

**Optimizing  
Composite Repair  
by  
Tailored Heat  
Sources**

# FAA Sponsored Project Information

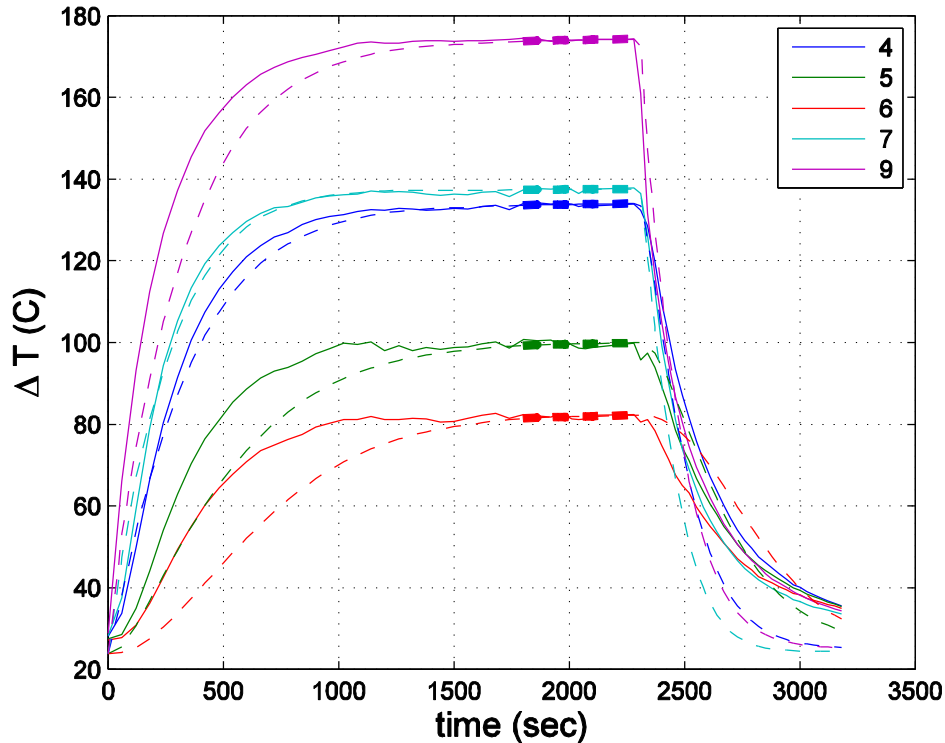
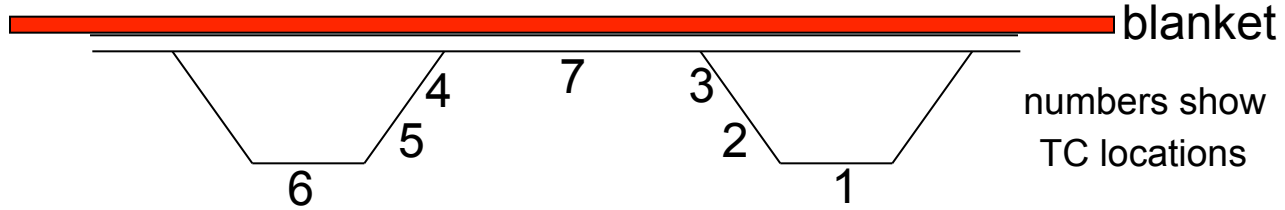
- A. Emery, and K. Johnson, UW
- E. Casterline, C. Mays, J. Lombard, Heatcon
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- Curtis Davies, David Westlund, FAA Technical Monitors
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- Heatcon and Boeing
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# Goal

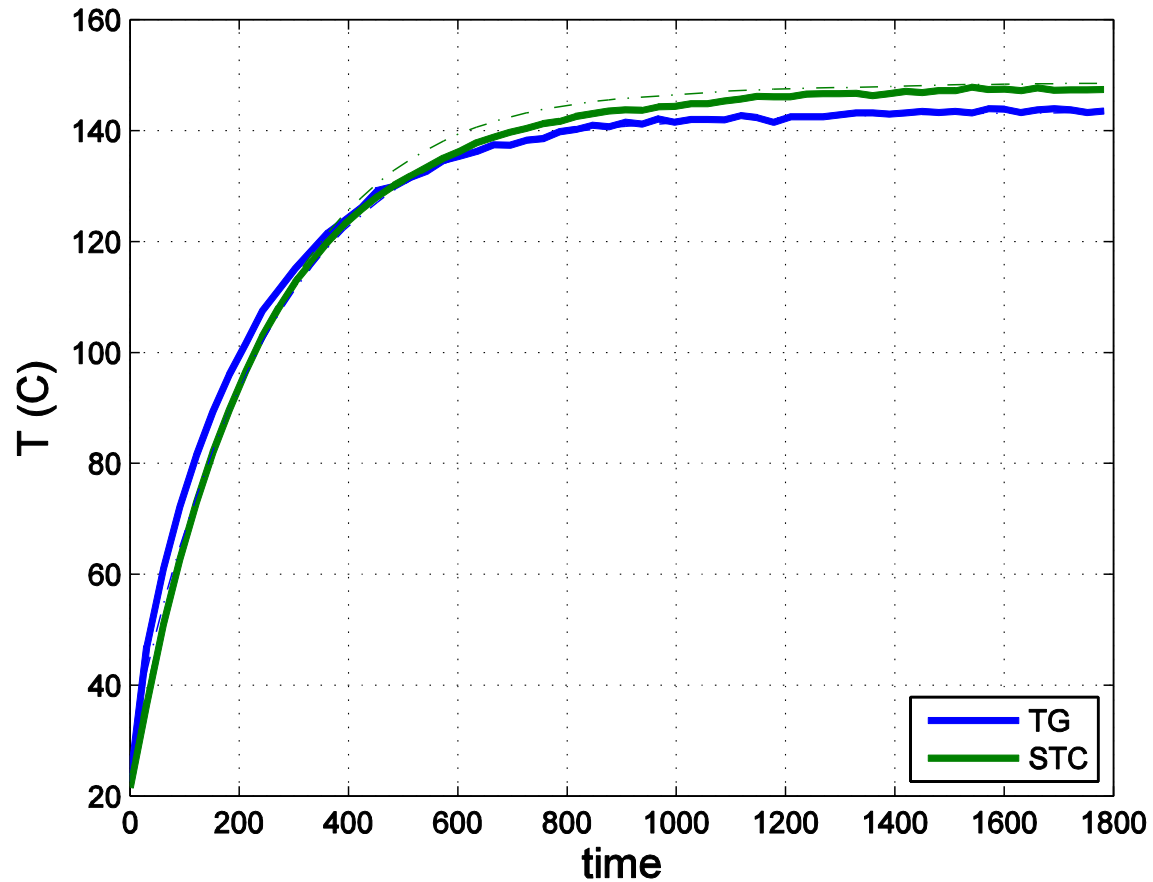
To specify the spatial distribution of heat flux  
from a heating source (blanket)  
to produce  
a specified and constant temperature  
throughout the cure zone

**with a minimum of pre-repair testing**

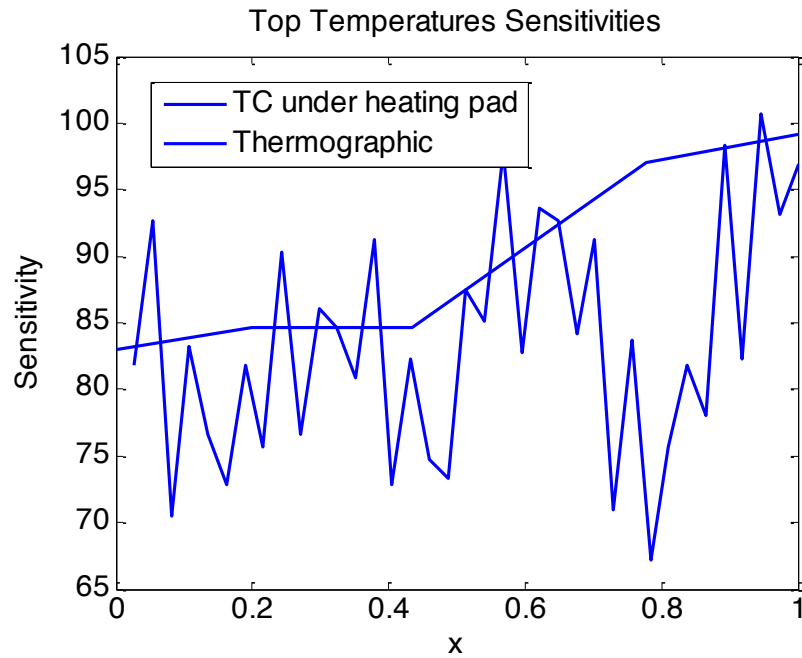
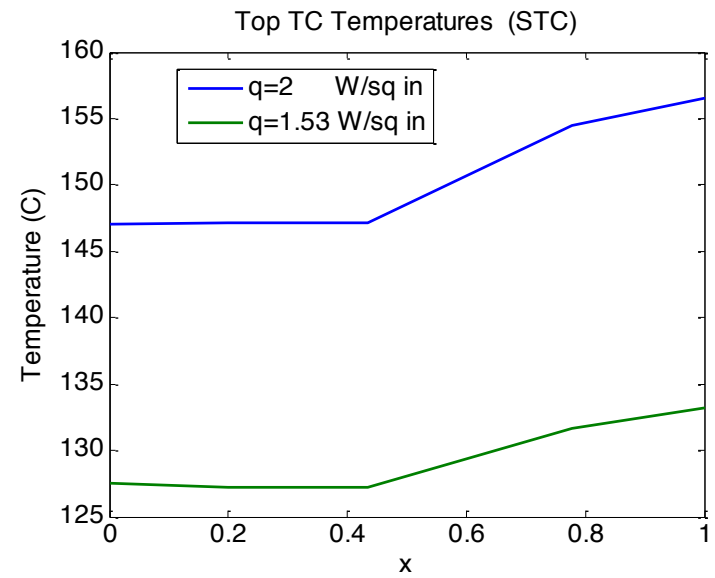
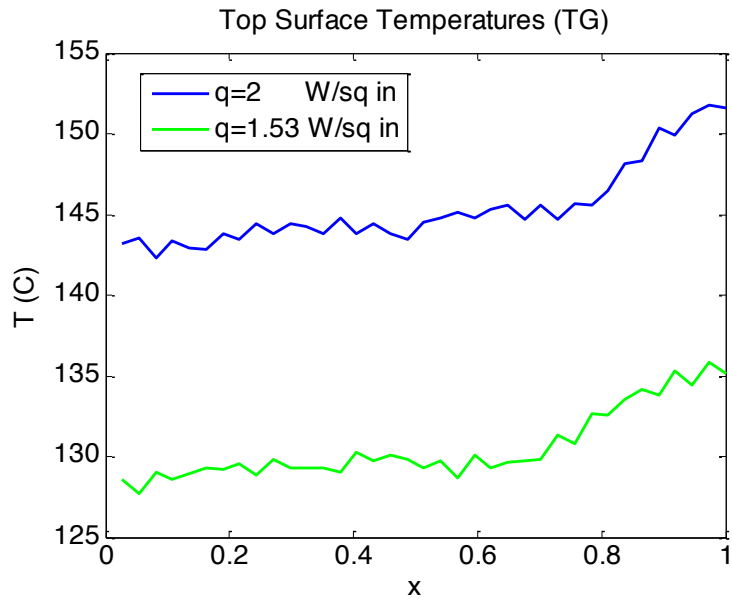
# Model Simulation



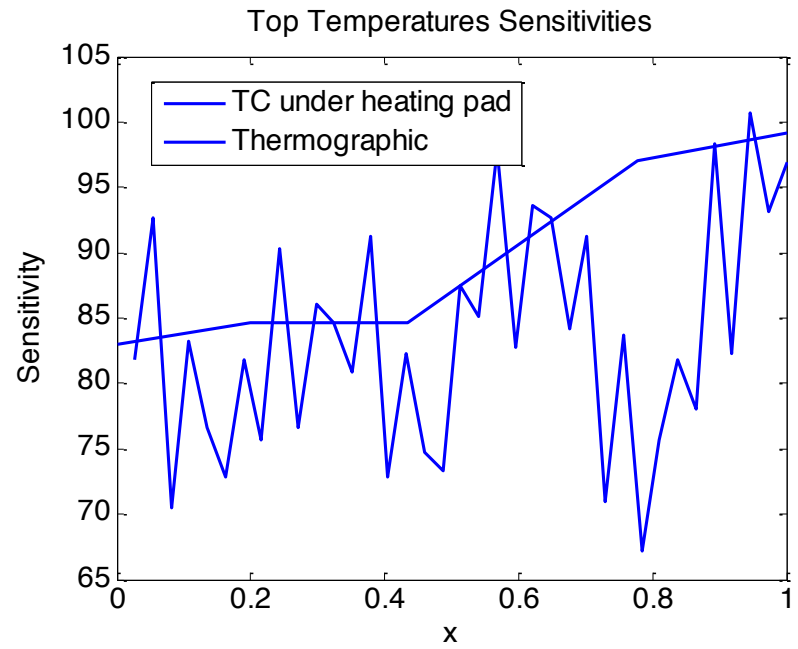
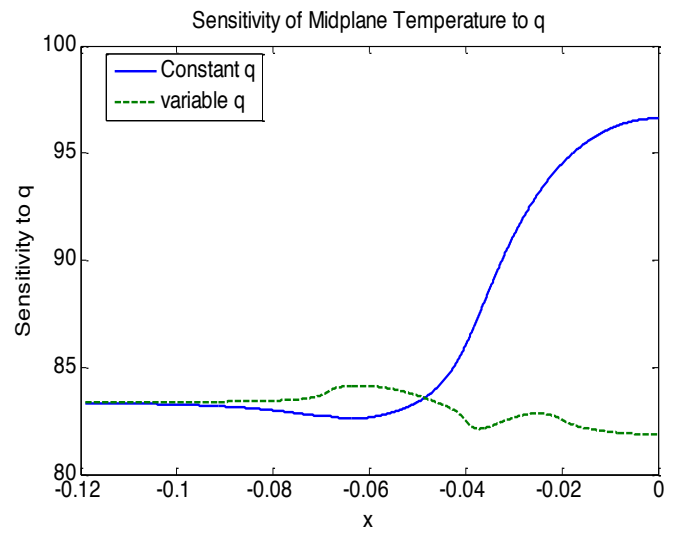
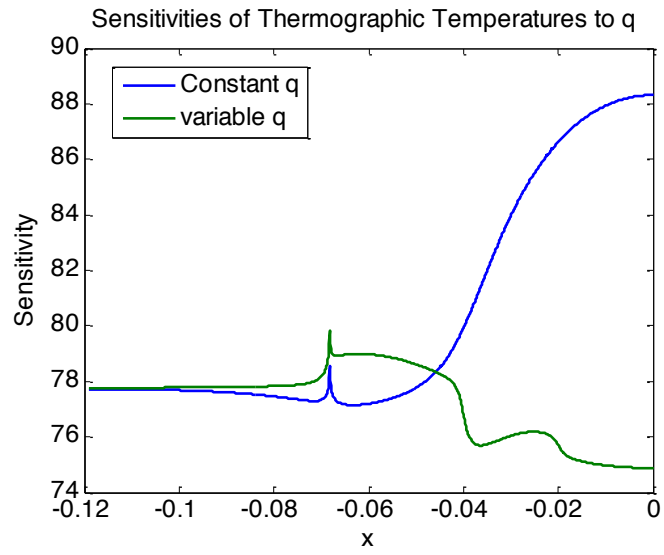
Although we were unable to simulate the transient response, we were able to match the steady state quite well.



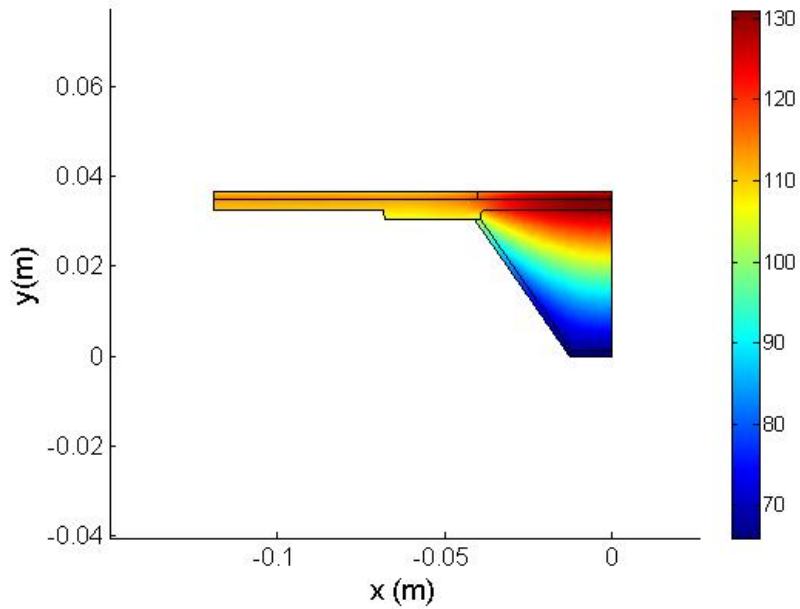
**Since we can simulate steady state temperature distributions well, compute the sensitivity of the temperatures to the heat input based on the best model**



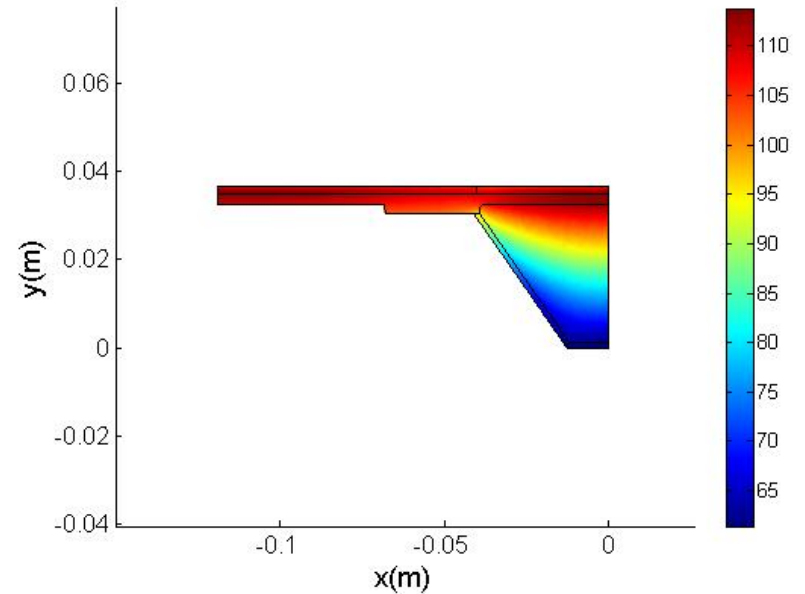
**Experimental Results**



Sensitivities from Experiments



Constant Heat Input  
2 W/sq in

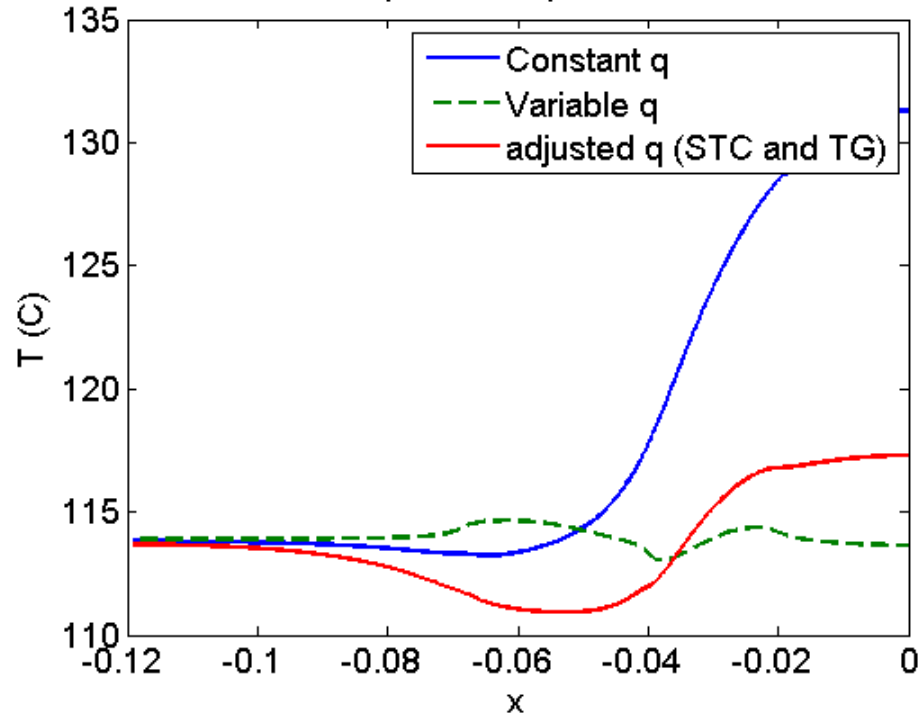


Heat Input over Stringer  
reduced by 15%

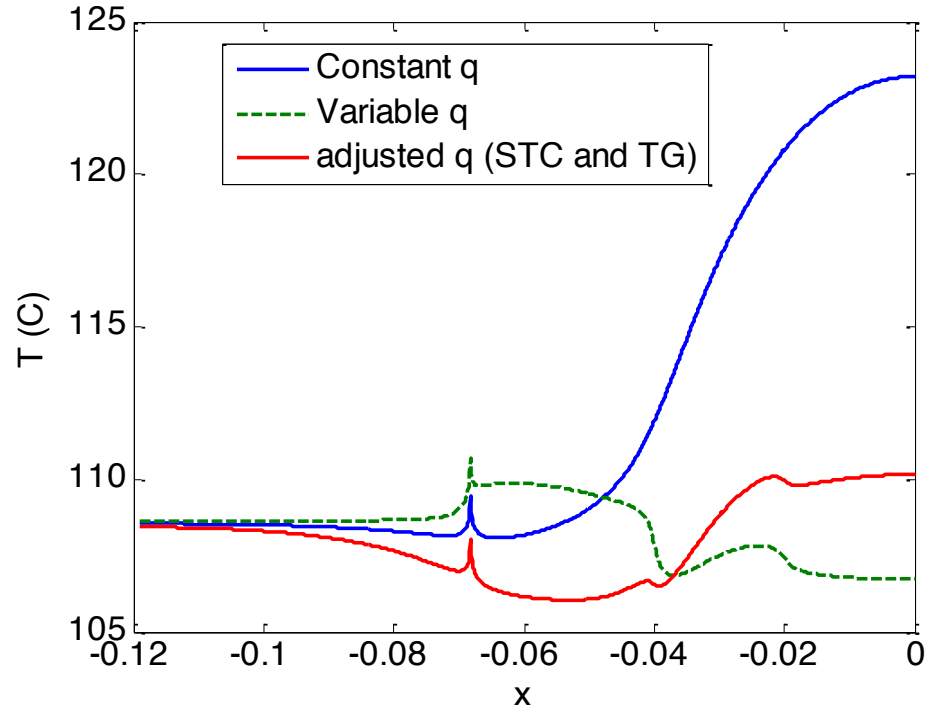
**Effect of Varying the Heat Input**  
**The 15% reduction was based on**  
**the Experimental Sensitivities of**  
**the midplane temperature to  $q$**



Midplane Temperatures



Thermographic Temperatures



**Simulated Temperature Distributions  
based upon Experimental Sensitivities**

# Conclusions

- A) Sensitivities can be determined experimentally and agree with those from simulation when based upon thermocouples placed between the heating pad and the thermographic temperatures from the top of the heating pad
- B) Using the experimental sensitivities to estimate the heating input spatial distribution gives acceptable midplane temperatures
- C) Suggested operation: Place the heating pad over the repair site, using a low heating rate let the temperatures come to equilibrium; then increase the heating rate. Do this for several heating rates to estimate the sensitivities. The estimate the spatial distribution of the heating rate