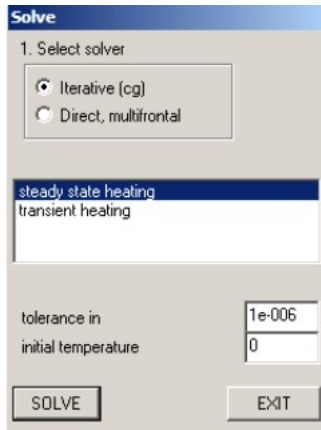
- Select the top exposed face of the centre rod.
- Click on 'Plot/Add Actions' command.
- Select 'Face convection' and enter 100 in the HTC field and 275 in the temperature field. Select 'APPLY'.



- While still in the Thermal Loads dialog, enter .000005 in the HTC field, and 75 in the temperature field to represent the room temperature convection (refer to picture above).

- In the Alibre Design Explorer tab, display all faces, and use the ‘shift-select’ method to select faces 3 thru 22, as shown.
- Select “APPLY”.

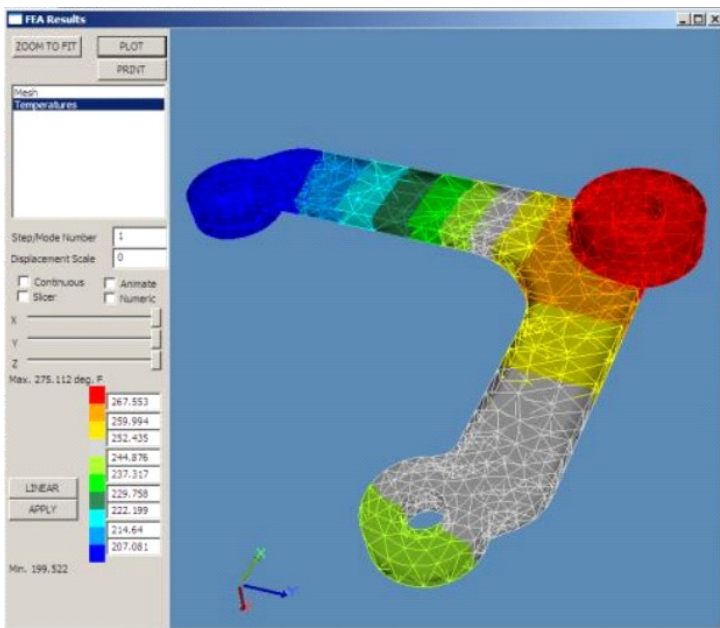
NOTE: it is critically important that the values used for heat transfer coefficient match the model units, e.g. for models in inches, HTC units should be BTU/s•in²•°F; for models in metres, W/s•m²•°K.



Solving

Now that all loads are correctly applied, the FE model solution can be started. For thermal analyses there is no need for reactions.

- Click ‘Solve’ command.
- Select ‘Iterative’ and ‘steady state heating’ on dialog box.
- Click on ‘SOLVE’. A status box with solver progress information appears.
- When the status box disappears, the solution is ready.



View Results

Click the ‘Plot Results’ command again to bring up the results dialog box.

- Select ‘Temperatures’ from the list of available results. We can see that the longer arm cools more, which is what is expected.
- If you are interested in the temperature in a specific area, zoom into the area select the “Numeric” check box and click on the screen to display up to 10 numeric nodal values.