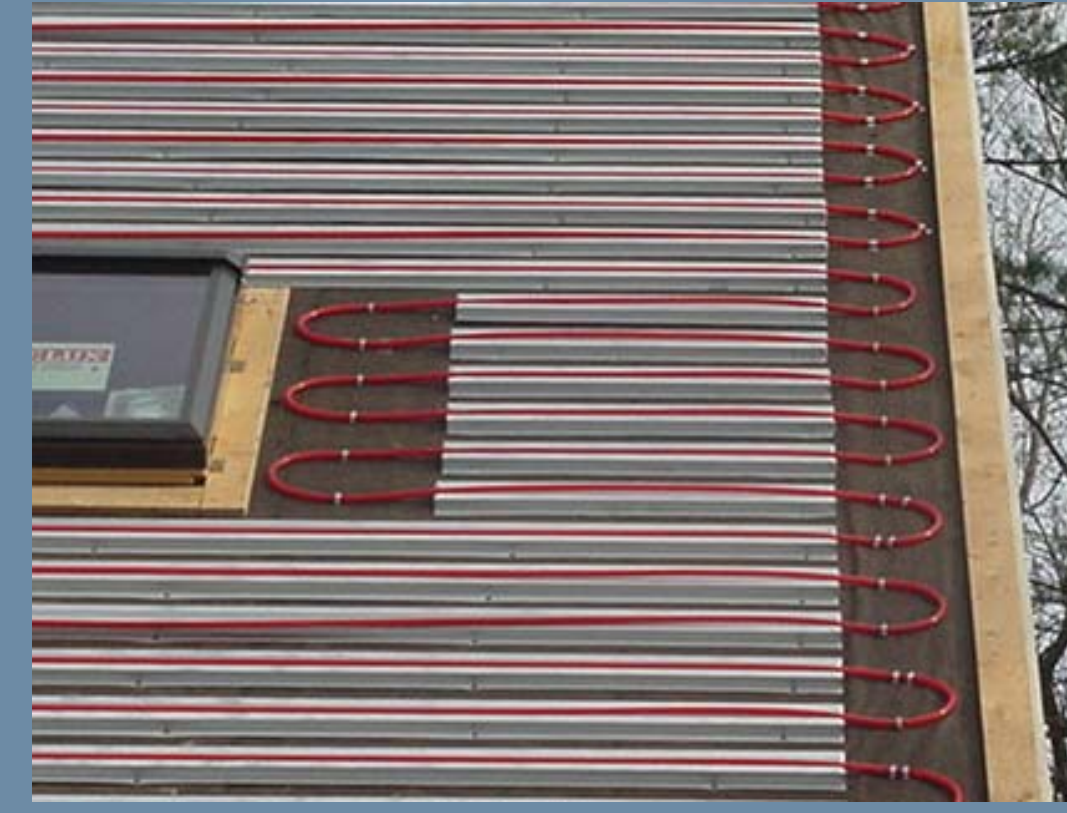


# DAWN SOLAR THERMAL COLLECTOR DESIGN PROJECT

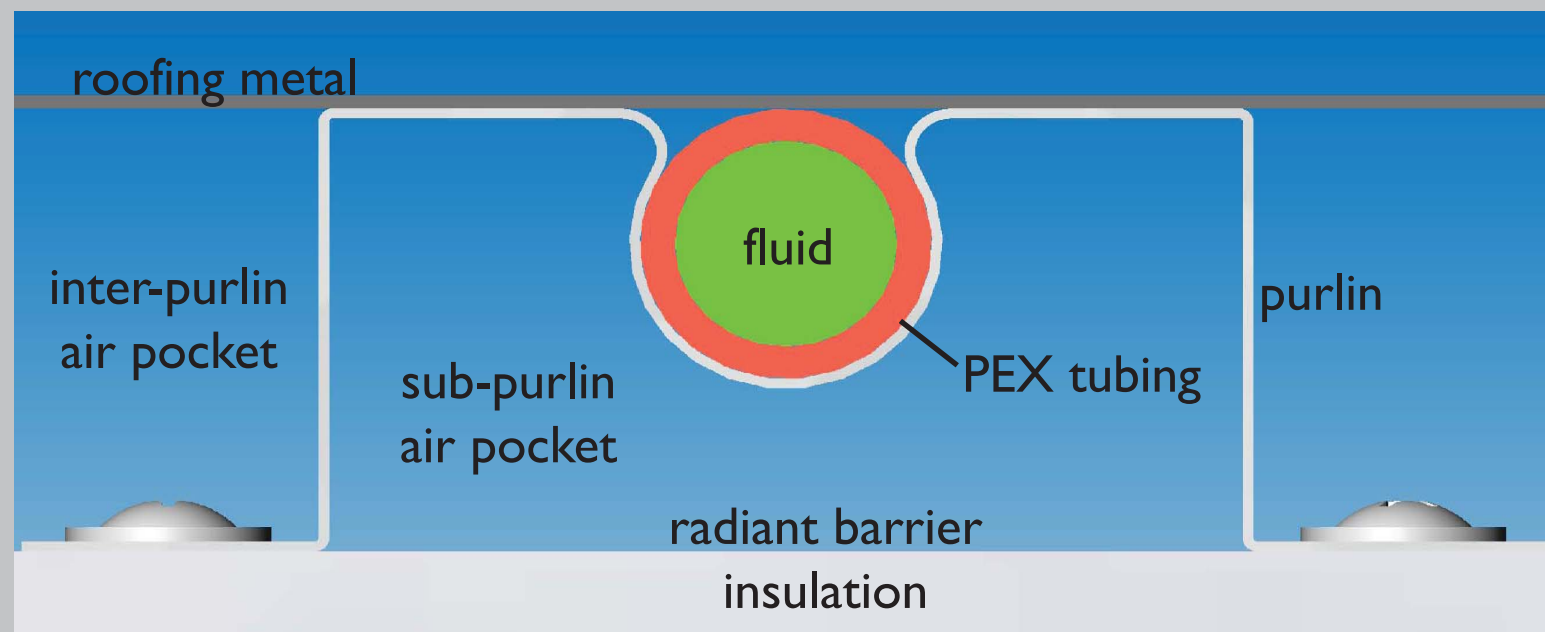
**GOAL:** Optimize Dawn Solar's 3004L thermal collector system efficiency without increasing the cost by more than 15%

## Major Project Activities:

- || building a solar lab to facilitate testing
- || modeling the current system to identify weak areas and inform design decisions
- || full-scale testing to determine performance of current system and design changes
- || mini-experiments to test design changes and answer modeling questions
- || model validation

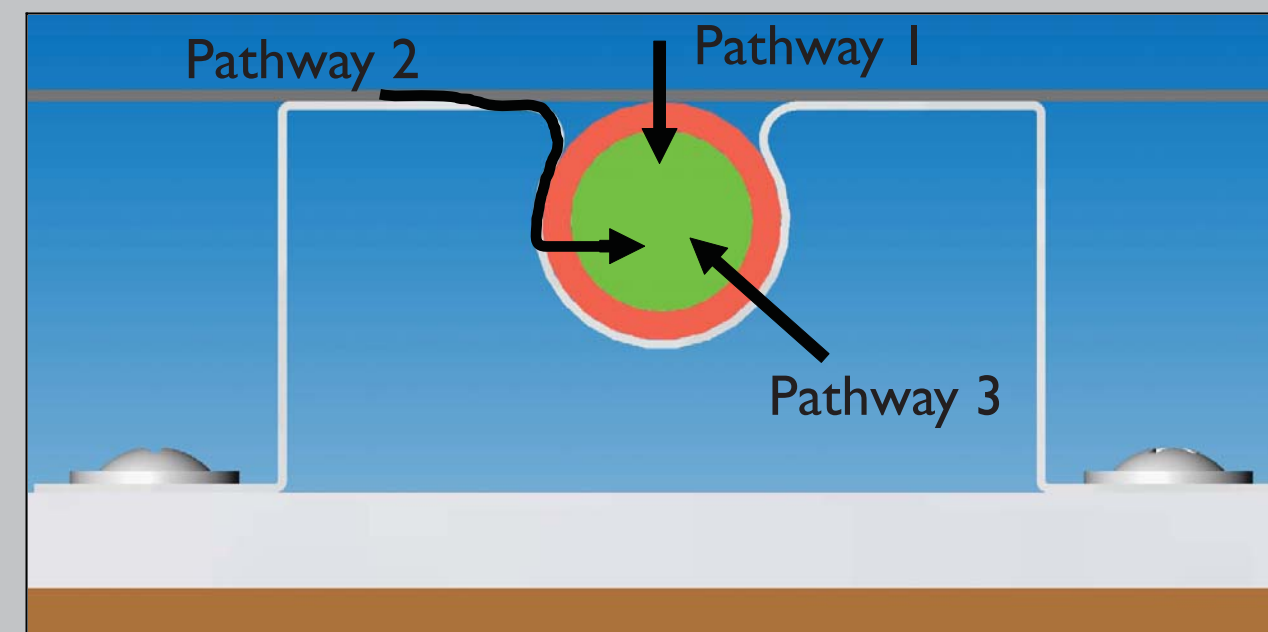


## SYSTEM MODELING:



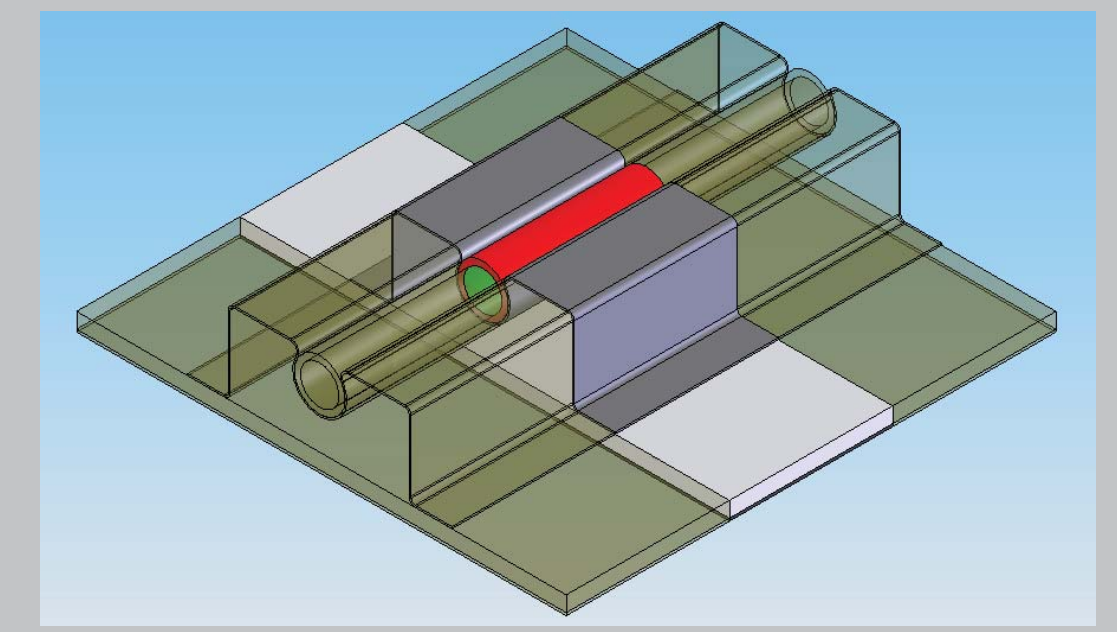
### Four Primary System Components:

- || the roofing metal
- || air pockets underneath and between the purlins
- || the PEX tubing
- || the fluid flowing through the tubing



### Three Primary Heat Transfer Pathways:

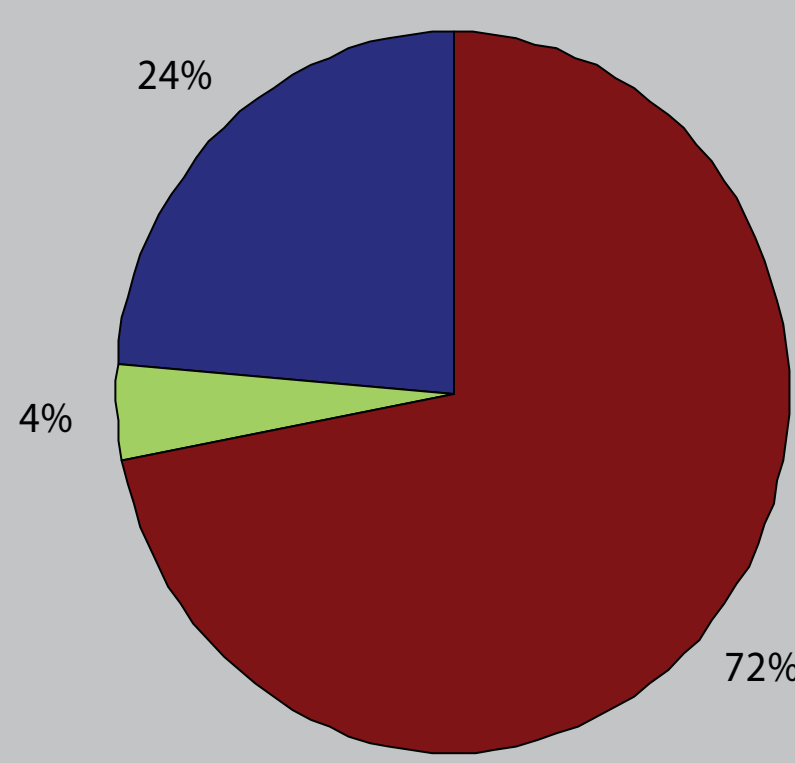
- || Pathway 1: conduction from roof to top of tube
- || Pathway 2: conduction from roof to purlin, purlin to tube
- || Pathway 3: conduction from sub-purlin air pocket to purlin, from purlin to tube



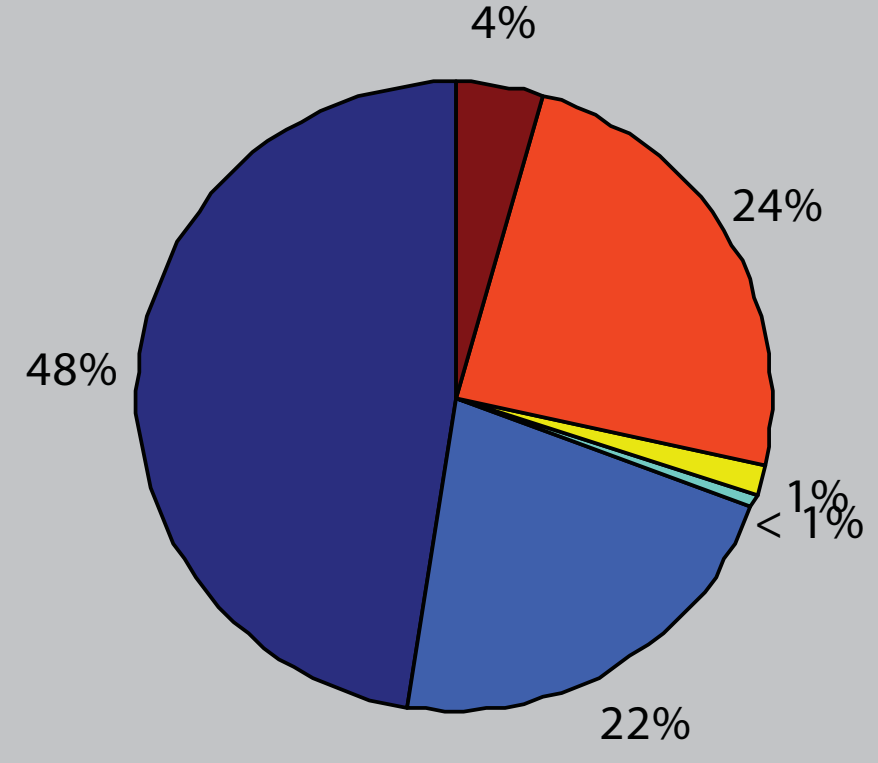
### System Geometry:

The roof system is broken into many finite volume elements, and examined along the downstream direction. Diffusion and fluid motion are considered in the model.

Relative Thermal Resistances of Three Heat Transfer Pathways



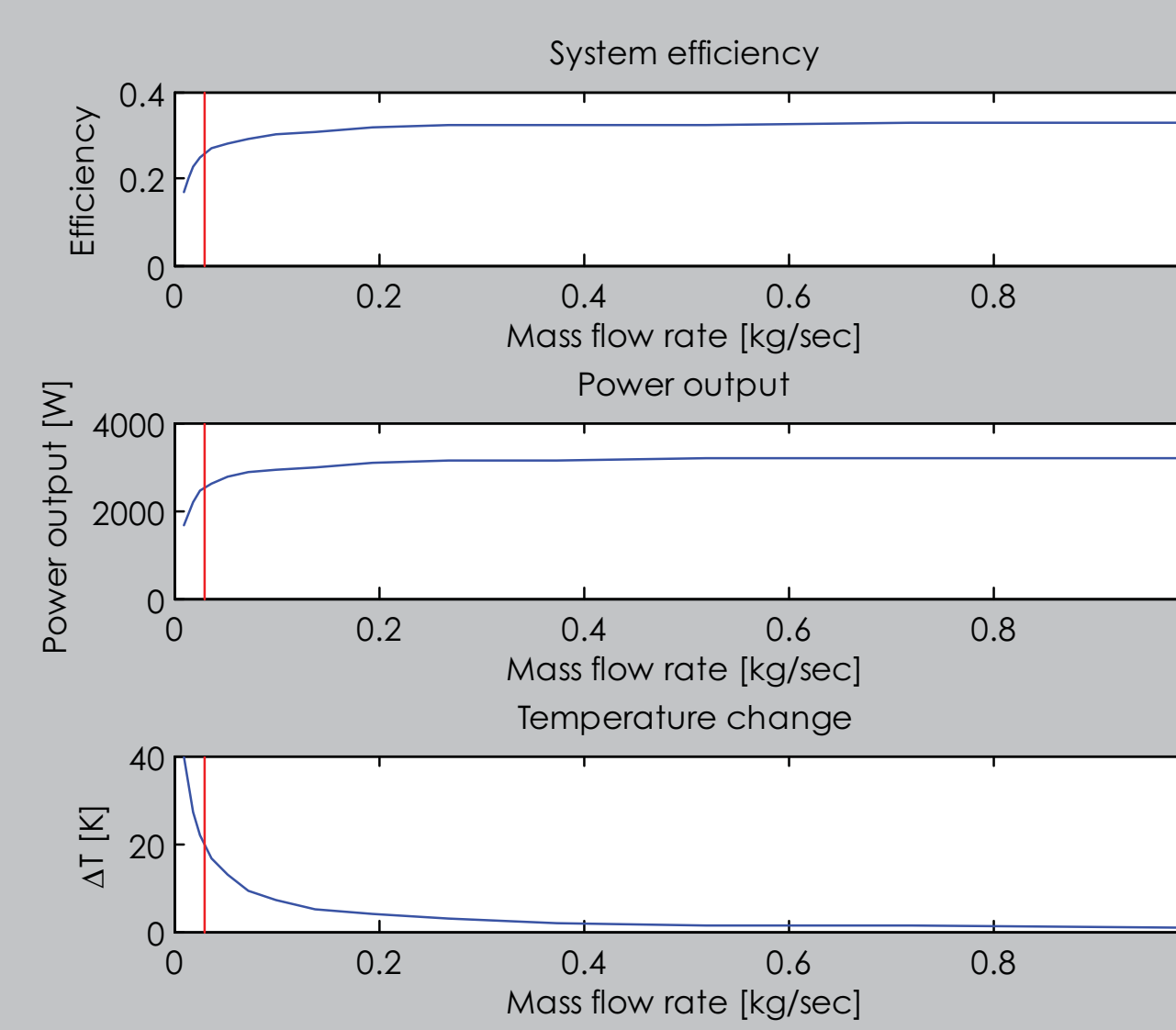
Relative Rates of Heat Transfer in DS 3004L System



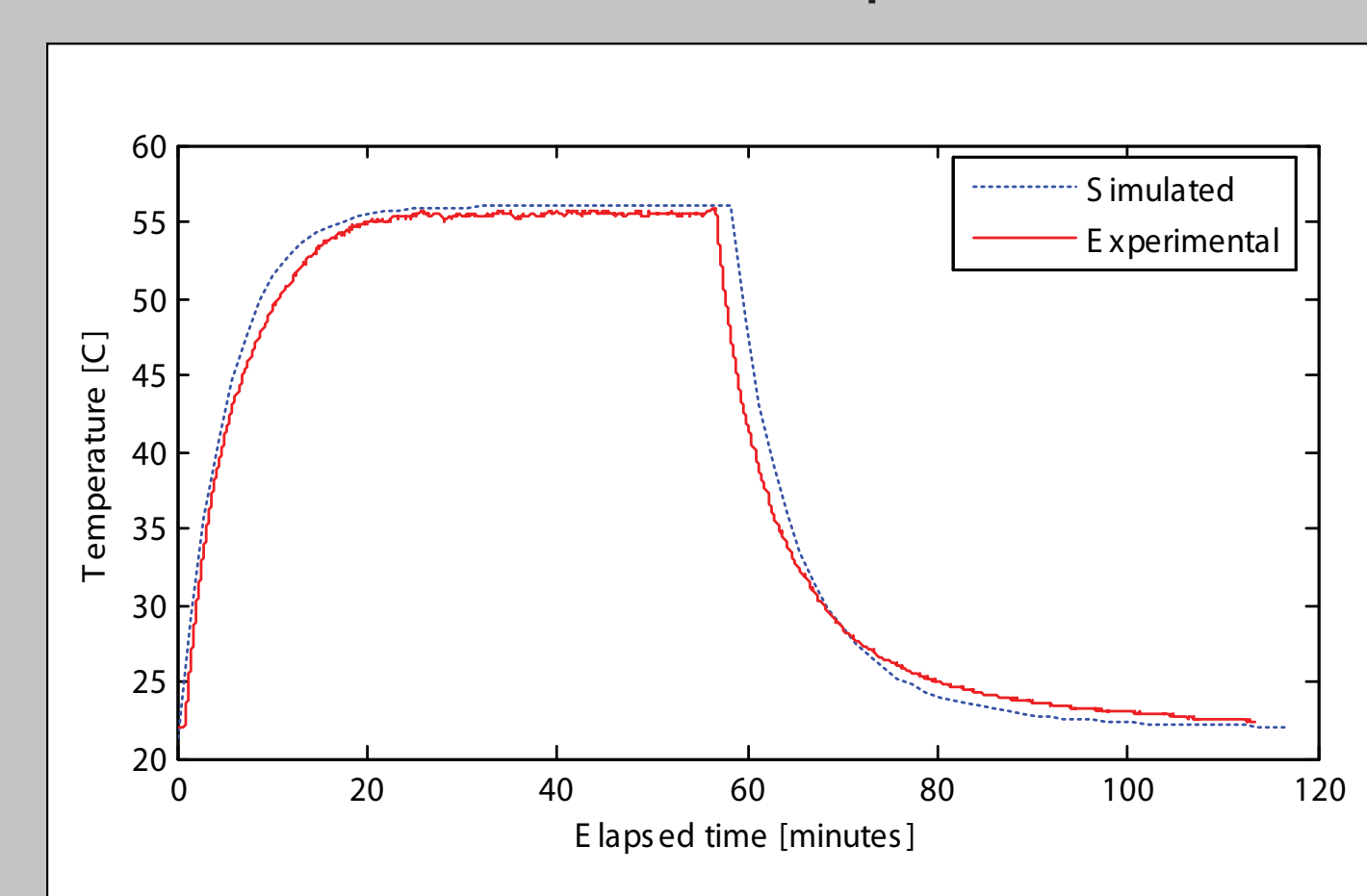
- Pathway 1 (Roof -> Tube -> Fluid)
- Pathway 2 (Roof -> Purlin -> Tube -> Fluid)
- Pathway 3 (Roof -> Air pocket -> Tube -> Fluid)

- Radiative loss to sky
- Convective loss to atmosphere
- Heat transfer to inter-purlin pocket
- Heat transfer: Pathway 3
- Heat transfer: Pathway 2
- Heat transfer: Pathway 1

System Characteristics as a Function of Mass Flow Rate

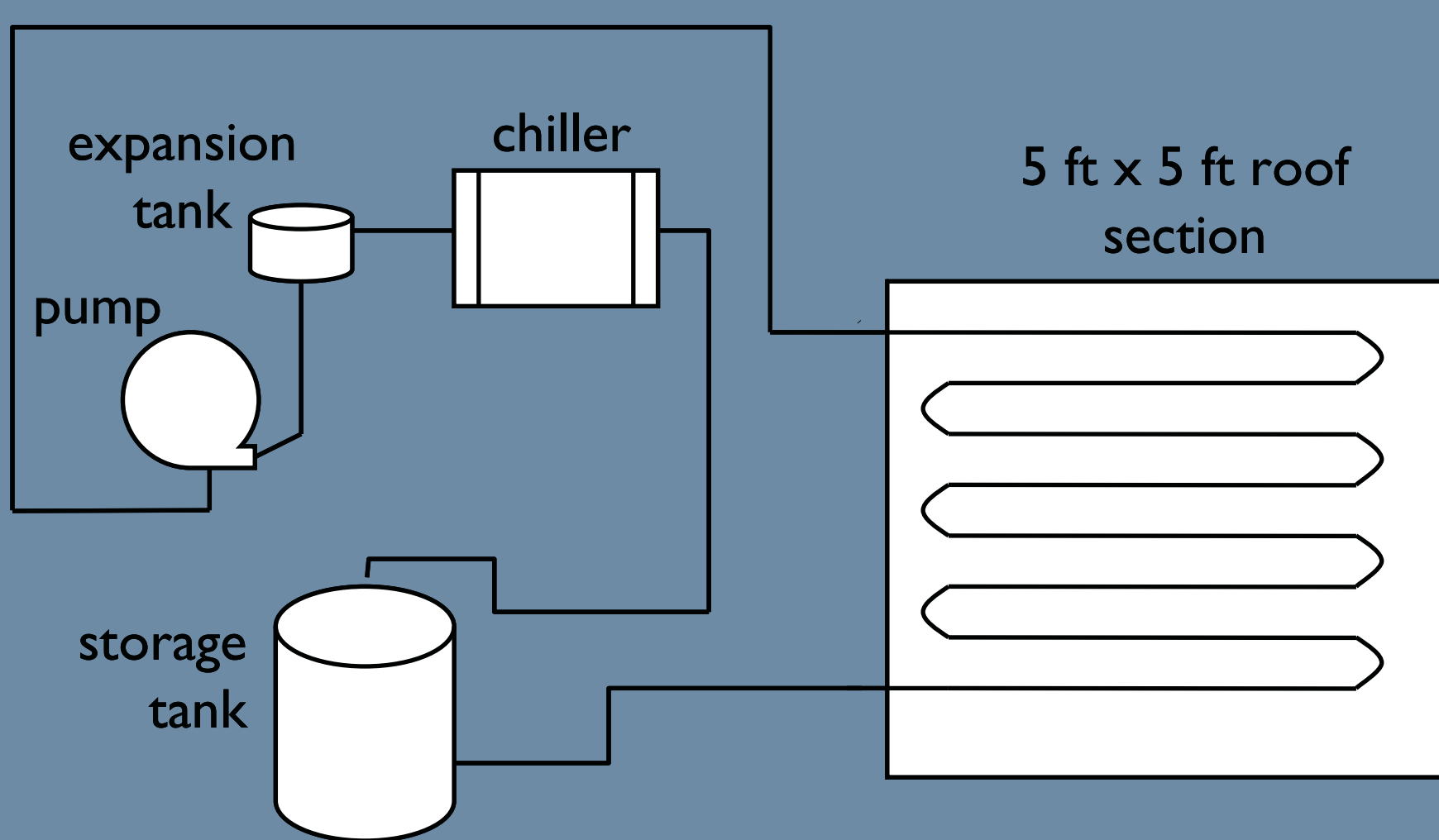


Comparison of Predicted and Recorded Roof Temperatures

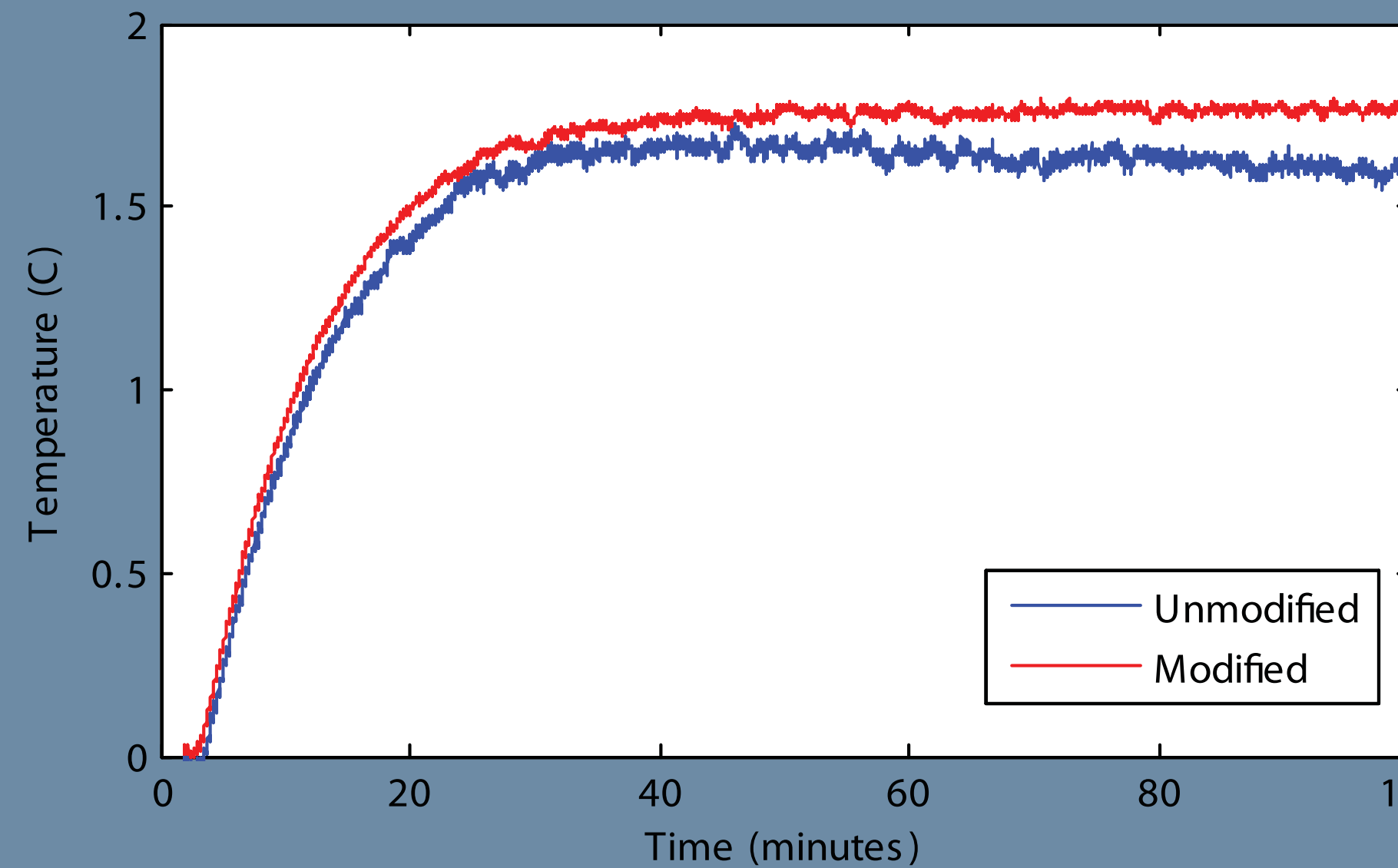


## TESTING: ROOF PLATFORM (5' x 5')

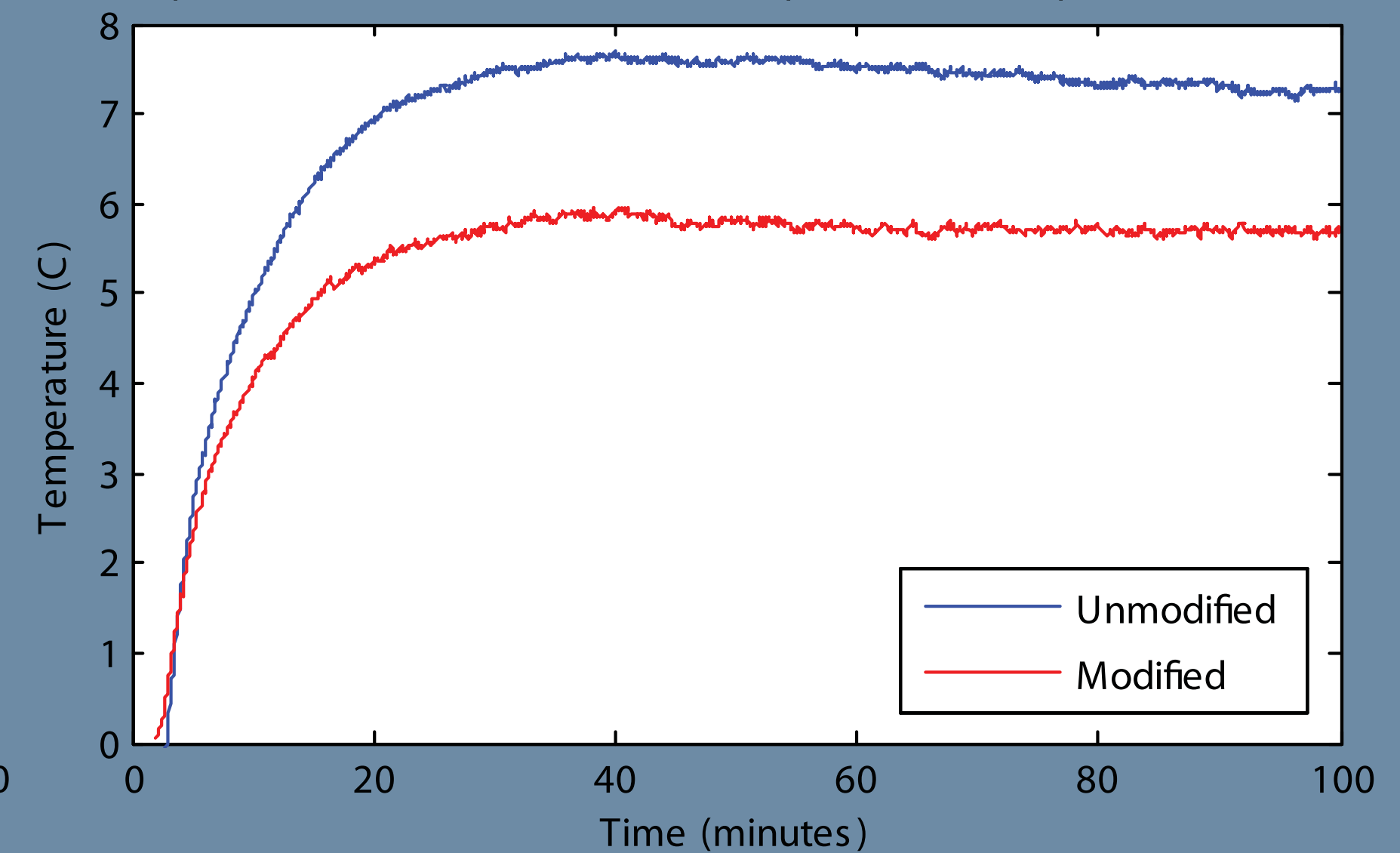
### System Test Configuration



Difference Between Inlet and Outlet Fluid Temperature

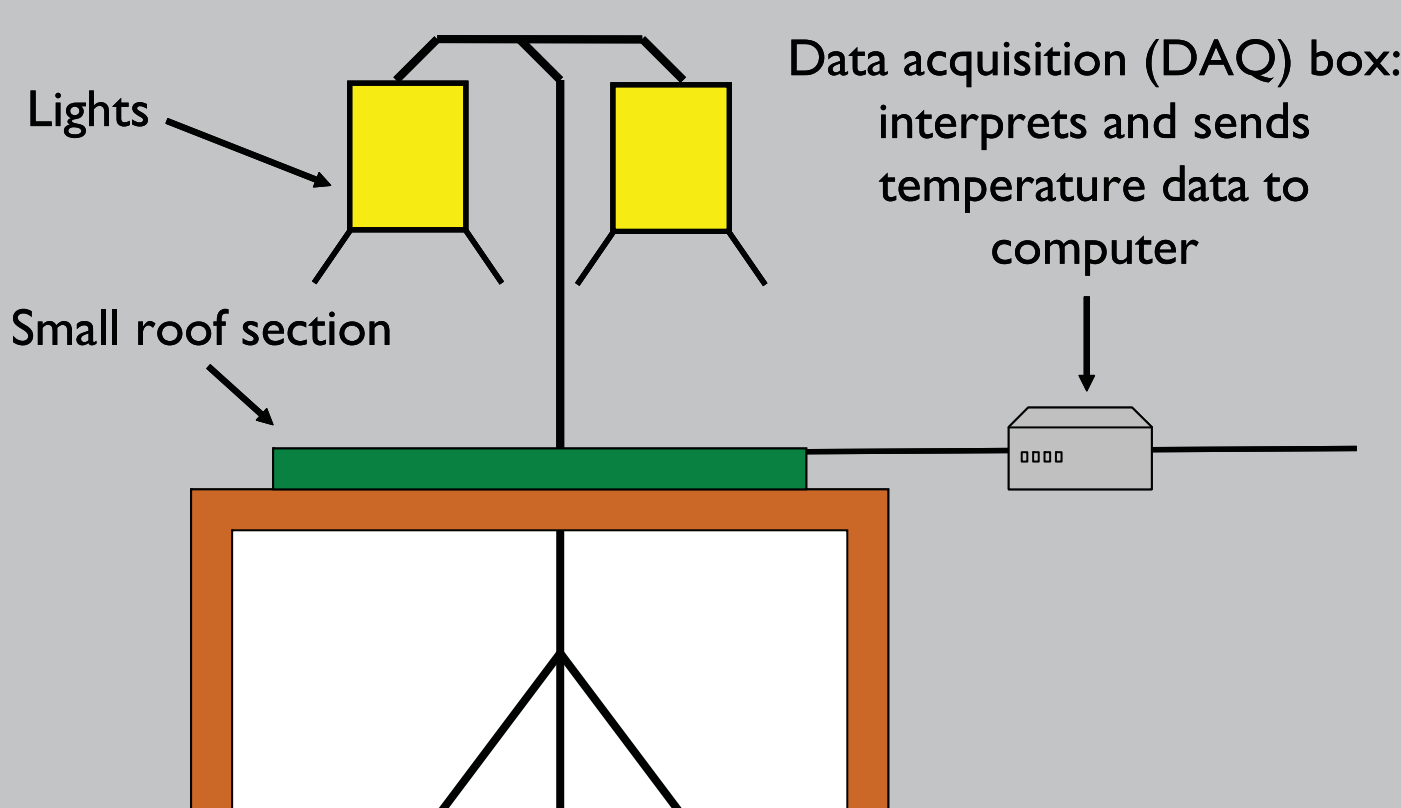


Temperature Difference Between Inter-purlin and Sub-purlin Air Pockets

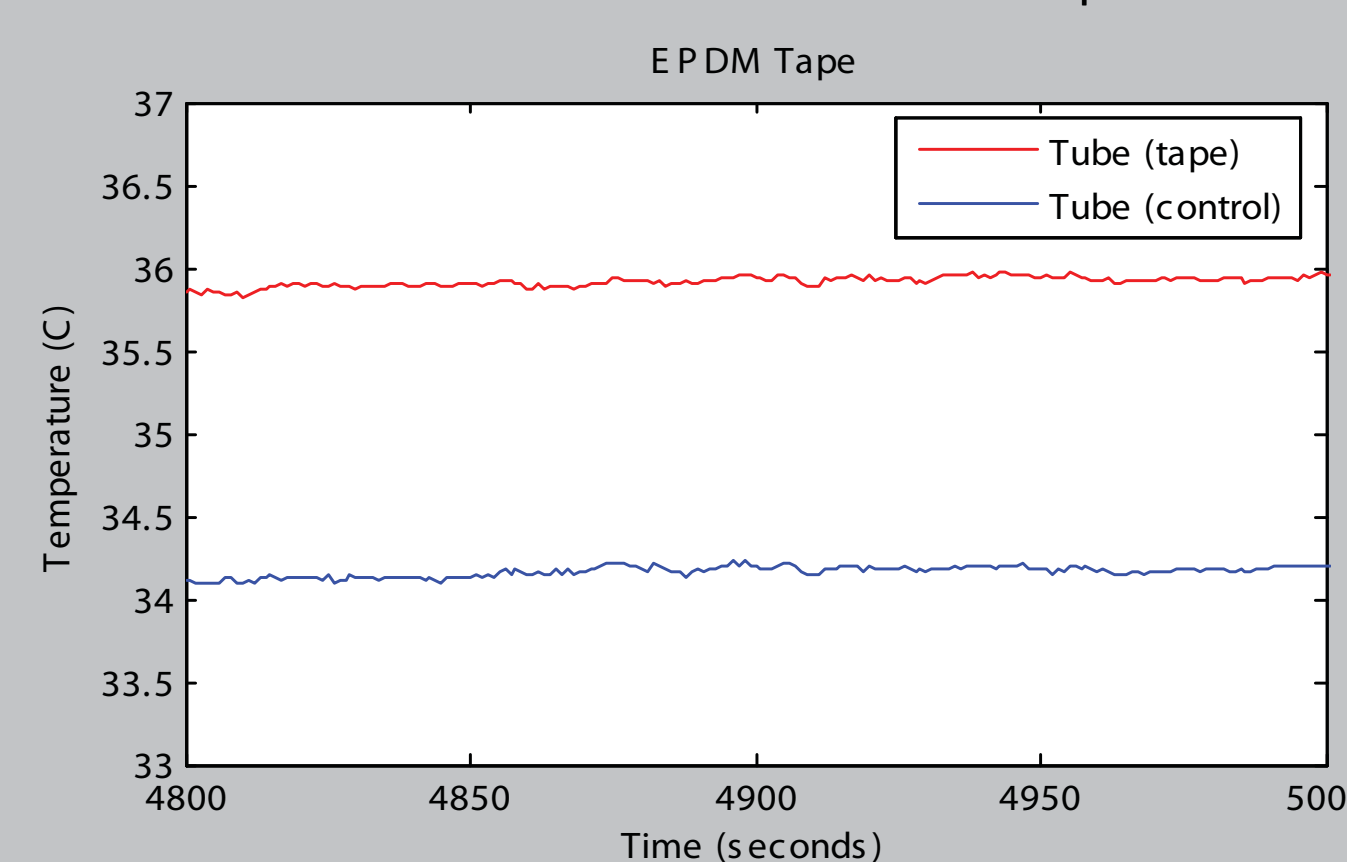


## TESTING: MINI-EXPERIMENTS (2' x 2')

### Mini-Experiment Configuration



### EPDM Tape Between Roof and Purlin



### Insulation Comparison

