

# Tethered and Navigated Air Balloon: Prototype 2

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## Background Information

The Tethered and Navigated Air Blimp (TANAB) is a microclimate monitoring system developed by AIR labs at the University of Guelph. The TANAB is comprised of a balloon for lift, and instrumentation gondola which protects the device's sensors and control systems. The Primary functions of the TANAB are to measure and record environmental data, capture thermal images, and characterize air quality at different elevations.

## Objectives

Improvements will be made to the gondola's structure and layout in order to achieve:

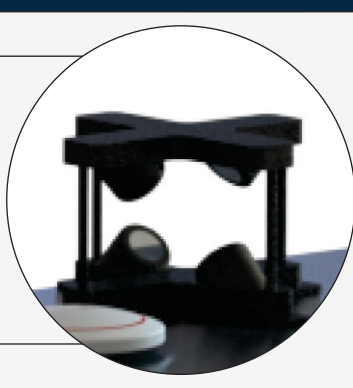
- reduced gondola weight (below 3 kg)
- introduce capability to manage internal temperature
- increase internal organization and ease of use

## Design Elements

### Sensors and Control Systems

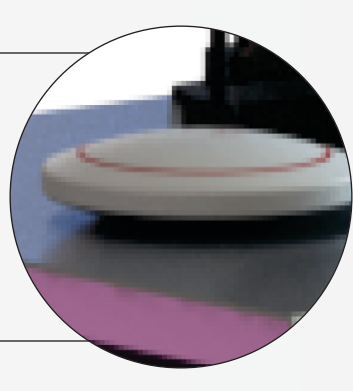
#### Lightweight Ultrasonic Anemometer

- determines wind speed and direction



#### GPS Tracking System

- N3 drone tracking system; tracks flightpath



#### Data Logger

- records environmental and flight data

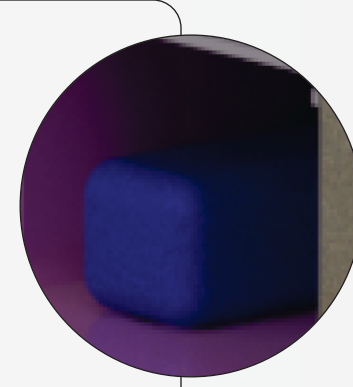


#### Flight Controller

- stabilizes camera gimbal

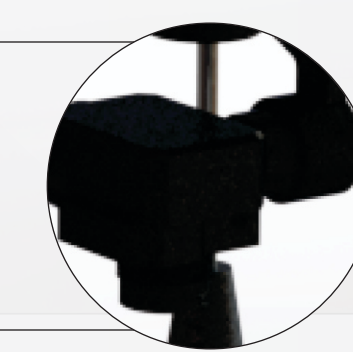
#### Temperature Regulation System

- arduino controlled temperature sensor and heater



#### DJI Zenmuse Thermal Imaging Camera

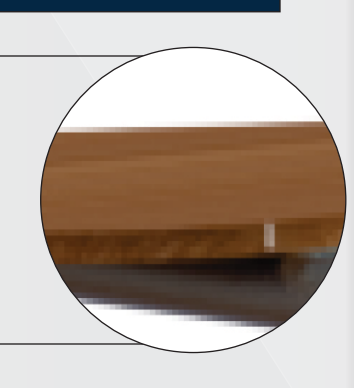
- captures thermal images for area under study



### Gondola Structure

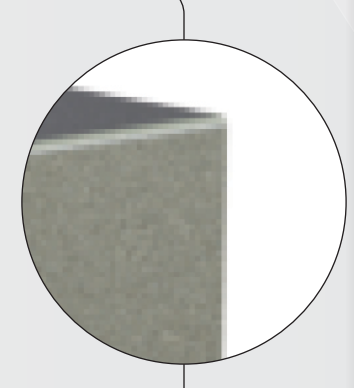
#### Carbon Fibre Reinforced "T"

- attaches gondola to balloon



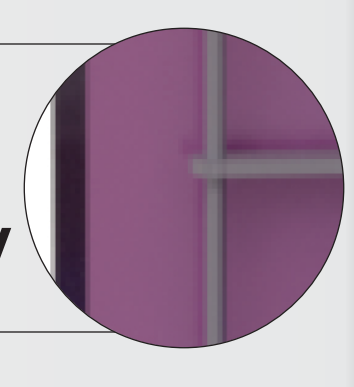
#### Rigid Aluminum Housing

- provides structure and protection
- made from aircraft grade aluminum



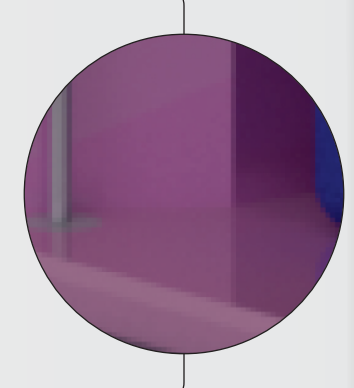
#### Internal Shelving Units

- optimizes organization and usability



#### Insulation

- rigid EPS; increases capacity to function at low temperatures

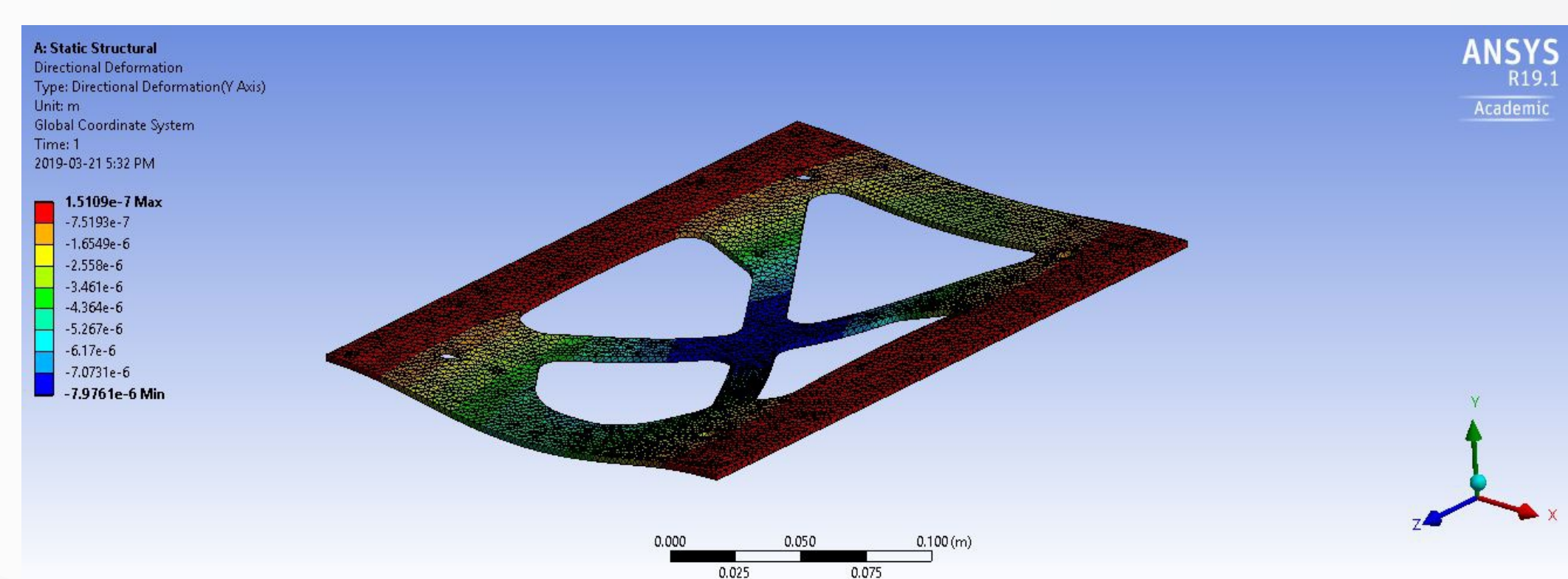


**Gondola weight:** 947.4 g

**Instrument weight:** 1418 g

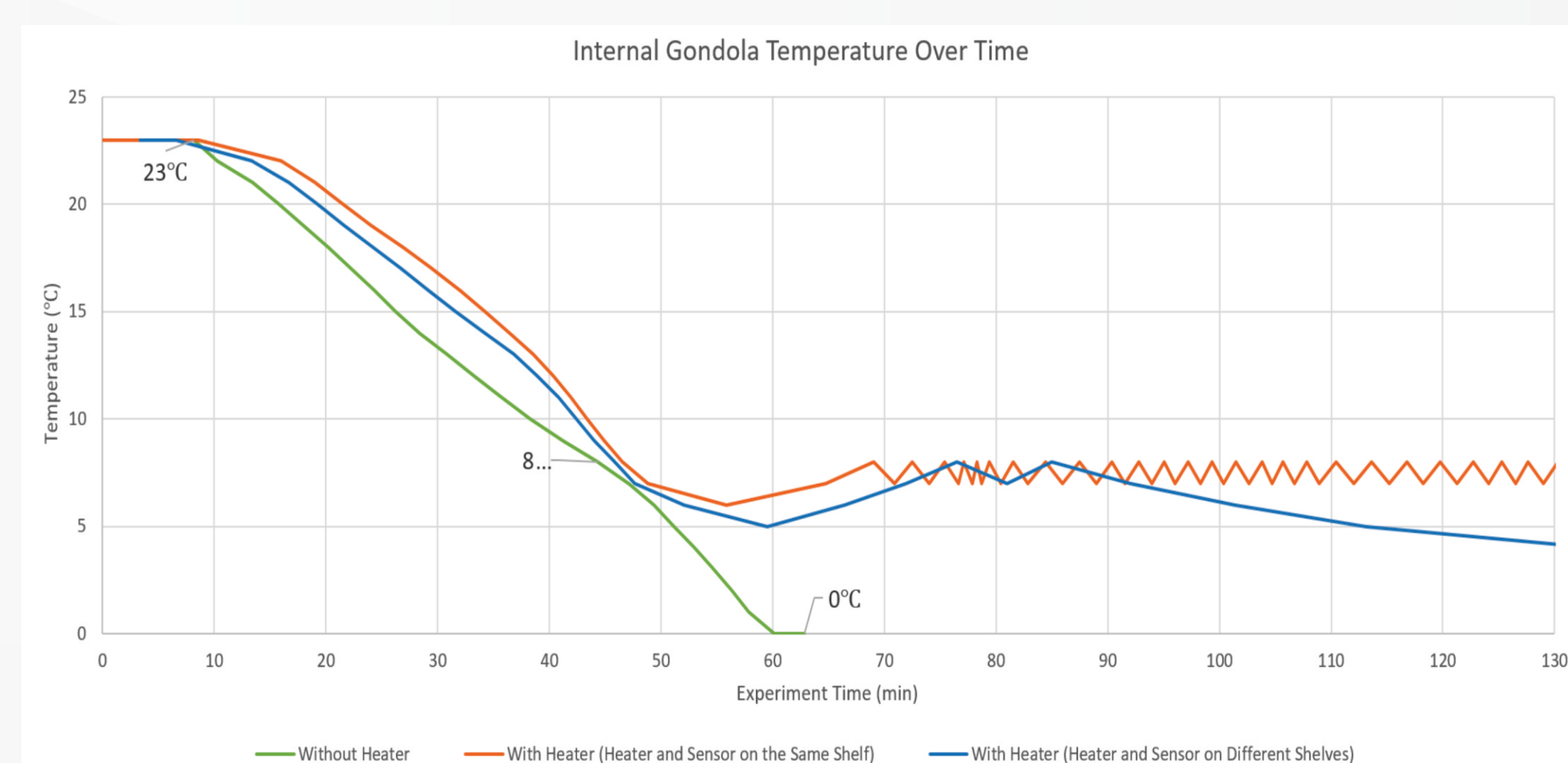
**Total weight:** 2365.4 g

## Results



### Stress Analysis

- load bearing base plate
- less than  $\frac{1}{10}$ <sup>th</sup> mm deflection during flight conditions



### Heat Loss

- rigid 1 inch EPS foam insulation
- initial internal temperature: 23°C
- external temperature: -15°C

## Conclusions

The TANAB prototype 2 has successfully managed internal temperature in sub freezing temperatures, increased organizational capacity within the gondola, and increased overall gondola robustness. The recommended next steps for this project are as follows:

- flight test gondola with full instrumentation suite
- investigate heater configuration within gondola
- investigate heat loss of gondola at lower temperatures