

## Epic Quest 2: Architecture Collaboration Cool Roof Project

In California, keeping buildings cool is a major expense which can be partially mitigated by careful design and material selection in initial construction.

Collect Data:

You will have at least two temperature probes that will be installed in your structure.

- In contact with the back surface of your structure.
- In open air or in contact with the thermal mass of your structure.

Each of you will be assigned at least two structures:

With several possible arrangements of -

- Translucent materials
- Insulated sides
- Roof Overhang
- Thermal Mass
- All Cardboard
- Plywood top painted white
- Plywood top painted black

Measurements:

- Reference measurement of outside temperature (i.e. NOAA)
- Probe Measurements for a 1 hour period.
- Probe Measurements for a 48 hour period.
- Surface Temperature measurements (at least 6 measurements, one for each face)

Mathematical models:

- Temperature
- Energy
- Power
- Cost for keeping a your structure cool as compared to the average California home

Plots (for each structure):

- Temperature as a function of time from actual data.
- Temperature as a function of time from projected data for a year. (Model)
- Incident Energy as a function of time from actual data.
- Incident Energy as function of time from projected data for a year. (Model)
- Instantaneous power (positive or negative) from actual data
- Instantaneous power from projected data for a year. (Model)
- 2 Instantaneous 3D Graphs of wall temperature from measurements.

Calculations:

- A table of energy incident on each structure per hour for 47 consecutive hours
- Total energy incident in the box in a year. (Think about the thermal mass of the box and use basic thermodynamics)
- The total cost to keep a California home in the comfort range over the course of a year.
- Error (Uncertainty, systematic error) and analysis (linear regression, standard deviation) for all measurements, calculations, and mathematical modeling

In class you will work with the other students to obtain needed data. Your deliverable is an individual 6 - 10 page report that addresses each of the measurements, models, graphs and calculations above; as well as analysis and conclusions for all of your assigned structures. Additional evidence (i.e. documentation of your structures, MATLAB code and outputs) maybe included in appendices. All calculations, graphs, tables of data and mathematical models should be created, appropriately annotated and formatted with MATLAB.

