# Coriolis Rig Heat Loss Scheme Verification and New Test Section Design


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## Coriolis Rig Heat Loss Verification

### Background/Objective

The Coriolis Rig is designed to examine the effects of rotation on internal cooling passage flow heat transfer. It consists of two rotating arms that are 8ft in diameter and can rotate up to 750rpm. The objective of this analysis was to validate the heat loss scheme being used in data reduction and then apply the scheme to an area of interest at the endwall of the first bend.

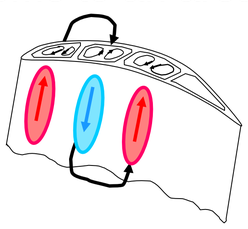

**Figure 1: Rotational Effects on Internal Passage Heat Transfer**

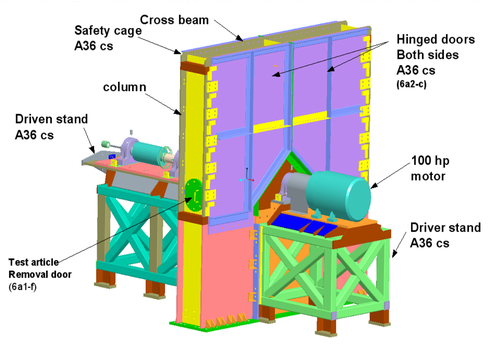


**Figure 2: Coriolis Rig Setup**

### Method

A model of the 3-pass serpentine channel Coriolis Test section was created in ProE and then imported into ANSYS Workbench. The boundary conditions were applied to the model for three different cases. One case was an insulated channel and the other two were modeled to simulate a smooth and trip strip channel with flow.

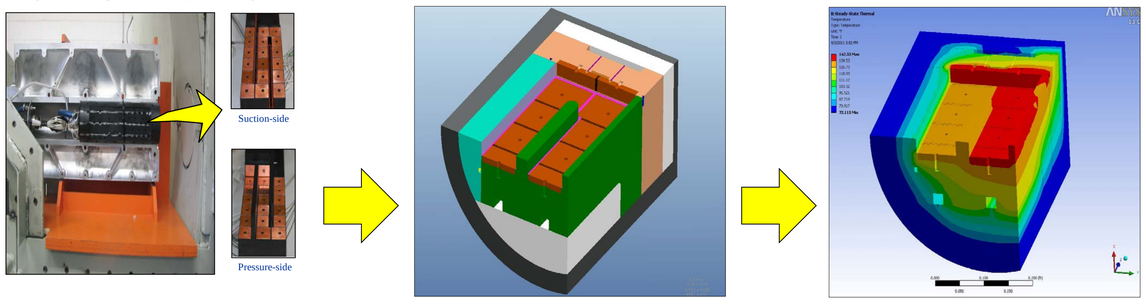


**Figure 3: Process from actual test section to ProE model to ANSYS**

### Results/Conclusions

Figure 4(b) displays the results of the heat loss test with the experimental data. The results of the analysis are within 10% for each plate. Figures 4(c) and 4(d) display the results of the flow cases at the endwall region. The endwall region of the smooth channel was consistent with experimental results. However, the endwall region of the trip strip case showed a large discrepancy.

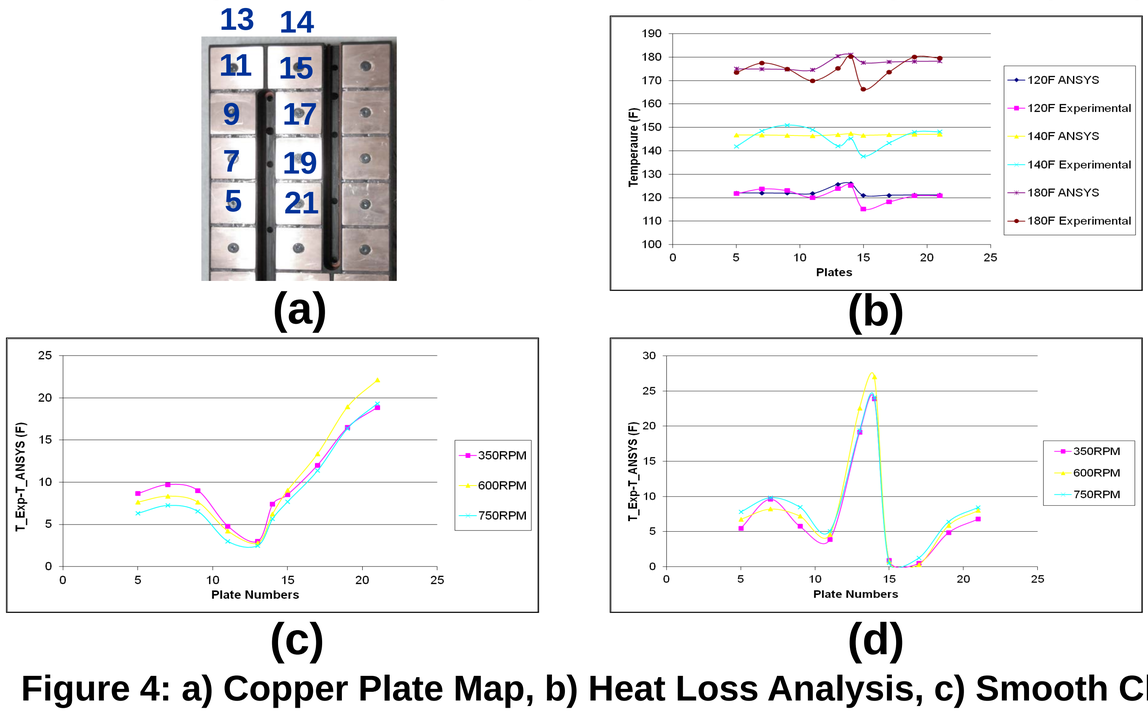


**Figure 4: a) Copper Plate Map, b) Heat Loss Analysis, c) Smooth Channel Endwall Analysis, d) Trip Strip Channel Endwall Analysis**

## New Test Section Design

### Background/Objective

With the conclusion of the 3-pass serpentine channel tests the Coriolis Rig was being redesigned to examine another cooling scheme. The new test section will include two straight channels. One channel will be lined with trip strips and the other with a pin-fin arrangement. The objectives for this preliminary design were:

- Redesign and scale test section to match engine conditions
- Create new copper plates for both channels
- Calculate required heater power to simulate desired flow conditions

### Method

- The test section was scaled using 4 dimensionless parameters: Buoyancy Parameter, Reynolds Number, Density Ratio , and L/Dh
- Created copper plates for new channel using ProE as seen in Figure 5 below
- Used energy balance to calculate the bulk temperature inside the channels so that the required heater power could be calculated

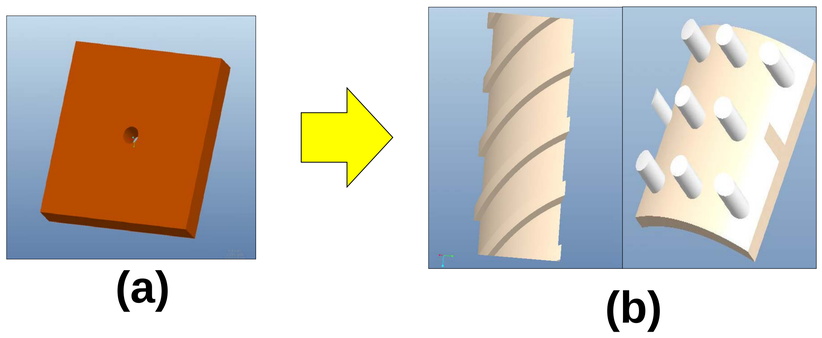


**Figure 5: a) Original Copper Plate, b) New Test Section Copper Plates**

### Results/Conclusions

- A 7X scale test section was selected to match the four dimensionless parameters
- 30 copper plates were created in ProE
- The required heater power was calculated to be approximately 250 W
- Two halves of the test section were assembled as seen in Figure 6

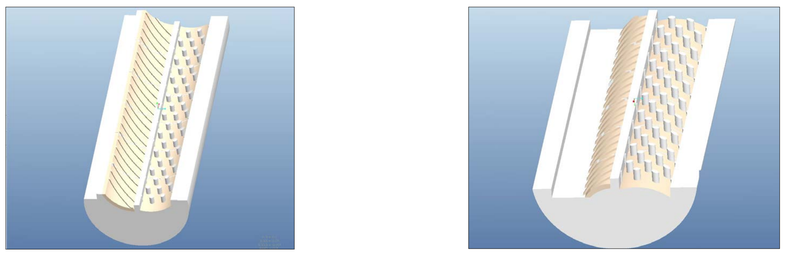

**Figure 6: Assembled halves of the New Test Section Designed**


### Acknowledgments

I would like to acknowledge Dr. Andrew C. Nix, my advisor and Dr. Yong Kim, my mentor at Solar Turbines. Also I would like to acknowledge the Southwest Regional Institute, DoE and Solar Turbines, Inc. for this opportunity.